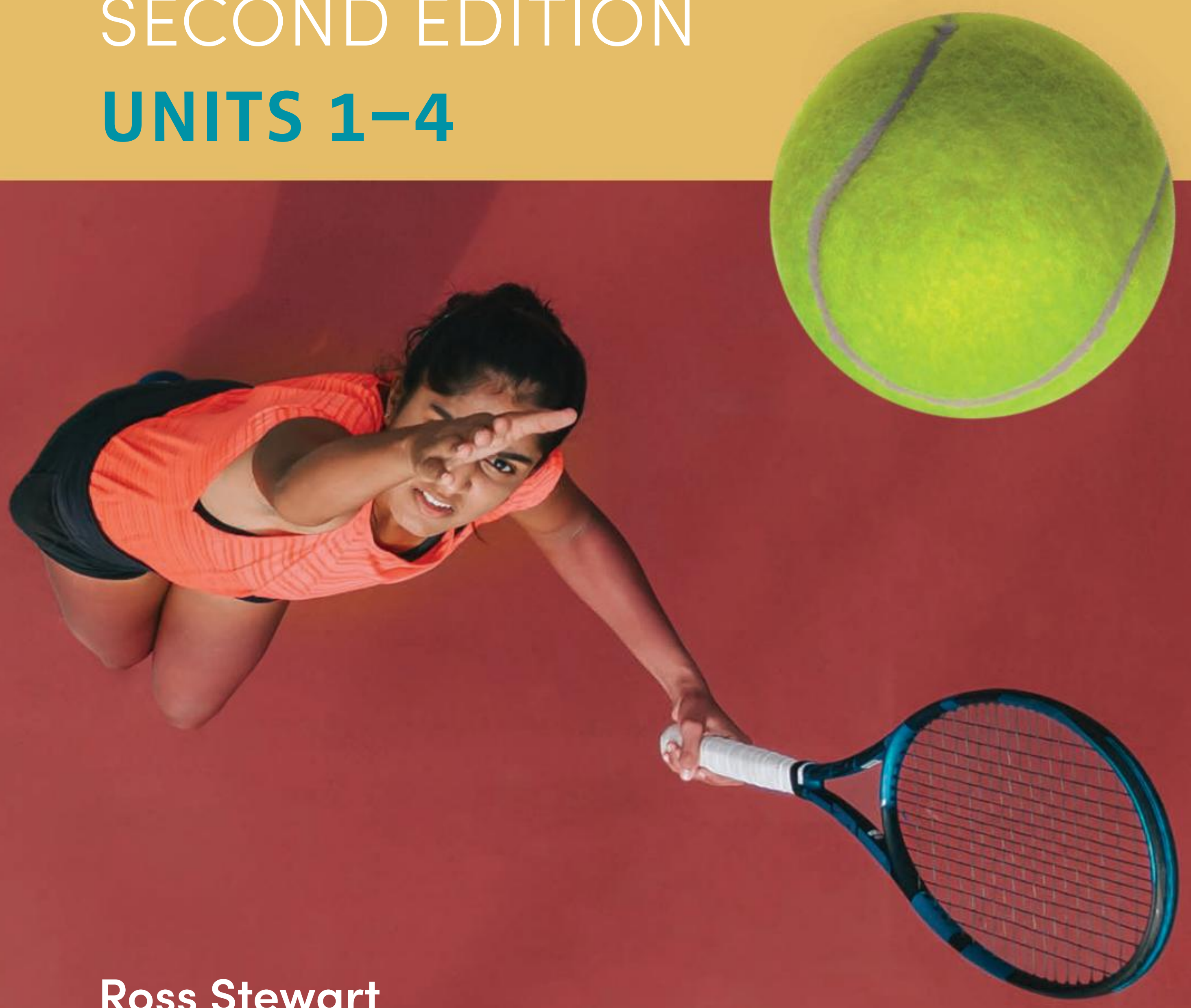
CAMBRIDGE

Senior Physical Education for Queensland

SECOND EDITION

UNITS 1–4



Ross Stewart
John Clancy
Greg Naughtin
Andrew Southey

ISBN 978-1-009-31125-0 Stewart et al.

CAMBRIDGE

Shaftesbury Road, Cambridge CB2 8EA, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

103 Penang Road, #05-06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press & Assessment is a department of the University of Cambridge.

We share the University's mission to contribute to society through the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org

First published 2019
Second Edition 2024
20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Cover and text designed by Jennifer Jones
Typeset by QBS Learning
Printed in China by C&C Offset Printing Co. Ltd.

A catalogue record for this book is available from the National Library of Australia at www.nla.gov.au

ISBN 978-1-009-31125-0

Additional resources for this publication at www.cambridge.edu.au/go

Table of contents

ISBN 978-1-009-31125-0 Stewart et al.

ISBN 978-1-009-31125-0 Stewart et al.

ISBN 978-1-009-31125-0 Stewart et al.

ISBN 978-1-009-31125-0 Stewart et al.

ISBN 978-1-009-31125-0 Stewart et al.

About the authors

Ross Stewart has been teaching Physical Education in Queensland for 25 years, over 20 of these as a head of department in Physical Education and Sport. He began work with the Queensland Curriculum and Assessment Authority (QCAA, formerly the QSA) in 2002, and was appointed the State Review Panel Chair for Senior Physical Education in 2010, a position he held for 10 years. Ross has been involved in syllabus writing and reviewing, and has produced syllabus support materials for the QCAA. He worked with the QCAA on trials for Endorsement and External Examinations for Physical Education during the transition to the 2019 Physical Education syllabus, and now works in Endorsement as a lead endorser. Ross has presented seminars on syllabus interpretation and implementation and is a published author, having previously written a number of textbooks and resource materials for Physical Education in Queensland. He teaches Senior Physical Education, Psychology and Health at Meridan State College on the Sunshine Coast.

John Clancy is the Director of Sport & Activities at Brisbane Grammar School and has taught Physical Education for over 35 years throughout Queensland from P–12 through to university. He has presented at state, national and international conferences in relation to physical performance, pedagogy, and assessment and standards. He has fulfilled many roles for the QCAA, including Senior Assessor for the trial Senior Physical Education External Examination and Lead Endorser for the trial of Physical Education Endorsement and Assessment. He has been involved in Queensland School Sport throughout his teaching career, including chair of the Secondary Schools Athletics Committee.

Greg Naughtin has been a Health and Physical Education teacher for over 40 years and is the Head of Department for Health, Physical Education and Sport at Nambour State College. He was the QCAA (formerly the QSA) District Panel Chair for Physical Education on the Sunshine Coast from 1995 until 2019. He has been involved in the development of Senior Physical Education in Queensland as a member and as chair of QCAA syllabus writing teams for over 20 years. Greg has tutored in pedagogy and curriculum at the University of the Sunshine Coast. Currently, he is a lead confirmer in Physical Education and an external assessment marker in Health with the QCAA.

Andrew Southey is a nationally certified Highly Accomplished Teacher who has been teaching Health and Physical Education for over 20 years. Andrew has frequently been engaged as a subject-matter expert in the development of resources and quality assurance for Physical Education. He holds various roles at a lead level within QCAA assessment development and moderation processes for Physical Education. Most notably, Andrew has been a lead marker and lead confirmer since 2020 and acted as chief confirmer in 2023. He has presented his practical applications of assessment preparation at various seminars across the state. With a background in Sports and Exercise Science, he has extensive knowledge of collecting performance data by integrating Information and Communications Technologies into the senior Physical Education Curriculum.

ISBN 978-1-009-31125-0 Stewart et al.

How to use this resource

Integration of learning

As stated in the rationale in the senior Physical Education syllabus, the work of Arnold (1979, 1985, 1988) 'provides a philosophical and educative framework to promote deep learning in three dimensions: about, through and in movement contexts (Brown & Penney 2012; Stolz & Thorburn 2017)' (QCAA, 2024, p. 2). Teaching and learning through this framework requires an integrated approach that encapsulates an inquiry process. In particular, a **physically educated student** will learn *about*, *through* and *in* physical activity in order to solve problems relating to the engagement and performance of themselves and other athletes. The quality of learning will be dictated by the authenticity of the tasks in which they engage. This resource has been designed specifically to provide subject matter with the associated activities necessary to enhance learning and understanding *about*, *through* and *in* authentic physical activities. It provides an integrated approach to becoming physically educated, and fosters an inquiry process to utilise subject matter to optimise performance and engagement in physical activity.

Learning about physical activity involves developing deeper knowledge of theoretical concepts and principles related to movement. It will allow students to reflect on and relate personal experience and scenarios to develop conceptual understanding of typical physical and social responses. Furthermore, it allows students to apply the biophysical, sociocultural and psychological concepts to strategies that optimise engagement and performance.

Learning through purposeful engagement in physical activity supports students to develop the critical personal, intellectual and social skills required for sustained participation and improvements in performance. These skills enable students to transform their theoretical knowledge so it can be implemented in a practical environment. They also encourage the ability to work both independently and collaboratively to develop and test strategies for optimising engagement and performance.

Learning in physical activity ensures that athletes become the focal point of the inquiry process. It requires students to explore the physical, emotional and cognitive sensations associated with the movement, which allows students to deepen their knowledge of the biophysical, sociocultural and psychological factors that resonate with their levels of engagement and performance, and will ultimately progress them towards optimal levels.

Engaging with this resource

CHAPTER ORGANISATION

Throughout this text, students will have the opportunity to test, apply and improve their knowledge of the subject matter. Each chapter begins by foregrounding the key concepts learners will encounter and highlights key inquiry questions that students will answer as the chapter progresses. It also identifies the specific syllabus subject matter that is addressed within the chapter.

Chapters progress with the presentation of subject matter in digestible chunks, which are supported with a variety of activity types that allow in-depth learning to occur about, through and in physical activity. These activities also incorporate an inquiry process, encouraging the collection of primary and secondary data, and, in many instances, reflect the processes required for assessment.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER FEATURES AND ACTIVITIES

KEY MESSAGE Maintaining integrity in sport through ethical strategies is key to ensuring its high value in Australian society.

KEY MESSAGE Ethical strategies include guidelines, policies, frameworks and codes that outline behavioural standards.

KEY MESSAGE Ethical violations reflect poor integrity and lower the cultural and economic value of physical activity.

FIGURE 0.1 Key messages – used to highlight essential subject-matter insights

Key messages

Throughout chapters, *Key messages* are used to summarise sections and provide a natural juncture to stop and reflect on subject matter. They are simple key takeaways that highlight big concepts from the syllabus.

Glossary terms

Glossary terms are used to highlight the meaning of key subject-matter elements from the syllabus as they are introduced in the main text.

Chapter activities

Throughout the chapters, there are three types of activities. Each activity provides a key to the syllabus objectives required to complete the activity, enabling teachers to explicitly teach these cognitions as the activity is undertaken.

CHECK-IN 2.2

1. How effective are the cognitive systems and traditional teaching approaches for enabling flexibility or variation of a skilled performance to solve an issue at a particular point in time?
2. In the chaos of an invasion game, use an example to explain how likely it is that a set motor program will be used.

FIGURE 0.2 Example Check-in activity – used to check for understanding

Check-in activities are traditional-style short-response tasks that require students to recall theories, concepts and principles, and utilise their knowledge to respond to scenarios. They test the understanding of concepts presented in the preceding sections of the text.

In addition, activities unique to this resource focus on active involvement in the inquiry process in order to facilitate data collection and foster the development of challenging cognitive processes.

ENGAGE 7.1

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What factors are impacting your motivation to perform in chosen physical activities?

Demonstrate and apply

1. Prepare the class to participate in a chosen physical activity for the duration of the lesson.
2. Before the lesson, rate your motivation towards participating in this physical activity using the motivation rating scale in Table 7.4.
3. Complete the physical activity and rate your motivation again.

KEY COGNITION **Analyse**: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

Analyse and synthesise

4. List all factors that influenced your motivation during the performance.
5. Identify at least two cause-and-effect relationships between your performance and your motivation – for example, I dropped the ball a lot in the first half (cause), my perceived competence decreased and I stopped trying (effect).

Evaluate and justify

6. Write a sentence justifying which factor (competence, autonomy, relatedness) had the most influence on your motivation.

FIGURE 0.3 Example Engage activity – used to support students to deepen their understanding

Engage activities expose the learner to segments of the inquiry approach in order to deepen their understanding of a topic, often in isolation from other influences. As the name suggests, they require students to engage in physical tasks or directed research to gather the required data to form a justifiable opinion. As well as indicating the key syllabus objectives, the Engage tasks also define the *Key cognitions* required for the successful completion of the task.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 19.1

RECOGNISE & EXPLAIN | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: Can physical activity lessons be inclusive of the ability level of all class members?

Recognise and explain

1. Collect primary data by tracking individual performance for all class members in a selected physical activity for a number of lessons.
2. Using an appropriate game performance assessment instrument, assess the level of individual skills and make an overall evaluation of the ability level for each class member.
3. Make notes on how your teacher accounts for different ability levels in their teaching practice (games and activities).
4. Divide the class into three groups: higher ability, typical ability and lower ability. Have each group reflect on how the skill development needs of their allocated ability level are currently being met, and how they could be improved.

Analyse and synthesise

5. Analyse the primary data collected by reviewing strengths and weaknesses in individual skills and the range of overall ability levels within the class. Analysis may include presenting data in tables or graphs to identify trends.

KEY COGNITION **Synthesise**: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

6. In small groups, design a one-lesson strategy (lesson plan) that employs inclusive practices to enhance the skills of all ability levels within your class for your selected physical activity of study. Your group must document the use of the five-stage ethical decision-making framework to devise this ethics strategy. While using the framework, ensure that your group undertakes secondary research to synthesise contemporary and inclusive training activities to develop the desired skills. In devising your strategy, consider:
   a. the different skills that require improvement (addressing everyone's needs)
   b. how students are organised (individual, ability groups, mixed-ability groups, whole class)
   c. the amount and range of activities included (addressing student needs, interest levels and enjoyment)
   d. skill-development activities or game play
   e. autonomy (student choice versus allocated activities)
   f. safety and resources (what can safely be undertaken and monitored).
7. Over a series of lessons, implement the strategies devised by each group.
8. At the completion of each group's lesson, survey class members to identify how inclusive the lesson was in meeting their developmental needs. Possible survey questions may include:
   a. To what degree did the lesson meet your overall needs?
   b. Did the lesson target the skills on which you needed to focus?
   c. Do you feel like you experienced improvement by the end of the lesson?
   d. Did the lesson cater for your ability level more than a typical Physical Education class?
   e. Did you feel part of the class group?
   f. Which aspect of the lesson was most inclusive?
9. You should also develop a rating scale for survey responses (e.g. not really, somewhat, pretty well, extremely well).
10. As a group, collate your post-lesson primary data and analyse the results.

Evaluate and justify

11. In a 200-word evaluative statement, use two pieces of evidence to highlight the effectiveness of your strategy in being inclusive to all ability levels in the class. Make one recommendation that would further enhance your overall strategy.

FIGURE 0.4 Example Active investigation activity – used to guide students through the process of inquiry

Active investigations require the learner to answer inquiry questions through engaging in the whole inquiry process. These are extended investigations that can be pursued over a number of lessons. The key focus of the Active investigations is to collect authentic primary data that can be compared with reputable secondary sources to develop justifiable responses to the inquiry questions. In most cases, these activities will allow students to engage in the same inquiry processes required by an assessment task, or may form the basis of your actual assessment instrument.

Chapter summary and review

Each chapter concludes with a **Chapter summary** of the major points presented in the same order as the chapter progressed. These are reduced to simple dot points for ease of reviewing.

Each chapter is completed with a **Chapter review**. This section provides key questions to test student understanding of the concepts. Like the external exam, these questions are comprised of multiple-choice, short-response and extended-response activities. They can be undertaken in class, for homework or under exam conditions.

ISBN 978-1-009-31125-0 Stewart et al.

UNIT 1

Motor learning, functional anatomy and biomechanics in physical activity

Unit 1:
Motor learning, functional anatomy and biomechanics in physical activity

- Topic 1: Motor learning in physical activity
  - Chapter 1
  - Chapter 2
  - Chapter 3
  - Chapter 4
- Topic 2: Functional anatomy and biomechanics in physical activity
  - Chapter 5
  - Chapter 6

Unit description

In Unit 1, students engage with concepts, principles and strategies about two topics.

In Topic 1, students engage in learning that includes the integration of motor learning subject matter and selected physical activities.

In Topic 2, students engage in learning that involves the integration of functional anatomy and biomechanics subject matter and selected physical activities.

Students recognise and explain the concepts and principles about motor learning, functional anatomy and biomechanics through purposeful and authentic learning in physical activity contexts. Students investigate body and movement concepts and demonstrate specialised movement sequences and movement strategies.

Students apply concepts and principles to specialised movement sequences and movement strategies in authentic performance environments to gather data about their personal application of motor learning, biomechanical and body and movement concepts. Students analyse and synthesise relationships between the motor learning and biomechanical requirements of physical activity and their personal performance. Students then devise a motor learning and biomechanical strategy to optimise performance in a selected physical activity.

Students evaluate the effectiveness of the motor learning, biomechanical and movement strategies and justify using primary data and secondary data.

ISBN 978-1-009-31125-0

Unit objectives

Objectives	Activity icons
1. Recognise and explain motor learning, functional anatomy and biomechanical concepts and principles about selected physical activities.	RECOGNISE & EXPLAIN
2. Demonstrate specialised movement sequences and movement strategies in selected physical activities.	DEMONSTRATE
3. Apply concepts to specialised movement sequences and movement strategies in selected physical activities.	APPLY
4. Analyse and synthesise data to devise strategies about motor learning, functional anatomy and biomechanics.	ANALYSE & SYNTHESISE
5. Evaluate motor learning, functional anatomy, biomechanical concepts and principles and movement strategies.	EVALUATE
6. Justify motor learning, functional anatomy, biomechanical concepts and principles and movement strategies.	JUSTIFY
7. Make decisions about and use language, conventions and mode-appropriate features for particular purposes and contexts.	DECIDE

Source: *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

ISBN 978-1-009-31125-0 Stewart et al.

UNIT 1

TOPIC 1

Motor learning in physical activity

Topic 1:
Motor learning in physical activity

- **Chapter 1** Motor learning
- **Chapter 2** Approaches to motor learning
- **Chapter 3** Factors affecting the motor learning process
- **Chapter 4** Body and movement concepts

Introduction

Being physically educated is concerned with developing knowledge in the biophysical, sociocultural and psychological domains that underpin physical activity and utilising this knowledge to maximise enjoyment, engagement and physical performance for yourself and others. The physically educated become advocates for both the social and physical importance of being physically active.

This topic explores motor learning as a key element within the biophysical and psychological sub-disciplines of physical activity. Through an understanding of motor learning, the physically educated can be self-directed in establishing learning activities to promote motor skill development. They can design and implement activities that target the learning needs of the performer, allowing for faster and more targeted motor skill development. Effective feedback can be utilised as an important catalyst to performance improvement.

UNIT 1 TOPIC 1
Overview

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 1

Motor learning

What's ahead?

Chapter 1
Motor learning

- **1.1** What is motor learning?
- **1.2** What is a motor program?
- **1.3** What is skill?
- **1.4** What is the classification of skills?

Key subject matter

- Recognise and explain that motor learning is a discipline concerned with the learning of skilled movements through biophysical knowledge about neural, muscular and sensory systems, practice and feedback.
- Recognise and explain motor learning concepts, including motor skills and motor programs.
- Recognise and explain classifications of motor skills.
- Recognise and explain characteristics of motor skill learning and performance to include improvement, consistency, stability, persistence and adaptability.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- How do we know motor learning occurs?
- How does motor program analysis assist learning?
- How can motor skills be classified?

ISBN 978-1-009-31125-0 Stewart et al.

1.1 What is motor learning?

Learning has many definitions, stages and influences upon it. Generally, however, learning is considered to have occurred when an individual acquires skill, information or knowledge. It should be remembered that learning is **non-linear** in nature. The learner's ability to use their skill, information or knowledge to achieve a goal is not static, but may vary depending on many factors involving the individual, the task and the environment. Due to this, learning may not be permanent and may fluctuate. This then leads us to the question of what constitutes motor learning.

Motor learning is the ability to learn how to affect the nervous system's reactions. It offers techniques and strategies that work for coaches on a daily basis. Knowing basic concepts takes much of the guesswork out of finding the best instructional sequences and progressions to learn sport skills. According to the *Medical Dictionary for the Health Professions and Nursing* (2012), motor learning is:

> 1. The process of acquiring a skill by which the learner, through practice and assimilation, refines and makes automatic the desired movement.
> 2. An internal neurologic process that results in the ability to produce a new motor task.

non-linear there is no fixed, pre-programmed path or schedule by which learning occurs; instead, motor learning progresses and regresses as a stable pattern of performance develops based on personal preferences

motor learning the study of the processes involved in acquiring and refining skills; the field of study concerned with understanding changes in motor control

Comparison of these two definitions gives us some insight into the confusion that exists between motor learning and skill acquisition. The following terms are commonly used interchangeably and often refer to the same information: motor learning, motor skill, motor skill acquisition, motor control and motor development.

The debate over the exact nature of motor learning is a result of the many theories that have been proposed over the past 100 years concerning how humans learn. These changing theories can be observed in the field of motor learning, through ongoing changes in training and teaching techniques. They have given rise to a diverse understanding of motor learning with different underpinning concepts. Later in this unit, both a traditional and a contemporary approach to motor learning will be explored. However, for our purposes, motor learning relates to any process relating to the acquisition, retention and/or refinement of skills. The *Physical Education 2025 v1.1 General Senior Syllabus (Queensland)* (QCAA, 2024, p. 12) states that motor learning is a 'discipline concerned with the learning of skilled movements through biophysical knowledge about neural, muscular and sensory systems, practice and feedback'. As a field of study, it is 'concerned with understanding changes in motor control'.

Characteristics of motor learning and performance

Typically, motor learning is demonstrated as the number of successful attempts increases for the learner. Several factors can be used to ascertain the success of motor skills. Factors include **improvement**, **consistency**, **stability**, **persistence** and **adaptability**. Consistency relates to the ability to replicate a skill and produce the same outcome. Stability speaks of the ability to negate external forces on performance. The learner in repetition of tasks demonstrates persistence. Adaptability relates to the ability to change the movement based on external factors. Practice is integral to facilitating the improvement of these characteristics.

improvement the degree of progress observed in a movement

consistency the degree to which the performance does not vary

stability the state of being stable and resistant to change

persistence continuing to do something even if difficult

adaptability the ability or willingness to change

ISBN 978-1-009-31125-0 Stewart et al.

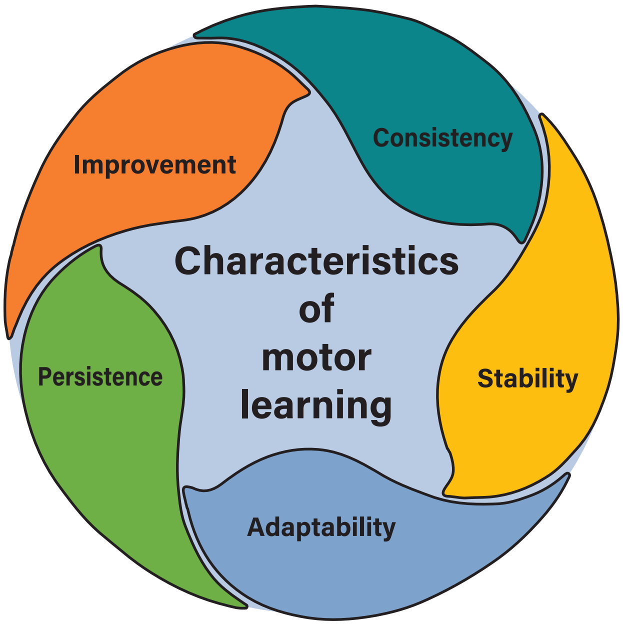


FIGURE 1.1 Motor learning can be characterised by the progression in a variety of factors.

CHECK-IN 1.1

1. In your own words, describe when learning has occurred.
2. Explain how motor learning is displayed when completing a basketball jump shot. Include in your response an explanation of how learning can be non-linear.

1.2 What is a motor program?

A motor program is a series of subroutines organised into the correct sequence and timing to perform a movement. Motor programs are used for all movements undertaken by an individual. However, in relation to the learning of movements, motor programs generally refer to the specialised **movement sequences** needed for a specific activity – the technique or action. When applying a more traditional approach to motor learning, a motor program is stored in memory and retrieved when a skill is required to be performed. Similar to a subroutine in computer programming, it is a sequence of smaller tasks or programs that combine to perform the larger specific movement sequence. For example, to complete a javelin throw in track and field, a number of smaller tasks or programs need to be completed for an effective throw to occur.

> **movement sequences** the coordinated and timed movements in response to the demands of the surrounding environment

FIGURE 1.2 Organised and timed subroutines combine to create the movement sequence necessary to perform a javelin throw effectively.

The subroutines for javelin may be:

- appropriate grip
- initial start position
- velocity of movement and feet position through the sector
- height of body in transition phase
- head, hip and feet position prior to release
- speed of arm
- angle of release
- height of release
- summation of forces during weight transfer and hip drive.

Historically, due to the nature of traditional approaches such as the cognitive systems approach, the concept of subroutines and the classification of skills have played an integral part in understanding motor learning. Breaking down a skill into smaller components is still an important aspect of skill development, particularly where an athlete's personal motor programs can be assisted through biomechanical analysis of the body and movement concepts to enhance the efficiency, accuracy, consistency or speed of the movement.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 1.1

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE

Inquiry question: How can an analysis of a motor program enhance performance?

Recognise and explain

1. Review a video of a motor program in your physical activity at the elite level.
2. Deconstruct the skill into subroutines.

Demonstrate and apply

3. Video your execution of the skill during game play or practice.

Analyse and synthesise

4. View the footage and examine your performance of the subroutines.

KEY COGNITION

Appraise: evaluate the worth, significance or status of (something); evaluate, judge or consider a text or piece of work

Evaluate

5. Appraise the similarities and differences between the elite performance and your own to identify strengths and weaknesses of your technical ability in the specific motor program for the selected movement sequence.

CHECK-IN 1.2

1. Choose three specialised movement sequences from a specific physical activity.
2. Break down the motor programs for each movement sequence into subroutines.
3. Review critically whether refined motor programs that demonstrate highly effective biomechanical principles are important for success, or if skilled movements need to be adaptable and changing. Consider a variety of sporting movements.

1.3 What is skill?

Traditionally, ‘skill’ has referred to the refinement and successful application of specialised movement sequences. A skilful performance has been concerned with demonstrating technical proficiency within a game situation. Therefore, individuals developed ‘skills’ as they demonstrated the specific movements required for the activity, and practice focused on the refinement of an ideal motor program (good technique).

In a modern approach to learning, ‘skill’ is more focused on what produces a successful outcome for the individual given the specific situation. In this way, refining a ‘perfect technique’ is not as important as finding the right thing to do that will be successful.

Therefore, a modern view of skill incorporates two key components:

- **technical proficiency of specialised movement sequences** – this includes developing motor programs that are consistent, are accurate and, where required, demonstrate speed, but can also be adapted and modified in many ways to suit the task or the environment
- **tactical awareness** – knowing what is happening in the environment and what options are available, and then selecting a motor sequence that will be successful; that is, skill is also reading and responding to the situation.

Modern motor learning approaches tend to view skill as holistic, rather than as individual ‘skills’ – that is,

ISBN 978-1-009-31125-0 Stewart et al.

an athlete will develop 'touch skill' as they learn rugby, rather than viewing individual components of pass, dump or ruck. This is an important distinction when developing modern coaching activities. Modern coaching pedagogy tends to endorse the development of both technical proficiency and tactical awareness simultaneously for enhanced motor learning. This notion will be explored further in Chapter 15.

1.4 What is the classification of skills?

Skill classification deals with grouping different skills based on the size of muscle movement, the type of movement occurring and the environment in which the skill occurs. This can be useful when developing training activities, as similar skills can often benefit from similar training approaches. Teachers and coaches regularly modify effective training activities designed for one skill in order to apply them to another.

Fine motor skills are those skills that require small muscle movements. Generally, these are associated with greater dexterity, precision and accuracy, and involve fingers or hands – for example, adjusting the grip on a golf club. **Gross motor skills** are those that require large muscle movement to complete a task. Generally, these require less precision and accuracy – for example, completing a full spin throw in discus or hitting a softball pitch to the outfield.

Open motor skills occur in environments that are highly unpredictable. This may occur due to the variables within the activity. In an invasion game, the completion of the activity may depend on your own position on the field, as well as those of your teammates and your opponents. The timing of the skill is uncertain, as external factors may affect the completion of the task – for example, attacking in a game of touch. **Closed motor skills** occur in highly predictable environments. The performer generally determines the timing of these skills – for example, sinking a snooker ball. It is very unusual to find physical activity tasks that are classified as completely open or closed.

Discrete motor skills have a distinct start and finish – for example, hitting a golf ball. **Continuous motor skills** do not have a definite finish or end, but rather are repetitive in nature – for example, running. **Serial motor skills** are those where a number of discrete motor skills are linked together – for example, triple jump.

fine motor skills small movements that use the small muscles

gross motor skills bigger movements that use the large muscles

open motor skills skills that occur in environments that are highly unpredictable

closed motor skills skills that occur in highly predictable environments

discrete motor skills skills that have a distinct start and finish

continuous motor skills those that do not have a defined end, but are repetitive in nature and may continue for an unspecified length of time

serial motor skills those where a number of discrete motor skills are linked together

FIGURE 1.3 Consistently pitching in the strike zone is an essential element of this softball skill. Increasing consistency is also one factor that demonstrates motor learning is occurring.

CHECK-IN 1.3

Search and watch the YouTube video – *Fastest Workers in the World | Fast Movers - God Level Expert 2020* *https://cambridge.edu.au/redirect/10557*

1. List five skills that you enjoyed watching.
2. Identify the common characteristics that enabled the skilled performances to occur.
3. Consider what was required for this level of skilled performance to be achieved.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 1.2

RECOGNISE & EXPLAIN DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What is the classification of skills?

Recognise and explain

1. Draw a table that includes each of the following activities in preparation for their categorisation:
   - tennis serve
   - shot-put throw
   - swimming six laps
   - darts throw for bullseye
   - adjusting the grip on a cricket ball from off spin to leg spin
   - 3 vs. 3 game of futsal
   - two kicks for a goal in Rugby League
   - triple jump
   - flying a kite.

Demonstrate and apply

2. Perform each task.

Analyse and synthesise

KEY COGNITION

Categorise: place in or assign to a particular class or group; arrange or order by classes or categories; classify, sort out, sort, separate

3. Categorise each task according to the different classifications of skill. For each, explain in your own words why the task matches that classification.
4. Reflect on the following tasks in a game of soccer:
   a. a penalty shot on goal
   b. soccer general play.
5. Classify the tasks from question 4 according to the environment.

Evaluate and justify

6. Explain and justify in no more than 50 words whether soccer is an open or closed skill.
7. Evaluate batting in cricket and complete the following tasks.
   a. Classify the skill.
   b. List the subroutines involved.
8. Reflect on Mitch Marsh's innings from the 2023 Men's Cricket World Cup after watching the video at https://cambridge.edu.au/redirect/10371.
   a. Does Mitch Marsh demonstrate the perfect model for batting?
   b. Make a decision regarding whether there is a perfect technical model.
9. Evaluate how the knowledge of subroutines and classification of skills may affect the design of training and learning environments.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Motor learning is the learning of skilled movements through biophysical knowledge about neural, muscular and sensory systems, practice and feedback.
- Motor learning can be characterised by the progression in the areas of improvement, consistency, stability, persistence and adaptability.
- A motor program is a series of subroutines organised into the correct sequence and timing to perform a movement sequence.
- Skill and a skilful performance is not just about producing an accurate technique, but also the ability to read the situation, make an accurate decision on how to act and effectively adapt the movement selected to produce a successful response.
- A skilful performance includes both technical proficiency and tactical awareness.
- Skills can be classified to assist in understanding, analysing and improving them.
- Fine and gross motor skills are categorised based on the muscles required to perform the movement.
- Open and closed skills are categorised based on the environment in which they are performed.
- Discrete, continuous and serial skills are categorised based on how long they can be performed for and how they are constructed.

FIGURE 1.4 Mitch Marsh of Australia celebrates his century during the ICC Men's Cricket World Cup India 2023 between Australia and Pakistan.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Motor learning is:
   A. a term used in car racing.
   B. a process of acquiring and refining skills.
   C. completely separate from motor skill, motor skill acquisition, motor control and motor development.
   D. a process to provide feedback.

2. Which of the following is not a characteristic of motor learning?
   A. Persistence
   B. Stability
   C. Longevity
   D. Adaptability

3. A motor program is:
   A. a series of subroutines organised to perform a movement sequence.
   B. a series of skills that produce a successful result.
   C. an effective movement that produces a coordinated response to the situation.
   D. all of the above.

4. A skilful performance is demonstrated when:
   A. a technique has been refined to demonstrate effective form.
   B. tactical strategies are used in response to the situation.
   C. an effective result is the outcome, no matter how it is achieved.
   D. both effective technical and tactical elements are applied to produce an effective outcome.

5. Playing a grand piano is considered to be completion of:
   A. a gross motor skill due to the size of the piano.
   B. an open motor skill due to the environment in which it is played.
   C. a continuous and closed skill due to limited external influences.
   D. a serial motor skill due to the small movements of the fingers.

SHORT-RESPONSE QUESTIONS

1. How might improvement, consistency, stability, persistence and adaptability be used to ascertain if learning has occurred?

2. Selecting only three motor programs (techniques), from any physical activity, provide examples that cover all the classification of skills.

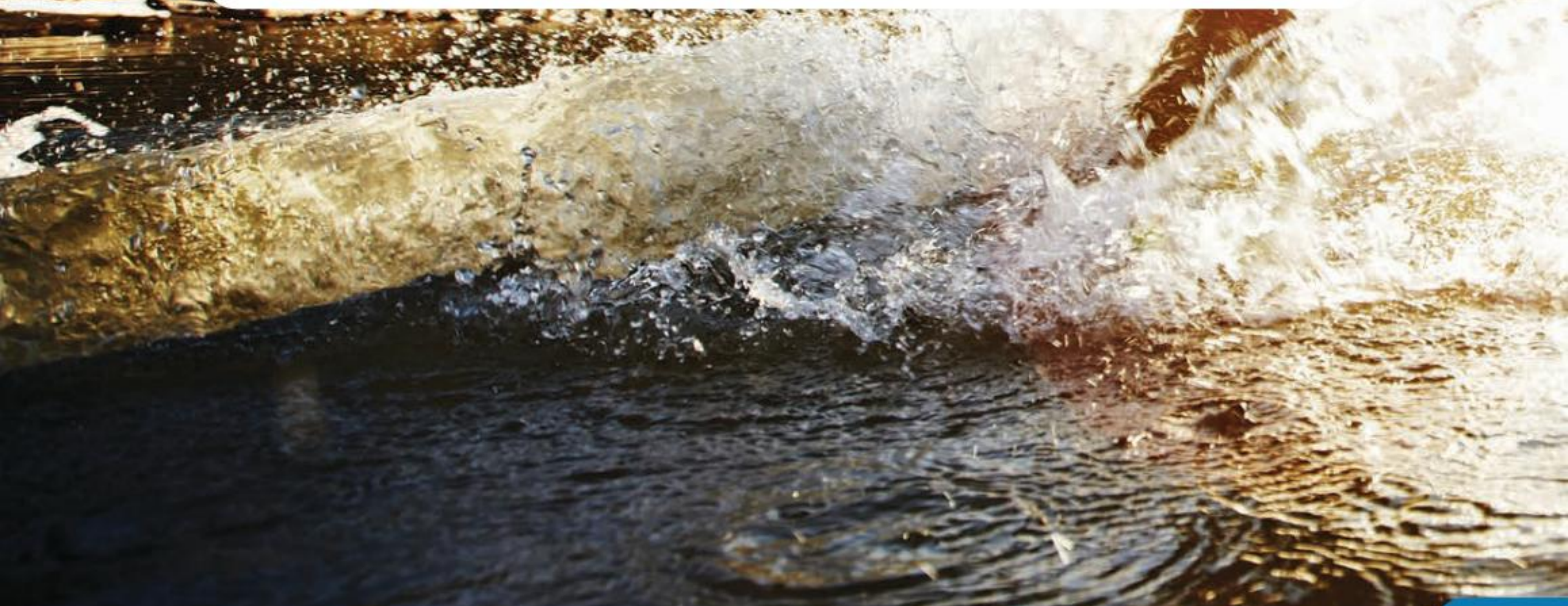
EXTENDED-RESPONSE QUESTION

Select one motor program from the physical activity currently being studied and outline three subroutines that are currently negatively affecting your performances. (Consider if it is the improvement, consistency, stability, persistence or adaptability of the movement being affected.) Make one recommendation on how to improve one of the subroutines being affected.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 2

Approaches to motor learning



What's ahead?

Chapter 2
Approaches to motor learning

- **2.1** Two major approaches to motor learning
- **2.2** Cognitive systems approach to motor learning
- **2.3** Dynamic systems approach to motor learning

Key subject matter

- Recognise and explain that two major approaches to investigate motor learning have developed over time: the cognitive systems approach and the dynamic systems approach.
- Identify and explore cognitive models of learning, including the information processing model and Fitts and Posner's (1967) stage model of motor learning.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What are the two major approaches to motor learning?
- How can a cognitive systems approach be applied to enhance motor learning?
- How can a dynamic systems approach be applied to enhance motor learning?

ISBN 978-1-009-31125-0

2.1 Two major approaches to motor learning

As an understanding of learning has developed over time, two major approaches to investigating motor learning have developed. Each approach has a number of different learning models associated with it, and each of these two major approaches is underpinned by different assumptions about how performers learn motor skills. More traditional approaches to motor learning generally take a **cognitive systems approach** to learning, while more contemporary motor learning models tend to reflect a **dynamic systems approach**. Each approach works to explain the learning process and to highlight effective teaching and coaching pedagogies to enhance the learning of motor skills.

cognitive systems approach acquisition of information-processing abilities

dynamic systems approach the theory that movement behaviour is the result of complex interactions between many different factors, such as the environment and the task at hand

information processing model a cognitive systems approach to learning where the notion of input, processing and output is described as the phases of perception, decision-making and response execution

perception the brain's interpretation of the current situation, based on the information received from the sensory system and proprioceptive information from the body

decision-making (information processing) selecting a motor program in response to the current situation

response execution occurs when the decision is passed to the relevant body parts and the selected motor plan is enacted

feedback (in motor learning) any information received during or after a performance about the movement itself or the level of success achieved by the movement in that situation

2.2 Cognitive systems approach to motor learning

The cognitive systems approach, also referred to as the cognitive model, is a more traditional approach to motor learning, whereby improvement occurs as the result of feedback following a process of input, information processing and output – that is, the body is viewed as a computer with the brain being the central processing unit. Input of information occurs from the environment (ascertaining what is occurring), processing of the information occurs by the brain (deciding what movement is required and selection of a motor program) and an output results (executing the movement sequence). This more traditional approach to motor learning is based on a hierarchical model of control, where higher control centres pass commands to lower control centres, resulting in linear changes in movement. A cognitive systems approach requires an understanding of the process that occurs in making decisions, planning and executing movement.

A well-known cognitive systems approach is the **information processing model**. In this learning model, outlined by Welford (1968) and later Whiting (1969), the notion of input, processing and output is described as the phases of perception, decision-making and response execution. **Perception** occurs as the athlete's senses pass on to the short-term memory relevant data about the current circumstances surrounding the performance. **Decision-making** occurs through comparison with similar previous experiences stored in the long-term memory in order to select a motor program. **Response execution** occurs when the decision is passed to the relevant body parts and the selected motor plan is enacted. Learning occurs as **feedback** about the success of this process is retained so that future performances in similar situations can be refined.

ISBN 978-1-009-31125-0 Stewart et al.

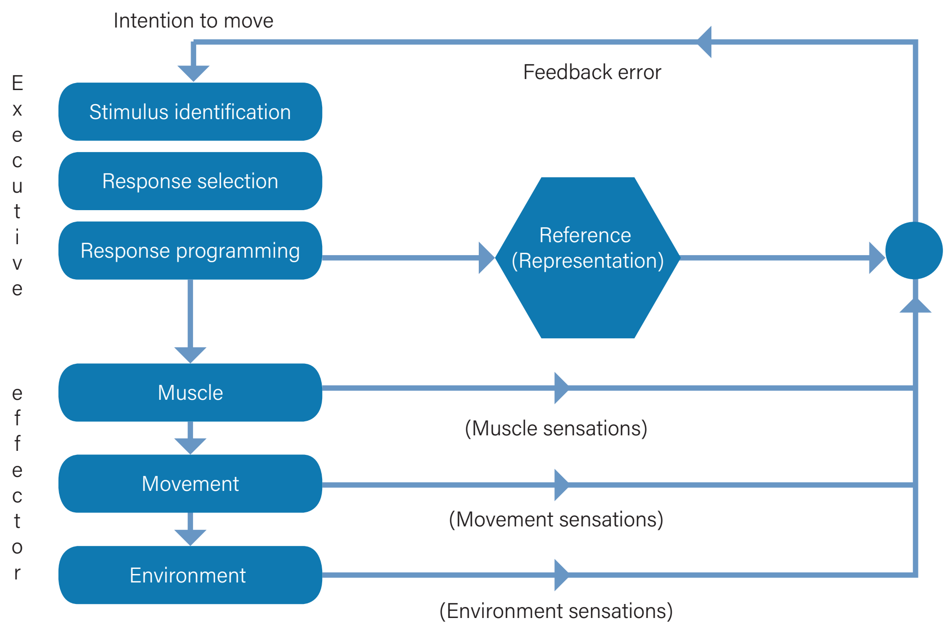


FIGURE 2.1 Information processing occurs in the central nervous system through a series of discrete cognitive stages involving perception, decision-making and response execution.

Source: Davids et al. (2008, p. 10)

In addition to information processing, Fitts and Posner (1967) propose that learning changes for an individual as their ability to process information develops. Under a cognitive systems approach, Fitts and Posner propose three stages in a staged model of motor learning. Under staged learning, an individual progresses from beginner to expert as they enhance different aspects associated with information processing.

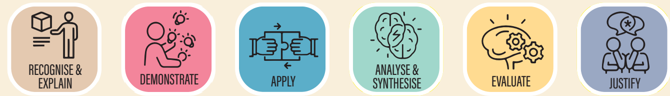
Fitts and Posner's stages of learning model describes skill acquisition as a gradual process, whereby the learner moves through three learning stages in a linear progression. The *beginner or cognitive stage* sees the learner concerned largely with gathering information along with formulating basic motor programs. This stage is characterised by large gains in skill development; however, inconsistent performance is common, as motor programs are put together and stored. The *associative stage* involves the process of putting actions together in more coordinated ways and becoming increasingly familiar with the situations in which the skills can be used successfully. The associative phase is characterised by small gains, with a focus on refining performance through conscious reflection on performance feedback. Given enough time and practice, the athlete may advance to the final stage of motor learning, the *autonomous stage*. This stage is characterised by performances that seem unconscious, automatic and smooth. The motor programs involved are well learned and are now ingrained in long-term memory.

CHECK-IN 2.1

1. Draft a table labelled 'Fitts and Posner's stages of learning model.' In the table, do the following.
   a. Identify each stage of learning in a row.
   b. Assign a column each to 'Perception', 'Decision-making' and 'Response execution'.
2. Complete the table by identifying characteristics for each stage under the heading 'Information processing'.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 2.1



Inquiry question: How do we develop motor learning?

Demonstrate and apply

Option A – striking and fielding games

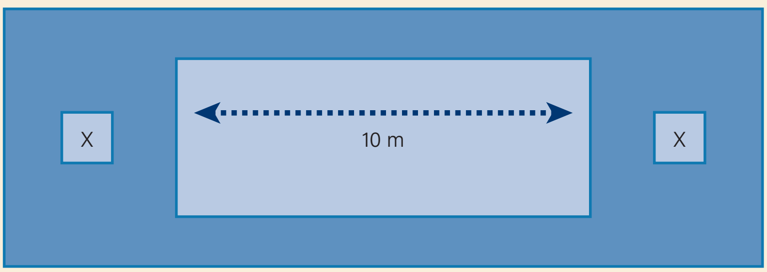
Participate in Drills 1 and 2.

Aim: To develop motor learning in softball

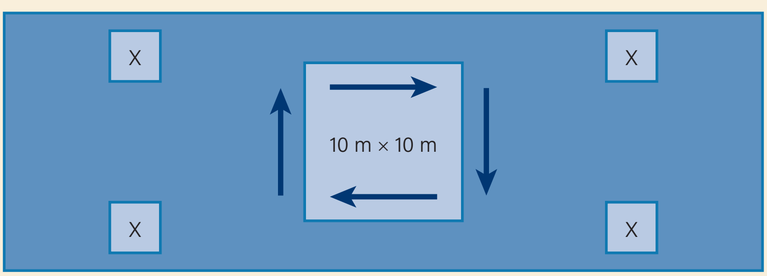
Equipment: 1 ball, 4 markers

Space: Drill 1 – 10 m, Drill 2 – 10 m × 10 m

Drill 1: Complete 60 stationary passes in pairs.



Drill 2: Pass the ball around the square, again completing 60 passes.



Recognise and explain

1. Design a mind map with developing softball technique in an authentic environment as the central theme.
2. Identify in branches off the central theme the subheadings of type of skill undertaken and the type of practice.
3. Identify the type of skill and the type of practice undertaken in Drills 1 and 2.

Analyse and synthesise

4. Consider and explain in branches off the subheadings, characteristics that are pertinent to the classification of the type of skill and type of practice.
5. Identify what was needed to complete the drills successfully.
6. Identify what differences there are in the drills depending on the game environment – for example, tracking of ball, tracking of team member, tracking of opponent.
7. Critically review how closely aligned the drills were to the game environment.

ISBN 978-1-009-31125-0 Stewart et al.

Evaluate and justify

Judge: form an opinion or conclusion about; apply both procedural and deliberative operations to make a determination

8. Judge whether motor learning of softball was developed in each drill.
9. Consider other factors that may be involved in completing a skill in a game environment. How do these other factors affect the successful completion of the skill?

Demonstrate and apply

Option B – net and court games

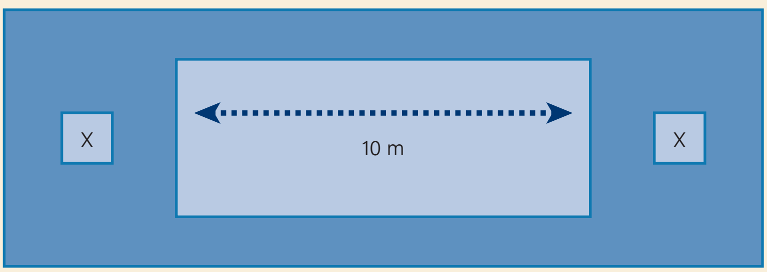
Participate in Drills 1 and 2.

Aim: To develop motor learning in volleyball

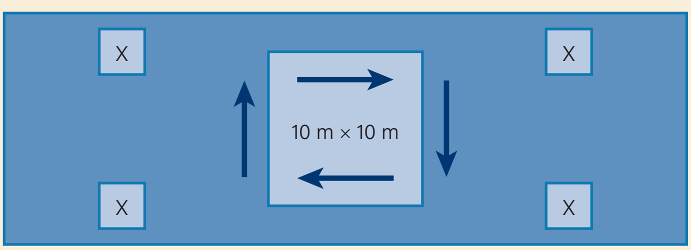
Equipment: 1 ball, 4 markers

Space: Drill 1 – 10 m, Drill 2 – 10 m × 10 m

Drill 1: Complete 60 stationary passes in pairs.



Drill 2: Pass the ball around the square, again completing 60 passes.



Recognise and explain

1. Design a mind map with developing motor learning as the central theme.
2. Identify in branches off the central theme the subheadings of type of skill undertaken and the type of practice.
3. Identify the type of skill and the type of practice undertaken in Drills 1 and 2.

Analyse and synthesise

4. Consider and explain in branches off the subheadings characteristics that are pertinent to the classification of the type of skill and type of practice.
5. Identify what was needed to complete the drills successfully.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

6. Identify what differences there were in the drills depending on the game environment – for example, tracking of ball, tracking of team member, tracking of opponent.
7. Critically review how closely aligned the tasks were to the game environment.

Evaluate and justify

Judge: form an opinion or conclusion about; apply both procedural and deliberative operations to make a determination

8. Judge whether motor learning in volleyball was developed in each drill.
9. Consider other factors that may be involved in completing a skill in a game environment. How do these other factors affect the successful completion of the skill?

> "The cognitive systems approach, including information processing and Fitts and Posner's stages of learning, are considered a traditional theory of motor learning. Several approaches considered traditional theories have common characteristics. These include a belief that learning involves constructing internal models of the world and of movements that facilitate interactions with the environment. These motor program memories are stored in the brain and are used when required for future actions. The simple notion is that a stored motor program can be enacted when the right situation is recognised. Over time, and with feedback, the motor program will be refined and become more efficient and effective. The learner's ability to perceive their surrounds and decide on how to act will also become quicker and more accurate; hence the performer is demonstrating the characteristics of learning."
>
> Source: Davids et al. (2008, p. 17)

However, traditional cognitive approaches have more recently been questioned over their ability to accurately describe motor learning, particularly in open dynamic environments. They inadequately explain the variability and manipulation required to successfully implement motor programs in these environments. The cognitive approach also struggles to account for learning that at times regresses in performance, and the adjustments in subroutines that are required during the execution of motor programs. Additionally, it cannot easily explain why very similar environmental cues may result in the performer producing two different responses. Using a traditional approach to learning when devising training activities also reduces the development of intelligent performers. Training activities based on a cognitive approach can be repetitive and focus on technique development in isolation. They may lack the variety and practice in authentic game-like scenarios required to effectively develop perceptual, decision-making and motor program manipulation skills. Davids and colleagues (2010, p. 99) reinforce that studies on developing intelligent performance through modern approaches have 'strong implications for a learner model' and suggest that 'the emphasis during learning should be on encouraging change and adaptation rather than achieving some hypothetical, idealized state' – attaining the perfectly refined technique in response to the ideal scenario.

FIGURE 2.2 Even a highly stable skill, such as a golf putt, requires adjustments to the movement patterns each time it is implemented to account for the subtle differences in circumstances.

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 2.2

1. How effective are the cognitive systems and traditional teaching approaches for enabling flexibility or variation of a skilled performance to solve an issue at a particular point in time?
2. In the chaos of an invasion game, use an example to explain how likely it is that a set motor program will be used.

2.3 Dynamic systems approach to motor learning

Contemporary motor learning theories tend to be more holistic in their approach to motor skill acquisition. Rather than simply looking at the acquisition, refinement and application of motor programs, a dynamic systems approach explores how movements emerge, or self-organise, through the dynamic interaction of the environment, the task being performed and the individual. This occurs as the performer knows where in an environment to search for affordances that will allow them to achieve a goal and has the ability to implement a plan to successfully complete that goal. This is important, as individuals aim to demonstrate intelligent performance through the manipulation of their technical and tactical ability. The dynamic systems theory is a more modern approach whereby the athlete is viewed as 'a complex, biological system composed of many independent but interacting systems' (Davids et al., 2008, p. 30).

The dynamic systems approach, also referred to as the ecological model, views an athlete as a complex system with many interacting components affecting it. This enables learners to adapt to variations in the task, themselves and the environment to provide different multiple solutions to problems or challenges. In this theory, motor learning is not considered linear in nature; rather, learning is non-linear as an individual's performance progresses and regresses as a stable pattern of performance occurs and erodes based on the learner, the task/goal and the environment. Progression of learning shifts up and down through Newell's stages of learning.

Newell's stages of learning model, not to be confused with stages of learning identified by Fitts and Posner, takes a more contemporary dynamic view of the motor learning process. This model also identifies three stages:

1. *Assembling a coordination pattern*
   In this stage, learners aim to establish a basic relationship among the key components of the task, environment and themselves. This is characterised by limited movements while assembling appropriate body actions to complete the task. The learner may seek many alternative movement actions as they seek to achieve a particular task or aim. Due to the exploration of many different movements, a pattern may emerge to complete the task; however, it may become destabilised or erode as readjustment to variables occurs. A learner seeking consistency or accuracy may seize upon a movement pattern with limited **degrees of freedom** to accomplish this – for example, serving in tennis.

degrees of freedom factors affecting the directions in which independent motion can occur

2. *Gaining control of a coordination structure*
   In this stage, a tighter fit occurs between the assembled coordinative structure and the performance environment. Subtle and refined deviations in the movement patterns occur in order to experiment with adaptability in different situations. This is crucial for flexibility of performance, as Davids and colleagues (2008, p. 87) state: 'theorists advocate that movement variability can play a functional role in helping humans adapt to novel surroundings and learn new skills' – that is, an attempt is made to improve motor patterns, which are functional under different conditions.

ISBN 978-1-009-31125-0 Stewart et al.

Furthermore, Davids and colleagues state that:

> “ movement systems do not have fixed coordination patterns which are somehow stored in their memories or physical structure. Instead, they exhibit coordination tendencies as parts come together long enough to form a functional movement pattern that can achieve a performance goal under specific environmental circumstances. ”
>
> Source: Davids et al. (2008, p. 88)

Due to this, the learner is able to adapt to slight variations in conditions and can vary movements to accommodate this – for example, adjusting a first serve in tennis to account for windy conditions.

3. *Skilled optimisation of control*
In this stage, the athlete is more flexible and open to exploiting environmental information sources, thus enhancing efficiency and control. Athletes are able to exploit their own and team members’ positions based on their opponent’s position and manipulate task execution based on their own strength and weakness for optimal, adaptable actions. This implies that **energy** use is at the most appropriate level while not expending excess energy. Davids and colleagues state that:

> “ Even at the stage of optimal skill performance, discovery learning plays an important role as people search for creative task solutions or patterns that are even more energy efficient. At all stages of learning, performers are searching for the most functional solutions for satisfying the constraints placed upon them. ”
>
> Source: Davids et al. (2008, p. 93)

energy the capacity to do work, including all human movement and activity

ACTIVE INVESTIGATION 2.1

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What are the approaches to motor learning and what is my stage of learning?

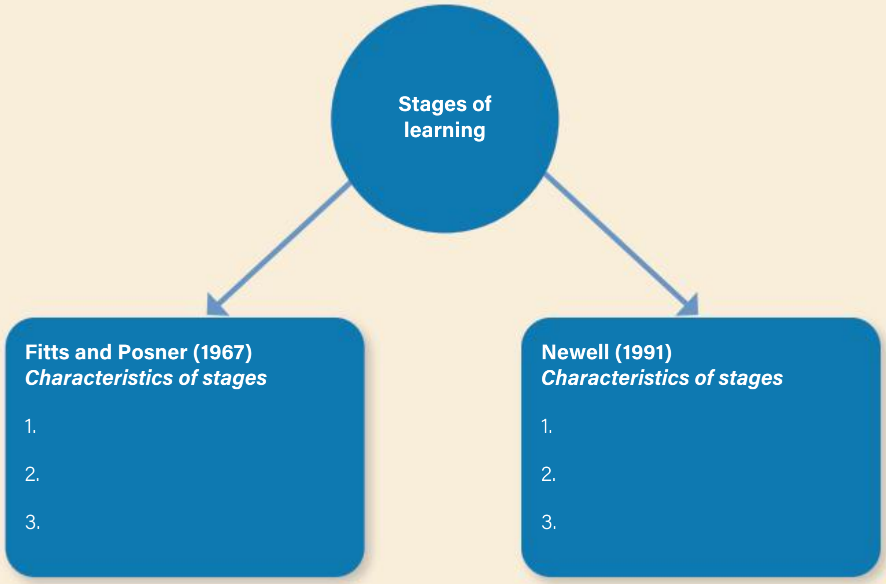
Demonstrate and apply

1. Capture digital evidence of your performance in a variety of modified game and match situations. Consider 1 vs. 1, 2 vs. 2, 3 vs. 3 type situations as appropriate for your physical activity of study. Ensure that digital evidence is stored in at least two locations for review, comparison and contrast later in the unit and in preparation for assessment.

Analyse and synthesise

2. Draft a graphic organiser with stages of learning as the central theme, similar to the example provided on the next page. From the central theme, list Fitts and Posner on one side and Newell on the other side. Under these, list the characteristics of the stages of learning in each model.

ISBN 978-1-009-31125-0 Stewart et al.



3. Examine the primary data that you captured in task 1 and analyse your performance by copying and completing the table below. Provide examples.

Has motor learning occurred?

Complete the sections below by commenting on your performance and giving examples.

Improvement	Consistency	Stability	Persistence	Adaptability

Evaluate and justify

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

4. Evaluate your level of performance according to Fitts and Posner's, and Newell's stages of learning models.
5. Justify your stage of learning using primary and secondary data.

ISBN 978-1-009-31125-0 Stewart et al.

The dynamic systems approach promotes a holistic approach to learning where dynamic interactions through activities can produce rich responses through **self-organisation** within a complex system. This system is non-linear in nature and embraces chaos where the learner responds to constraints to form a stable motor pattern. **Constraints** enable the emergence of movement behaviours or **affordances**. Constraints are the many different variables that affect the successful completion of a task within an authentic game environment. For example, weather conditions will affect the speed of the green in lawn bowls. Constraints can both enable performance (e.g. tall player completing a spike in volleyball) and limit performance (e.g. short player attempting to dunk in basketball). Constraints can be organised into those that involve the learner, the task or the environment. To maximise skill acquisition, training activities must be designed to reflect the constraints found in game situations so that skills and tactical implementations can be improved. It is now widely accepted that training activities that reflect constraints and a dynamic systems approach will produce greater learning gains than the application of a linear cognitive approach.

self-organisation a dynamic systems view that humans will instinctively formulate a physical response when confronted with their environment and that, given practice, this response will be modified to be more successful

constraints boundaries that shape a learner's self-organising movement patterns, cognitions and decision-making processes

affordances the opportunities for action provided by the environment or task in relation to the learner's ability

rate limiter a constraint that holds back or slows the emergence of a motor skill

Athletes therefore perceive – for example, through vision – and coordinate actions with their environment. Performance is characterised as functional under different conditions through the manipulation of movement patterns after variable repeated practice.

As learners are non-linear dynamic systems, according to modern theories and models, it is logical that practice should mirror this. Practice should therefore be non-linear in nature, where learning activities utilise constraints concerning the learner, the task or the environment to highlight specific affordances that will promote learning and overcome targeted **rate limiters**. Learning activities should be game-like and require the learner to solve problems about performance to learn, rather than involve repetitive use of motor programs in isolation from game situations. Such practice activities develop self-organisation of the learner and the variability and adaptability of performance required to demonstrate learning. From this knowledge, a modern framework for the pedagogy of motor learning developed, known as the constraints-led approach (CLA); it will be explored in more detail in Chapter 16.

FIGURE 2.3 Acquiring a skilled topspin forehand involves both the development of an effective technique and the capacity for it to be used tactically within a rally to win points.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 2.2

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What is the effect of motor learning theories on performance in authentic environments?

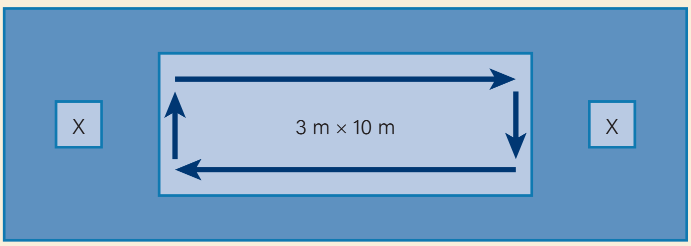
Aim: To improve motor patterns in Gaelic football

Equipment: 15 Gaelic footballs. If not available, volleyballs, soccer balls, Australian Rules footballs or tennis balls

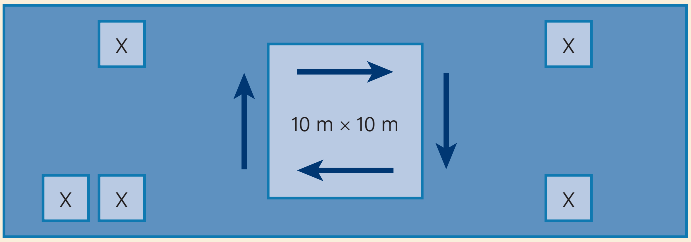
Space: Drill 1 – 3 m × 10 m, Drill 2 – 10 m × 10 m

Demonstrate and apply

Drill 1: Complete 60 stationary passes in pairs.



Drill 2: In groups of five, complete passing around the grid 30 times.



Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

1. Analyse what has been learned and its ability to be transferred to a game.

Demonstrate and apply

2. Participate in a small-sided game (5 vs. 5) of 'End Ball.'

   Aim: To improve motor patterns in Gaelic football

   Equipment: 3 Gaelic footballs. If not available, volleyballs, soccer balls, Australian Rules footballs or tennis balls

   Space: 3 × (20 m × 40 m)

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Rules: Initial rules are:

a. The ball must be passed on the full.
b. If the ball is knocked down by an opponent, you maintain possession.
c. If your team drops the ball, the opponents receive possession.
d. When you catch the ball, you must stand still but may pivot on the spot.
e. Defenders cannot make contact with the player in possession and must be 1 m away.

Analyse and synthesise

3. Analyse what has been learned and its ability to be transferred to a game.
4. Consider your answer to task 1 and reflect on this in relation to principles of play within invasion games:
   a. maintain possession – catch, pass
   b. use of space – maintaining space through face and space movement, maintaining space as attack option or support play in plus-1 situations
   c. creating space – supporting the ball carrier: width, back door, V-formation attack, team/partner plays
   d. defending space – use of field and time, using person-on-person or zone option
   e. the rules of Gaelic Football
   f. safety aspects of game play.

Demonstrate and apply

5. Participate in a possession game. The aim is to make 10 passes in a row inside the 10 m × 10 m grid. The same rules as for End Ball listed previously apply.

Analyse and synthesise

6. Analyse what has been learned and its ability to be transferred to a game.

Demonstrate and apply

7. Participate in a small-sided game (5 vs. 5) of End Ball. The same rules as previously listed apply. Additional rules added as game progresses:
   a. allowed to take four steps
   b. allowed to bounce the ball once after four steps and take another four steps
   c. foot pass – a kick is allowed
   d. ball allowed to hit the ground
   e. player disposed by one-handed knock out of the ball.

Analyse and synthesise

KEY COGNITION

Examine: investigate, inspect or scrutinise carefully; inquire or search into; consider or discuss

8. Examine what has been learned and its ability to be transferred to a game.
9. Evaluate the effectiveness of the various types of practice on your performance.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 2.2

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: How can representative practice improve motor learning?

Recognise and explain

1. Read the following extract.

> “Although physical education is a well-established profession with a sound tradition of formal training and established pedagogical practices, there has been some criticism that practice is often not based on a theoretical model of how learners actually learn (Newell & Rovegno, 1990). The need to base pedagogical practice on a sound theoretical model of the learner and of the learning process has previously been emphasized (Renshaw et al. under review).
>
> The aim of this paper is to show how key principles of ecological psychology and dynamical systems theory might underpin a philosophy of coaching practice based on nonlinear pedagogical principles.
>
> **Nonlinear pedagogy**
>
> In simple terms, nonlinear pedagogy is ‘application of the concepts and tools of nonlinear dynamics’ to coaching practice (Chow et al., 2006, p. 72). Nonlinear pedagogy is predicated on a view of the learner as a human movement system which is inherently nonlinear in character … An important task is to identify key constraints that impinge on any specialized nonlinear dynamical system in nature in order to understand emergent properties of such systems (Newell, 1986). In nature, different nonlinear dynamical systems satisfy a range of constraints as behaviour emerges from them (Davids et al., 2008). The basis of nonlinear pedagogy, therefore, involves the manipulation of key (personal, task and environmental) constraints impinging on learners leading them to satisfy these interacting constraints. In this way, constraints manipulation facilitates the emergence of functional movement patterns and decision-making behaviours in different sports and physical activities.”
>
> Source: Renshaw et al. (2009, pp. 540–602)

KEY COGNITION

Summarise: give a brief statement of a general theme or major point(s); present ideas and information in fewer words and in sequence

2. Summarise and understand the following key points.
   a. What is non-linear pedagogy?
   b. What are constraints?

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

3. Read the following extract.

The mutuality of the performer and the environment

“One of the established tenets of ecological psychology is the mutuality of the individual and environment: one cannot be considered without careful reference to the other … In team sports, the environment consists of team mates and opponents, as well as playing surfaces and inanimate objects that define specific performance contexts (such as an ice rink in skating, a bicycle in the triathlon, parallel bars in gymnastics or goalposts and pitch markings in the football codes). For an individual to engage effectively with other individuals, events, surfaces and objects in the performance environment their affordances for action need to be detected. An affordance refers to a property of the environment which can be detected as information to support an action, and which is related to an individual’s ability to use it (Gibson & Pick, 2000). For example, an unmarked team mate affords the option for a pass for a player with the ball in team sports, while the surface of the ice in a rink affords sliding across on the blades of a skate … Although these affordances are always available for actions by any individual athlete, the detection and learning of affordances is not an automatic process. The role of the learner is to learn to pick up the affordances that these specific environments offer them (Gibson & Pick, 2000). Some affordances will require significant periods of exploration, practice and time to enable detection for action (Gibson & Pick, 2000) … This finding implies that affordances are specific to each individual and relate to his/her action capabilities. In athletes, these capabilities may change as a result of growth and development of body sub-systems across the lifespan or by the application of principled training programmes that develop movement system variables such as strength, speed or range of flexibility.

The importance of exploratory behaviour for facilitating perceptual learning has important implications for coaches attempting to develop athletic performance. It highlights the need to accurately identify the key perceptual information sources in the performance environment (Davids et al., 2006) so that practice opportunities can enable learners to become attuned to specifying information sources available in specific performance environments (Beek, Jacobs, Daffertshoffer, & Huys, 2003).

In sports, performers may initially use non-specifying information when they are not attuned to specifying information sources. For example, skilled cricket batters determine differences between a wristspin bowler’s standard legspinner (clockwise spin) from the googly (anti-clockwise spin) by picking up specifying information from the hand position at ball release. Less skilled batters learn that the trajectory of a ball aimed outside off-stump will be a googly while a ball aimed at leg stump will be a legspinner (Philpott, 1995). Although this information may have some saliency it is based on non-specifying (less useful) information and the learner will often make incorrect decisions. With experience batters become attuned to the bowler’s action and he/she learns to differentiate between the two ball types by using the specifying information that is available from observing the bowler’s action (Renshaw & Fairweather, 2000) …

To help athletes pick up specifying information, it is important for coaches to understand whether practice sessions are representative of the performance environment … For coaches experimental settings equate to practice environments, implying that they need to accurately sample the environmental conditions of practice to ensure congruence with the performance environment in which the movements will be implemented (Davids et al., 2007). Designing representative practice tasks requires the coach to have an understanding of the interaction between key individual, task and environmental constraints of specific sports performances.”

Source: Renshaw et al. (2009, pp. 540–602)

ISBN 978-1-009-31125-0 Stewart et al.

4. Summarise and understand the following key points.
   a. What is the importance of linking the performer and the environment?
   b. What is an affordance?
   c. To whom are affordances specific?
   d. What are representative practice tasks?

Analyse and synthesise

5. Provide one example from the text and one from your experience in the current physical activity of the link between the performer and the environment.
6. Review the activities completed in this chapter during the Engage and Active investigation inquiries. Categorise whether or not they are representative tasks. Explain why, using the examples in the table below as a guide.

Task	Representative	Non-representative	Explanation
Engage 2.1 Demonstrate and apply – Option A: Drills		Non-representative practice	No defender in task. Always know where the ball is coming from and selection of skills; know where to pass it to. No external pressure/ defender.
Active investigation 2.2 Demonstrate and apply: End Ball	Representative		Similar to the game. Where, when, who and how to pass the ball are involved.

7. Review four separate learning activities that have been completed in class to help your learning of the current physical activity. Categorise whether or not each activity is a representative task. Explain why.

Evaluate and justify

8. Evaluate how representative practice may be beneficial to the athlete in authentic game environments.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 2.3

RECOGNISE & EXPLAIN DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How may the two motor learning approaches affect on performance in authentic environments?

Demonstrate and apply

1. Perform in and collect digital evidence of your performance in an authentic performance environment.

Analyse and synthesise

2. Review the footage gathered and identify one feature about your performance that is currently holding back your development. This aspect may be in relation to a specific technique in your performance, the use of a tactic or your ability to read the play.

Evaluate and justify

3. Evaluate your level of performance using both Fitts and Posner's, and Newell's stages of learning models.
4. Justify your level in 250 words using primary and secondary data.

Part A

Demonstrate and apply

5. Devise two training sessions using the cognitive systems approach. Ensure that these are appropriate for your stage of learning while using the traditional method.

KEY COGNITION

Implement: put something into effect – for example, a plan or proposal

6. Implement the training sessions over two lessons. Collect data from the sessions.
7. Participate again in an authentic environment and collect digital evidence.

Analyse and synthesise

8. Identify pre- and post-test data and explain briefly in a table using the following headings: 'Type of practice used'; 'Appropriateness to stage of learning'; 'Outcomes achieved technically in practice'; 'Outcomes achieved tactically in practice'; 'Transferability of technical and tactical aspects into the authentic environment'.

Evaluate and justify

9. Compare and contrast pre- and post-test data to evaluate the effectiveness of the training strategy.

Part B

Demonstrate and apply

10. Devise two training sessions using the dynamic systems approach. Ensure that these are appropriate for your stage of learning while using the constraints-led approach.
11. Implement the training sessions over two lessons. Collect data from the sessions.
12. Participate again in an authentic environment and collect digital evidence.

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

13. Identify pre- and post-test data and explain briefly in a table using the following headings: 'Type of practice used'; 'Appropriateness to stage of learning'; 'Outcomes achieved technically in practice'; 'Outcomes achieved tactically in practice'; 'Transferability of technical and tactical aspects into the authentic environment.'

Evaluate and justify

14. Compare and contrast pre- and post-test data to evaluate the effectiveness of the training strategy.

ACTIVE INVESTIGATION 2.4

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How do we perform in authentic environments?

Demonstrate and apply

1. Capture digital evidence in the performance domain.
2. Compete in 1 vs. 1, 2 vs. 2, 3 vs. 3, 5 vs. 5 and/or 10 vs. 10 game scenarios, focusing on both technical and tactical components.
3. Participate in a full field/court game.
4. Ensure that digital evidence is stored in at least two locations for review, comparison and contrast later on in the unit and in preparation for assessment.

Analyse and synthesise

KEY COGNITION

Examine: investigate, inspect or scrutinise; inquire or search into; consider or discuss an argument or concept in a way that uncovers the assumptions and interrelationships of the issue

5. Examine and identify key limiters and strengths in relation to your performance.
6. Analyse and explain your stage of learning.

Evaluate and justify

7. Evaluate and synthesise primary and secondary data about the influence of motor learning concepts and principles on personal performance of specialised movement sequences and movement strategies in authentic performance environments.
8. Hypothesise how you would manipulate a training program in the future to ensure optimisation of your own performance in an authentic performance environment.

ISBN 978-1-009-31125-0 Stewart et al.

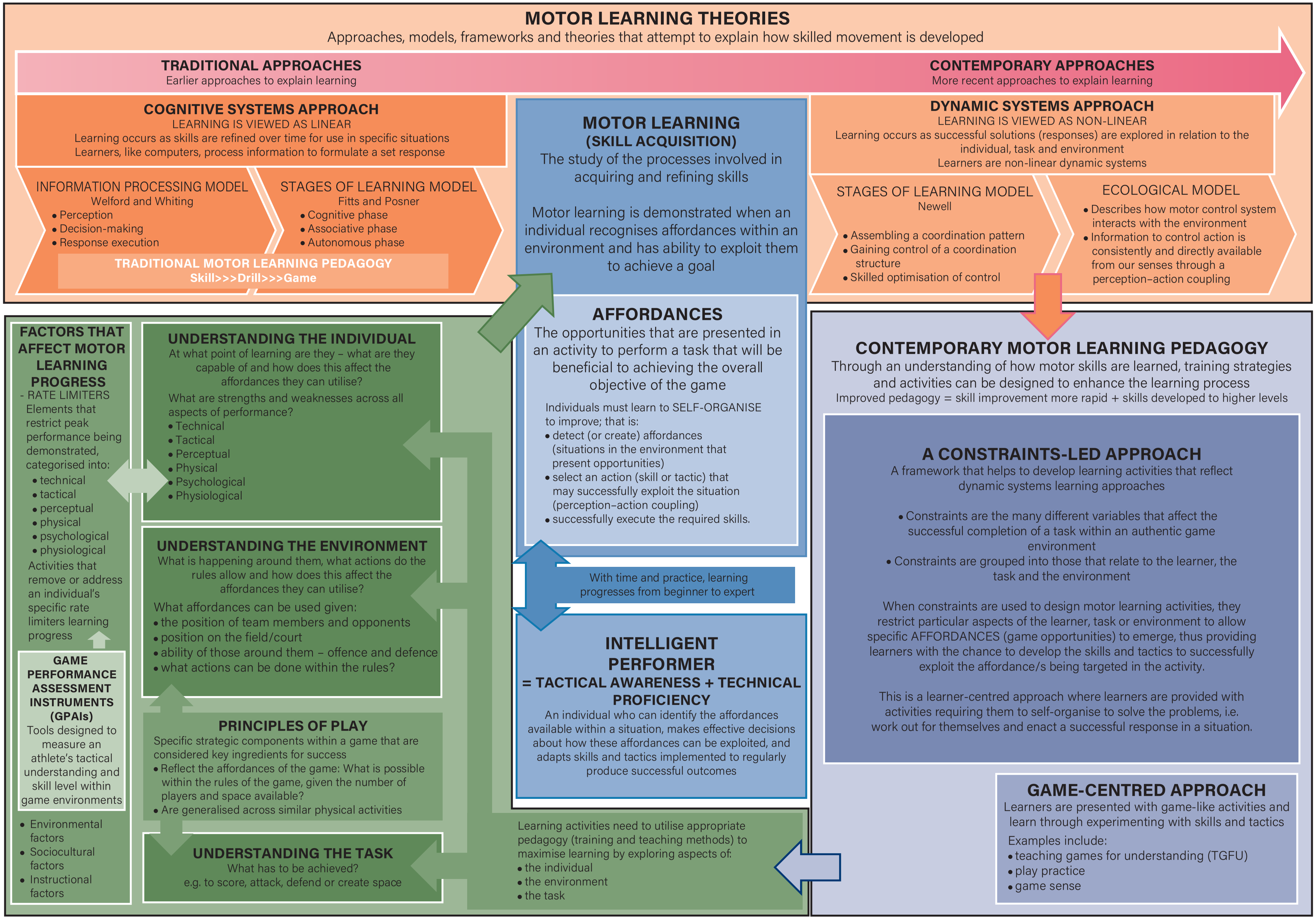


FIGURE 2.4 Motor learning theories

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- There are two major approaches to investigate motor learning: the traditional cognitive systems approach, also referred to as the *cognitive model*; and the contemporary dynamic systems approach, also referred to as the *ecological model*.
- The cognitive systems approach includes information processing, where learning is hierarchical and linear, and describes separate stages involving perception, decision-making and response execution.
- The cognitive systems approach includes Fitts and Posner's (1967) stage model of motor learning, which identified that as learners develop information-processing skills they will progress through the cognitive, associative and autonomous stages of learning.
- The dynamic systems approach explains that movements emerge, or self-organise, through the dynamic interaction of the environment, the task being performed and the individual.
- According to the dynamic systems approach, movements are not organised hierarchically, involve non-linear and unpredictable changes, and emerge as part of a complex dynamic system.
- According to the dynamic systems approach, performers will search for affordances in response to the constraints within the environment, task and themselves.
- A dynamic systems approach to motor learning includes Newell's stages of learning model, which sees a learner move about through the stages of assembling a coordination pattern, gaining control of a coordination structure and skilled optimisation of control.
- According to a dynamic systems approach, training activities that will improve motor learning and skill should reflect authentic game play, manipulate constraints to encourage appropriate affordances to emerge for the performer and allow effective self-organisation to occur in response to those affordances.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. The cognitive systems approach involves:
   A. input of information to the brain, processing of information followed by execution of movement.
   B. close alignment with Fitts and Posner's stages of learning.
   C. a more traditional approach.
   D. all of the above.

2. The dynamic systems approach involves:
   A. only skills completed in an open environment.
   B. alignment with Fitts and Posner's stages of learning model.
   C. a modern approach aligned with Newell's stages of learning model.
   D. the construction of tasks only for elite performers.

3. The stages in Newell's stages of learning model are:
   A. stage 1 – assembling a coordinated pattern; stage 2 – gaining control of a coordinated structure; and stage 3 – skilled optimisation of control.
   B. stage 1 – gaining control of a coordinated structure; stage 2 – assembling a coordinated pattern; and stage 3 – skilled optimisation of control.
   C. stage 1 – cognitive; stage 2 – associative; and stage 3 – autonomous.
   D. stage 1 – autonomous; stage 2 – cognitive; and stage 3 – associative.

ISBN 978-1-009-31125-0 Stewart et al.

4. Non-linear pedagogy is:
   A. antiquated and out of date.
   B. only applicable to invasion games where a change of direction is necessary.
   C. able to challenge learners to develop flexible, adaptable solutions to problems.
   D. useful only when needing to manipulate psychological constraints.

5. According to a dynamic systems approach, training activities that will improve motor learning should:
   A. be repetitive so that technique execution can be developed.
   B. focus initially on basic errors in the cognitive phase to see rapid improvement.
   C. mirror authentic game play without adjustment.
   D. be representative of the authentic environment, but use additional constraints.

SHORT-RESPONSE QUESTIONS

1. List the three stages of Fitts and Posner's, and Newell's learning models.
2. Evaluate how the use of small-sided or modified games may be beneficial to motor learning.

EXTENDED-RESPONSE QUESTIONS

1. With reference to your current physical activity of study, make a decision regarding your stage of learning using Newell's learning model and justify your reasoning.
2. Decide and justify whether the use of traditional or non-linear pedagogy would influence your motor learning and performance in an authentic environment.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 3

Factors affecting the motor learning process

What's ahead?

Chapter 3
Factors affecting the motor learning process

- **3.1** What factors affect motor learning progress?
- **3.2** What types of practice are available to enhance motor learning?
- **3.3** What is feedback and how does it affect motor learning?

Key subject matter

- Recognise and explain that rate limiters are factors that have an effect on the learning processes of an individual and may restrict performance; rate limiters can include technical, perceptual, tactical, psychological, physical and physiological factors.
- Investigate rate limiters in relation to personal motor learning and performance in physical activity.
- Recognise and explain that practice of skills is necessary for optimal performance and can be classified into different types.
- Recognise and explain that feedback is all the information an individual receives about the performance of a skill and is organised into two categories, intrinsic and extrinsic feedback.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What factors may negatively affect the learning process of a motor skill?
- What are rate limiters and how can they be used to evaluate motor learning and performance?
- How do different types of practice affect skill development?
- How can effective feedback accelerate motor learning?

ISBN 978-1-009-31125-0 Stewart et al.

3.1 What factors affect motor learning progress?

To develop appropriate learning activities for an athlete, it is essential to have a clear understanding of their current ability. In this way, teachers, coaches and the athlete can target areas that will bring about improved performance through specifically designed training strategies. A key to improved learning, therefore, is understanding what is currently limiting performance and improvement.

One skill-acquisition researcher, Newell, suggests that any aspect that reduces the rate at which learning progresses can be termed a **rate limiter**. Rate limiters are numerous, and vary from athlete to athlete; however, they can be classified as **technical**, **perceptual**, **tactical**, **psychological**, **physical** and **physiological**. This indicates that aspects from any category may be acting as rate limiters, hampering development in other areas and the overall development of the motor skill.

rate limiter a constraint that holds back or slows the emergence of a motor skill

technical rate limiter a constraint to motor learning that relates to the motor programs and movement sequences required for the activity

perceptual rate limiter a constraint to motor learning that relates to the interaction between the body and the environment, and may be the result of inaccurate interpretation when forming an awareness of the situation and requirements

tactical rate limiter a constraint to motor learning that relates to the decisions and actions of players in the contest to gain an advantage over the opposing team or players

psychological rate limiter a constraint to motor learning that relates to the mental and emotional state of the person and how this may be affecting learning progress negatively

physical rate limiter a constraint to motor learning that relates to the physical capabilities of the learner, where the athlete's components of fitness or energy systems may be restricting potential improvement

physiological rate limiter a constraint to motor learning that relates to the genetic make-up of body systems

> “The slow development of one sub-system can act as a rate limiter, meaning that skills may only emerge when all the relevant sub-systems have reached a critical level of development (Thelen, 1995). For example, in child development, muscle strength is a rate limiter for the emergence of walking (Haywood & Getchell, 2005).”
>
> Source: Renshaw et al. (2007, p. 549)

Technical factors

Technical factors that act as rate limiters to motor learning relate to the motor programs and movement sequences required for the activity – that is, the performance of the techniques required (e.g. a forehand or backhand in tennis). Motor learning for the performer may be slowed if:

- they don't know how to perform the movement sequence
- subroutines are inappropriately sequenced or timed
- their movements are uncoordinated or inefficient
- their movements produce inappropriate force and speed
- they are unable to manipulate the movement pattern in different ways to suit the situational requirements.

Tactical factors

Tactical factors that act as rate limiters to motor learning relate to 'the decisions and actions of players in the contest to gain an advantage over the opposing team or players' (Martens, 2004, p. 170). This may occur through the manipulation of oneself, the goal to be achieved or the environment. Motor learning for the performer may be slowed if they:

- don't know how to perform the movement sequence adequately in game-play scenarios
- don't know when to use the technique during authentic situations
- are unaware or unfamiliar with all the rules that affect the play, position and options during game play

ISBN 978-1-009-31125-0 Stewart et al.

- are unaware or unfamiliar with all the strategies available to maximise the chances of success
- are unaware of when specific strategies should be used successfully during authentic game-play situations
- are unable to identify and use strategies to combat the strengths and weaknesses of the opposition
- struggle to work with others to communicate and implement the required strategies.

Perceptual factors

Perception is the ability to understand the environment through the use of our senses. Through perception, humans gain specific types of awareness in relation to their surroundings and their body. The information from the sense and body is used to create:

- body awareness – the capacity to understand body parts, what they can do, and how they relate to each other
- spatial awareness – knowledge of how much space the body occupies and how to use that space
- directional awareness – an understanding of location and direction of the body in space
- temporal awareness – an awareness of the relationship between movement and time. (Frost et al., 2008, pp. 126–7)

Perceptual factors that act as rate limiters to motor learning relate to the interaction between the body and the environment and may be the result of inaccurate interpretation when forming an awareness of the situation and requirements.

Motor learning for the performer may be slowed if they:

- cannot accurately 'read the play' – interpret the situation and what is happening
- cannot accurately interpret environmental factors such as speed, direction and force of implements involved, as well as placement and movements of teammates and opponents
- do not recognise the opportunities available for them in the current situation (the affordances available)
- struggle to decide on the movement sequence or movement strategy that will best suit their performance in the situation they have perceived (poor perception–action coupling).

Physical factors

Physical factors that act as rate limiters to motor learning relate to the physical capabilities of the learner, where the athlete's components of fitness or energy systems may be restricting potential improvement. For example, is the strength of the muscular system limiting the learning of a complex movement in a sport aerobics routine?

Motor learning for the performer may be slowed if the:

- nervous and musculoskeletal system cannot produce the required subroutine movements for the selected motor program with adequate timing and force
- body is currently not capable of moving in the required way – for example, an injury or a lack of flexibility resulting in poor mobility
- current level of fatigue is impeding the production of the movements required
- required level of fitness is not currently developed for the specific fitness component – for example, the performer has insufficient speed and power to jump further in triple jump.

Psychological factors

Psychological factors that act as rate limiters to motor learning relate to the mental and emotional state of the person and how this may be affecting learning progress negatively. Psychological factors include the aspects of motivation, confidence, arousal levels, attention and concentration. Motor learning for the performer may be slowed if the learner:

- is not ready to learn or perform
- is not motivated to improve
- is not confident that improvement can or will occur
- is not stimulated to appropriate levels
- is not focused on the correct aspects to see improvement or success in training or game play
- is not happy or finding **enjoyment** in the physical activity.

> **enjoyment** (of physical activity) the level of pleasure that is taken from engaging in or succeeding at physical activity

ISBN 978-1-009-31125-0

Physiological aspects

Physiological aspects that act as rate limiters to motor learning relate to the genetic make-up of body systems. Here, the individual's body composition elements – such as height, weight or arm span – may be preventing further improvement. Motor learning for the performer may be slowed if the:

- body is not capable of producing movements that produce successful outcomes, even when trained
- body is not capable of moving in the required way
- body is not capable of reading and interpreting the situation due to perceptual issues
- brain is unable to make effective decisions about a course of action or create an effective motor program for the situation.

CHECK-IN 3.1

1. Identify two techniques for the physical activity you are currently studying that are holding back your performance.
2. Identify the one strategy used in your current physical activity that you find most difficult to put into action when in game-play situations.
3. Identify two features of the performance environment of your current physical activity that you do not always perceive accurately and provide examples for each of an outcome that has resulted from this misperception. Consider elements such as implement movement (speed or flight), court or field position, opponent position or movement, teammate position or movement.
4. Based on your current fitness levels, identify one component of fitness that could enhance your performance of your current physical activity if it was improved, and provide an example of how your performance would be enhanced.
5. When in a training activity or Physical Education class, which psychological aspect do you believe most negatively affects your motor learning – motivation, confidence, arousal levels, attention or concentration? Justify your selection with an example.
6. Identify one element of your body make-up that may prevent you from becoming an elite performer in your current physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

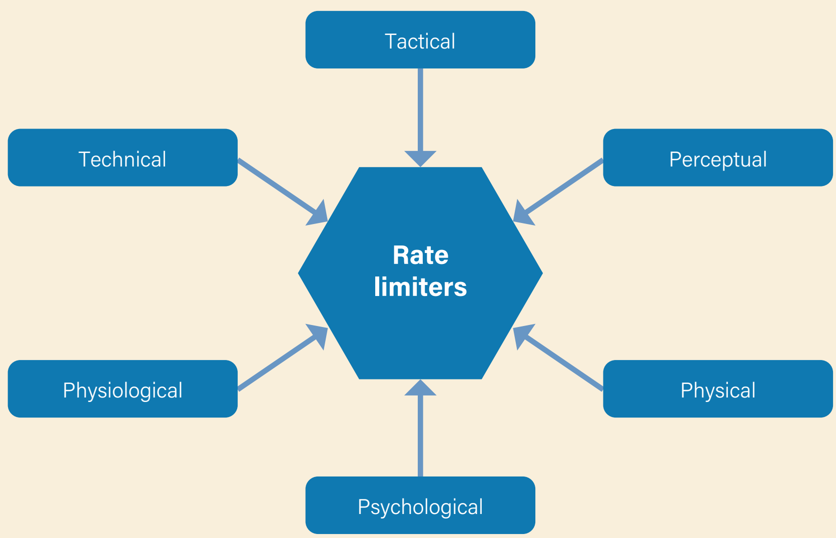
ENGAGE 3.1

Inquiry question: What types of training and limiting factors affect motor learning?

Recognise and explain

1. Using the rate limiter hexagon graphic organiser, categorise five aspects from each section that may limit performance in the physical activity being studied.

Rate limiter hexagon



Demonstrate and apply

2. Engage in 30 minutes of game play for the physical activity currently being studied. Pay particular attention to when you make errors and what might be the causes of them.

Analyse and synthesise

3. Order the limiters in each section by highlighting the top three limiting factors on your performance in the current physical activity. Remember to consider how each might be affecting the improvement, consistency, stability, persistence and adaptability of movements or strategies in your physical activity.
4. Decide which is the most significant rate limiter in each section for your performance in the current physical activity.

> **Analyse**: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

5. Analyse the most significant rate limiter for your performance in the current physical activity.
6. For the most significant limiting factor in each section, recommend a training activity that could be used to overcome this limitation and therefore enhance your learning and performance.

ISBN 978-1-009-31125-0

3.2 What types of practice are available to enhance motor learning?

Due to the two different approaches to motor learning – the cognitive systems approach and the dynamic systems approach – different types of practice to stimulate learning have been developed over time. These practice types have been developed in response to the different underlying assumptions in each approach. The cognitive systems approach relies heavily on practice types 1–9 in Table 3.1. These practice types are more traditional and reflect a 'drills' type approach, where techniques and tactics may be broken down into sub-components to refine and then are practised in different scenarios until they improve. The more modern approach of dynamic systems theory relies more on the characteristics of problem-solving, specificity and variability practice, as these are the key elements of a non-linear constraints-led approach to motor learning. These practice types are represented more in approaches 10–12 in Table 3.1.

TABLE 3.1 Types of practice

1. Massed practice. This involves continual repetition of a specific skill with no or limited intervals between. This is completed in a closed environment. According to the *Psychology Dictionary*, 'massed practice is considered less effective than a distributed practice.' An example is 50 passes between two futsal players.	**2. Distributed practice**. This involves short intervals focused on a specific skill with frequent intervals between – for example, 5 × 10 free throws in basketball with 5 lengths of the court dribbling of the ball, followed by 5 × 10 free throws.
3. Whole practice. This involves practice of the specific skill in total – for example, completing a golf shot.	**4. Part practice**. This involves breaking the skill down into separate sections or subroutines – for example, ball toss in tennis serve, racquet swing down back.
Many practitioners use a whole–part–whole approach to skill practice.	
5. Blocked practice. This involves chunked periods of time practising a single skill of a multitask activity – for example, in volleyball, 10 set passes followed by 10 dig passes, practised for 15 minutes.	**6. Random practice**. This involves the repetition of several skills simultaneously – for example, in basketball, shooting practice alternating between a three-point shot, free throw and lay-up.
The *Medical Dictionary* states that, 'Research shows that while blocked practice is superior at improving immediate performance, it is not as effective as other approaches, such as random practice, for retained learning.'	
7. Constant practice. This involves the repetition of a specific skill without variation – for example, passing a ball over 10 m.	**8. Varied practice**. This involves the repetition of a skill with minor variations – for example, passing a ball over 10 m, 15 m and 20 m.
9. Drills. This involves the repetition of a skill. It generally occurs in a closed environment with direct instruction by the teacher/coach. Limited, if any, external factors are involved as the player is aware of the direction of reception and the selected technique to be used. Another term that can be interchangeable with 'drills' is 'grids.' This generally is an extension of the original drill activity into a secondary drill. This is the same repetition of the skill in a closed environment with more players involved in a square or grid.	**10. Problem-solving practice**. This type of practice requires the player to use some decision-making to complete the task.
11. Specificity. This involves representative practice task designs that faithfully replicate performance environments during practice. This is important, as the perception and action are tightly coupled – for example, cricket batting practice using a bowler rather than a bowling machine.	**12. Variability of practice**. This involves different options to complete a specific task or goal – for example, training for touch football with a tennis ball.

ISBN 978-1-009-31125-0 Stewart et al.

massed practice the continual repetition of a specific skill in a closed environment with no or limited intervals between

distributed practice short intervals of practice that focus on refinement of a specific skill or subroutine within a skill

whole practice practice that involves the repetition of a skill in its entirety

part practice practice that involves breaking a skill down to hone separate sections or subroutines

blocked practice chunked periods of time to practise a single skill of a multitask activity

random practice the repetition of several skills simultaneously within the same activity

constant practice the repetition of a specific skill without variation

varied practice the repetition of a skill with the activity requiring minor variations to the motor program

drills the repetition of a specific skill or strategy, generally in a simplified, closed environment with limited external factors influencing skill implementation

problem-solving practice an activity that requires the player to use some decision-making to find a movement solution in completing the task or scenario

specificity (as practice) representative activities that replicate the performance environment demands with regard to attunement and perception–action coupling

variability of practice practice activities that encourage different options to complete a specific task or goal

ENGAGE 3.2

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE

Inquiry question: What types of practices affect motor learning?

Recognise and explain

1. Review the following videos:
   - *"the Piano Juggler" https://cambridge.edu.au/redirect/10673*
   - *Brickies Labourer in Bangladesh. https://cambridge.edu.au/redirect/10674*

KEY COGNITION

Consider: think deliberately or carefully about something, typically before making a decision; take something into account when making a judgement; view attentively or scrutinise; reflect on

2. Identify what was needed for each individual's motor development. Consider the qualities of improvement, consistency, stability, persistence and adaptability. How does each affect the motor control required to complete the tasks observed?

Demonstrate and apply

3. Complete a juggling task in relation to recognising the effect of practice on performance and to identify different training styles.

   Aim: To juggle the ball 30 times

   Equipment: 2 balls per pair

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Organisation:

- Students are to work with a partner. One is student A; the other is student B.
- Each pair of students requires four tennis balls.
- No practice is allowed.

4. Draft a table using the following format, but for 20 attempts.

Initial	Dominant hand: completion		Non-dominant hand: completion		Post-practice	Dominant hand: completion		Non-dominant hand: completion	
	Student A	Student B	Student A	Student B		Student A	Student B	Student A	Student B
1.					1.				
2.					2.				
3.					3.				

5. Student A is to attempt to juggle two balls in one hand up to a maximum of 30 catches. If the ball is dropped, the count stops. Student A has 20 attempts on their dominant hand and 20 attempts on their non-dominant hand. Student B counts and records the number of successful catches for each attempt.
6. Reverse the roles of student A and student B to collect further primary data and ensure that all trials are recorded in the table.
7. Both students now undertake further practice for this task. Student A undertakes 30 practices for each hand. If they reach 30 catches, they stop and start again. In between each practice attempt, student A must bounce the ball in one hand 20 times. At the end of 30 practices using each hand, student A sits and has no further practice. At the same time, student B has 10 minutes' continuous practice using each hand. There is no limit on catches.
8. Repeat step 5 to collect post-practice data and observe improvement.

KEY COGNITION

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

Analyse and synthesise

9. Categorise the practice types involved in the task.
10. Examine the data and consider which practice had the biggest impact on you and your partner.
11. Organise class data into one table.
12. Examine the data and identify which practice had the biggest impact on the class.
13. Evaluate what effect practice had on the performance of the juggling task.
14. In a 100-word statement, synthesise what you have discovered in this laboratory activity with what you already know about practice to hypothesise the impact practice has on motor learning.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 3.1

RECOGNISE & EXPLAIN DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How may creativity of performance be developed in authentic environments?

Recognise and explain

1. Read the following extract.

Encouraging creativity in learning and performance

" Extensive practice is essential to realise performance potential in any domain (Ericcson, Krampe & Tesch-Römer, 1993). Ericsson et al. (1993) built their 'expert-performance approach' on the concept of deliberate practice, defined as engagement in relevant activities that require great effort, lots of repetition and opportunities to acquire feedback and is not inherently enjoyable (Ericsson, 2003; Ward, Hodges, Williams, & Starkes, 2004). Even in later work, Ericsson (2007) described practice as deliberate 'when individuals engage in a practice activity (usually designed by their teachers), with full concentration on improving some aspect of performance' (p. 14). This view of practice proposed by Ericsson might be interpreted as emphasizing the need for early specialization and the need to practise using highly repetitive drills – the concept of perfect practice. However, given the importance of developing performers with adaptive variability, it could be argued (as Ericsson did in later work (Ericsson, 2003)) that this type of practice is far from perfect and can lead to performance that lacks flexibility to adapt in the ways demonstrated by highly skilled individuals.

In contrast to deliberate practice, nonlinear pedagogy advocates the need for practice that adopts the principle of 'repetition without repetition' (Bernstein, 1967). In this approach, coaches design representative practice tasks that allow individuals time and space to explore and discover co-ordination patterns and make decisions that are most appropriate for their unique constraints (Davids et al., 2008). In contrast to the deliberate practice framework, coaching based on a nonlinear pedagogy would not reject unstructured learning environments and would promote informal learning opportunities, including having children design their own games and activities (Chappell, 2004; Kidman, 2001, 2005).

In summary, providing opportunities to learn by playing modified tasks or games that are inherently enjoyable and intrinsically motivating for the performer will have the dual effect of helping to create 'love' for the sport while at the same time developing the integrated physical, technical, tactical and psychological skills needed for competitive success (Bloom, 1985; Chappell, 2004; Côté et al., 2007; Ericsson, 2007; Jannelle & Hillman, 2003). "

Source: Renshaw et al. (2009, pp. 540–602)

2. Draft a table that summarises the key points of the following and provide a specific example of each:
   a. the characteristics of **deliberate practice**
   b. issues that may arise from using deliberate practice
   c. alternative approaches to deliberate practice
   d. the benefits of a non-linear approach using small-sided or modified games with variability.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

deliberate practice a special type of practice that is purposeful and systematic

Identify: distinguish; locate, recognise and name; establish or indicate who or what someone or something is; provide an answer from a number of possibilities; recognise and state a distinguishing factor or feature

3. Identify and recall your involvement in an activity using deliberate practice.
4. Assess the effectiveness of the task by copying and completing the following table.

Task description:				
Rate the task according to the table headings using the rankings: 5 – very good, 4 – good, 3 – average, 2 – poor, 1 – very poor.				
Enjoyable	**Intrinsically motivating**	**Develop technical abilities in authentic environment**	**Develop tactical abilities in authentic environment**	**Develop psychological abilities in authentic environment**
Explain ranking				

Demonstrate and apply

5. Design and implement a small-sided or modified game using non-linear pedagogy.
6. At the conclusion of your small-sided or modified game, consider the effectiveness of the task in the above table.

Evaluate and justify

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

7. Evaluate the success of the small-sided or modified game in developing creativity of performance in an authentic environment.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 3.2

Inquiry question: What motor learning outcomes do the different practice types produce?

Recognise and explain

1. In small groups of two, four, six or nine, select one of the clustered types of practices from the list below:
   a. massed practice and distributed practice
   b. whole practice and part practice
   c. blocked practice and random practice
   d. constant practice and varied practice
   e. drills and problem-solving
   f. specificity and variability of practice.
2. Identify the characteristics of the two different types of practice selected.
3. Recall your major technical rate limiter in Engage 3.1.
4. Conduct some secondary research to design a training session targeting your major technical rate limiter using the two different types of practice you selected.

Demonstrate and apply

5. In groups, share and examine the designed practice session and critically review its appropriateness for developing motor learning and, if required, refine tasks.

Analyse and synthesise

6. Investigate the success of tasks by implementing all the groups' practice sessions. Collect evidence of performance. This may be notes on successful trials, accuracy of technique or video evidence.

Evaluate and justify

7. Evaluate the effectiveness of the practice for your performance.
8. Determine whether the practice would have an effect on the performance of your rate limiter in the authentic performance environment. Justify your argument using primary and secondary data.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 3.3

RECOGNISE & EXPLAIN ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: Why is variability of practice important in motor learning?

Recognise and explain

1. Read the following extract.

Coaching is a balance between maintaining stability versus creating instabilities

" Coaching is a balance between protecting the confidence of athletes by providing environments that enable them to be successful and risking the loss of existing confidence levels by exposing them to more demanding practice tasks.

Variability is an essential component of performance development

Variability within individual movement patterns has traditionally been viewed negatively, since a common goal for many coaches is the acquisition of an 'ideal' technique as a template for performance success. In fact, much traditional practice is based around the need for performers to have acquired a 'correct' technique before being exposed to the real game. However, there is now a large body of research that demonstrates that individual learners can achieve similar task outcomes by using different co-ordination patterns and that experts often display more variability within their movement patterns than less skilled individuals (Bootsma, Houbiers, Whiting, & van Wieringham, 1991; Brisson & Alain, 1996; Davids et al., 2006; Davids, Button et al., 2007; Renshaw & Davids, 2004; Schöllhorn & Bauer, 1998).

Despite this many coaches require athletes to practice in sterile conditions and undertake decomposed practice tasks such as run-throughs in order to provide what they believe is the best chance for their athletes to standardise their run-up. However, it is now well established that Olympic standard long jumpers are not capable of placing their feet in the same place for every run-up and actually adjust their step patterns as they approach the take-off board (Hay, 1988; Montagne, Cornus, Glize, Quaine, & Laurent, 2000). During a competition the jumper may need to make adjustments for changes in individual constraints such as fatigue and psychological stress as well as changes in environmental conditions such as run-up surfaces and changes in wind speed or direction. The implication is that while maintaining the essential specifying information for actions, rather than reduce variability, the coach might seek to increase variability in practice conditions so that the athlete develops adaptability and flexibility to cope with changing task constraints (Davids et al., 2007). "

Source: Renshaw et al. (2009, pp. 540–602)

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

2. Identify the key components of the article by copying and completing the table below in relation to a perceived positive or negative influence on player confidence and the outcome during an authentic performance environment.

	Positive	Negative
Stability rather than instability in practice		
Variability of practice in a traditional approach		
Variability of practice in a modern approach		
Variability in authentic performance environment		

Evaluate and justify

3. Evaluate and justify whether variability of practice is important in motor learning.

ENGAGE 3.4

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: How do we perform in authentic environments?

Demonstrate and apply

1. Capture digital evidence of your performance in a variety of modified game and match situations. Consider 1 vs. 1, 2 vs. 2 and 3 vs. 3 situations as appropriate for your physical activity of study. Ensure that digital evidence is stored in at least two locations for review, comparison and contrast later in the unit, and in preparation for assessment.

Analyse and synthesise

KEY COGNITION

Critique: review (e.g. a theory, practice, performance) in a detailed and analytical way

2. Critique the digital data and identify two strengths and weaknesses of your play.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 3.3

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What training activity can help you overcome a specific rate limiter to advance learning and performance?

Demonstrate and apply

1. Undertake 30-minutes of game play in your current physical activity of study and collect footage as primary data.

Analyse and synthesise

2. Review footage to find evidence of a tactical rate limiter that is currently restricting your performance and slowing the progress of learning for this activity. To assist in this process, review the information on tactical rate limiters from earlier in this chapter.

KEY COGNITION

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

3. Synthesise your primary data evidence into a brief summary statement that explains the limitations experienced when implementing the tactic selected.
4. Select a training type from those listed in Table 3.1. Using secondary research, devise a 15-minute training activity to improve the selected tactic. *If undertaking a team physical activity, this might be done with small groups who have selected the same tactic as their rate limiter. This will allow the training activity to incorporate a number of players all working to improve the same tactical aspect.*

Justify

5. Describe the training activity and justify how it will specifically improve the use of the tactic. Refer to the elements of motor learning – that is, is it specifically designed to bring about improvement, consistency, stability, persistence and/or adaptability?

Demonstrate and apply

6. Implement the training activity and record the session.
7. Record digital evidence of a further 30-minute session of game play in which you (or your group) strive to use the tactic that has been the focus of the training activity.

Evaluate and justify

8. Review the footage collected in steps 6 and 7 and evaluate the effectiveness of the training activity for enhancing learning and performance of the selected strategy. Ensure that your evaluation includes the effectiveness of the training type selected from Table 3.1.
9. From your evaluation and the primary data gathered, identify one modification that would make the training activities more effective, and justify how this would better enhance the effectiveness of tactical strategy in authentic game-play environments.

ISBN 978-1-009-31125-0 Stewart et al.

3.3 What is feedback and how does it affect motor learning?

Feedback is an essential part of motor learning, as it enables learners to reflect upon performance, identify positive and negative behaviours, and plan to maximise future outcomes.

The two major types of feedback involved in motor learning are internal feedback and external feedback. **Internal feedback** is when the body receives information during the performance. This occurs through the body senses, or proprioceptors. These senses help to develop a kinaesthetic sense for a movement and allow the athlete to differentiate between effective skill execution and error. Internal feedback can be **knowledge of performance feedback**, where the athlete is attuned to the senses and body movement in the performance. For example, in cricket batting, the athlete may identify that they feel they were reaching too far forward to hit the ball. In high jump, they may feel the arch was not held for long enough.

External feedback or augmented feedback comes from outside of the body. This can occur in several different formats. Verbal feedback can occur from an observer. Written feedback is obviously in writing. This may be in the form of notes, a long article or annotations on a checklist. Both verbal and written feedback can come from a number of sources – for example, a coach, peer, teammate, opponent, commentator or spectator. **Knowledge of results feedback** is also a part of external feedback and 'can include scores, times, and distances (Mononen et al., 2003).' (Roulier, 2014).

A **feedback loop** refers to a continual cycle of information in a traditional approach. First, it relates to the input of information. This occurs through the identification of information from the individual, the task and the environment. Our bodies are constantly receiving messages through internal feedback (body, position, balance, fatigue) and external feedback from the environment about key factors around us and in the game, such as the opposition, our teammates and the weather. This information is processed and output or the action occurs. From the output or action, further information is able to be gathered – for example, success of the action. This ongoing feedback allows for constant decisions to be made about what to do and when to do it – and also what might need to be adapted about the skill in order for it to suit the current situation. This is all facilitated through a feedback loop.

internal feedback information received from the body's senses and proprioceptors during a performance

knowledge of performance feedback internal feedback that is concerned with either perception–action coupling, decision-making of the selected movement strategy or sequence, or how the movement sequence itself was enacted

external feedback feedback that comes from a source outside of the body, such as a teacher, coach or video, either during or after a performance

knowledge of results feedback external feedback that is concerned with the outcome of the performance

feedback loop a traditional approach concept where a performer is in a continual cycle of receiving information, deciding on an action and then performing a response; this response then provides new information to again be processed and governs the next action

ISBN 978-1-009-31125-0

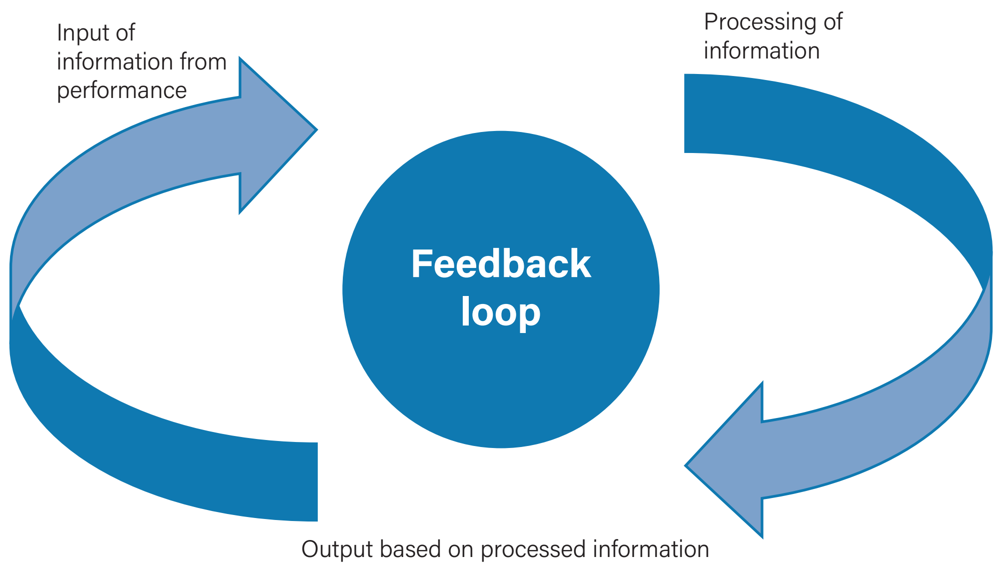


FIGURE 3.1 A feedback loop

The characteristics of good and bad feedback

External feedback that comes from a practitioner can be a powerful catalyst in the learning process. The quality of feedback given by a teacher or coach can enhance or restrict motor learning, and therefore it is essential to be aware of what constitutes effective external feedback.

Effective feedback should be:

- **positive rather than negative** – feedback can be either positive information, which is affirming, or negative feedback, which produces an adverse effect. Even when errors occur, describing what can be done, rather than what was performed incorrectly, will be more beneficial.
- **timely** – occurring as soon as possible after completion of the task
- **pertinent and relevant** – it should not overload the learner with information, but rather be specific to the current situation
- **directed,** so that learners solve problems.

It is worth noting that the amount of external feedback that is actually taken in and actioned by a learner has been questioned. Less 'white noise' is better – keep feedback short, targeted and specific for the learner to develop from the feedback given. When looking at feedback, you will notice that much of the information relating to feedback is coach-centred. However, for greater depth of learning to occur, it is far more beneficial for feedback to be learner-centred. Enhanced learning will occur if the individual is able to self-organise and to identify personal rate limiters.

To assist the learner to develop this self-reflective skill, the practitioner must use strategic questioning as an important part of the feedback process. Closed questions with a correct response are directed at the learner in relation to a technical aspect – for example, 'What type of shot should you have played?' Open questions allow for multiple responses and are usually directed at learners to solve problems. This may be a technical problem – for example, 'What did you need to do in that situation to pass the ball accurately to the spiker?' Greater height, accuracy of pass, proximity to the net and/or timing of the pass are the possible responses. However, open questions are usually used to solve more complex tactical problems, such as 'What options did you have in attack to enhance your scoring opportunity?' By teachers and coaches modelling effective questioning throughout the learning process, athletes learn to ask these questions of themselves and in turn to formulate successful future performances, without the need for an external person to 'tell them what to improve'.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 3.5

RECOGNISE & EXPLAIN DEMONSTRATE APPLY

Inquiry question: How is feedback effective?

Demonstrate and apply

1. During game play in your next performance lesson, find a partner with whom you can share immediate feedback.
2. Identify specific times in your performance when constructive advice could be delivered immediately – for example, after a point, after a try, a change of ends or a break in play.
3. Engage in the physical activity, taking it in turns with your partner to play or provide feedback. If possible, take notes on the feedback you give, so that your partner may review your advice after the lesson.

Recognise and explain

KEY COGNITION

Explain: give a detailed account, including reasons or causes, and make the relationships between things evident; make (an idea or situation) plain or clear by describing it in more detail or revealing relevant facts; provide additional information that demonstrates understanding of reasoning and/or application

4. At the completion of the performance, give your partner an overall summary of their performance by identifying the successful aspects you observed. Also give them one area to improve by focusing on how to develop a specific technique or an area of skill selection.

FIGURE 3.2 A water polo team discussing tactics

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- A wide variety of factors can restrict the learning of motor skills and hamper successful performance. These factors can be categorised into rate limiters.
- A rate limiter is any constraint that holds back or slows the emergence of a motor skill.
- There are six categories of rate limiters.
  - Technical factors that act as rate limiters to motor learning relate to the motor programs and movement sequences required for the activity.
  - Tactical factors that act as rate limiters to motor learning relate to 'the decisions and actions of players in the contest to gain an advantage over the opposing team or players' (Martens, 2004, p. 170).
  - Perceptual factors that act as rate limiters to motor learning relate to the interaction between the body and the environment and may be the result of inaccurate interpretation when forming an awareness of the situation and requirements.
  - Physical factors that act as rate limiters to motor learning relate to the physical capabilities of the learner, where the athlete's components of fitness or energy systems may be restricting potential improvement.
  - Psychological factors that act as rate limiters to motor learning relate to the mental and emotional state of the person and how this may be affecting learning progress negatively.
  - Physiological aspects that act as rate limiters to motor learning relate to the genetic make-up of body systems.
- Practice of skills to advance motor learning and produce optimal performance can be classified into different types, including:
  - massed practice and distributed practice
  - whole practice and part practice
  - blocked practice and random practice
  - constant practice and varied practice
  - drills and problem-solving
  - specificity and variability of practice.
- Training activities that allow practice and feedback in authentic physical activity environments and utilise constraints to allow the emerge of skills through situational problem-solving tend to produce better learning and performance outcomes.
- Feedback is an essential part of motor learning, as it enables learners to reflect upon performance, identify positive and negative behaviours, and plan to maximise future outcomes.
- Feedback can be intrinsic or extrinsic in nature, and is any information gained during or after the performance, about the performance.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Rate limiters include:

A. perceptual, functional and physiological factors.
B. technical, perceptual, and psychological factors.
C. tactical, psychological and sceptical factors.
D. technical, relational and tactical factors.

2. Misreading the ball speed of a softball pitch is an example of what type of rate limiter?

A. Perceptual
B. Tactical
C. Functional
D. Physical

3. Massed practice is:

A. implemented to ensure task representation occurs.
B. repetitive in nature.
C. the presentation of different game-play situations where the same technique is required.
D. identical to part practice.

ISBN 978-1-009-31125-0 Stewart et al.

4. The use of deliberate practice to develop performance in an authentic environment is:
   A. supported by research carried out by Ericsson in 2007.
   B. not integral to non-linear pedagogy approaches.
   C. only appropriate when the learner can take time to think about what should occur.
   D. effective when a session is planned in advance and equipment has been sourced.
5. Feedback can be given:
   A. by an expert coach.
   B. after video analysis has occurred.
   C. by reviewing the subroutines involved in each task.
   D. by any of the above.

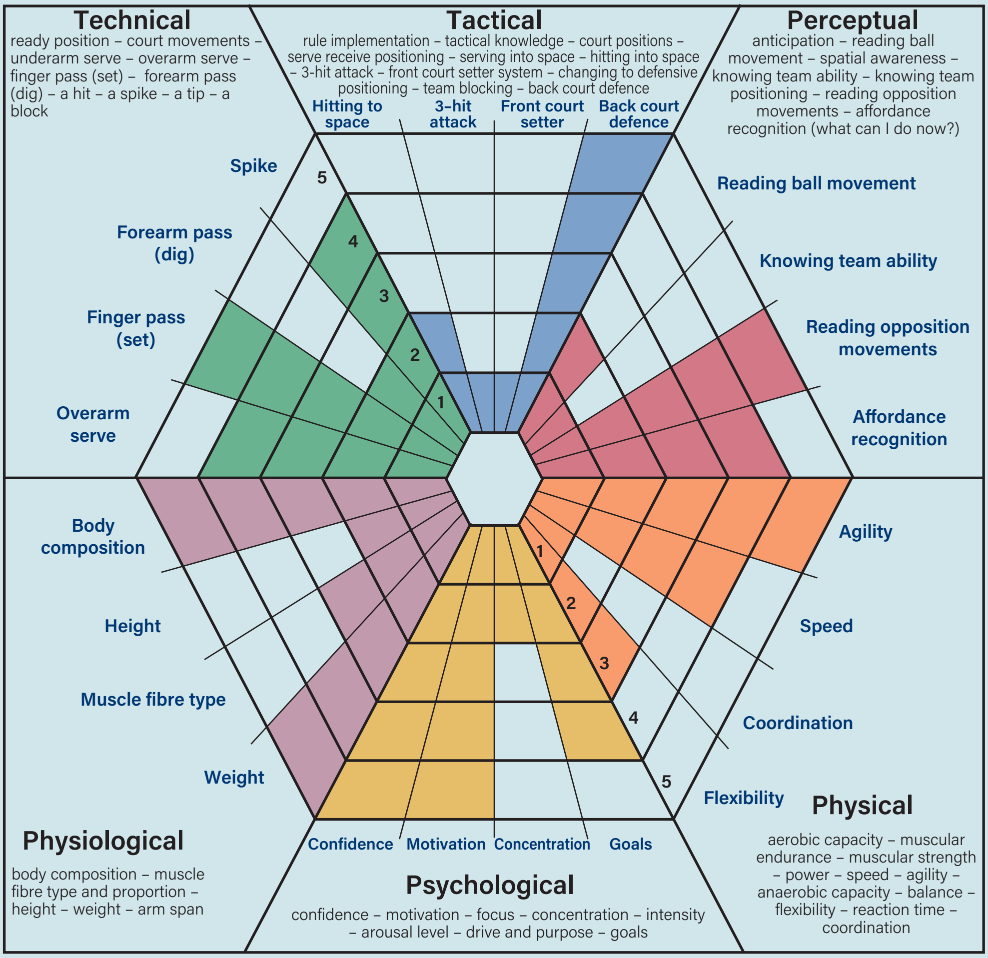
SHORT-RESPONSE QUESTIONS

1. Give three examples of different categories of rate limiters and explain how they may affect performance.
2. Identify and explain three different types of practice used in the traditional approach to motor learning.

EXTENDED-RESPONSE QUESTION

Use the primary data gathered by Athlete A, which is represented in the rate limiter hexagon below, to identify one specific rate limiter that is currently affecting learning and performance for volleyball. In an extended response:

- justify the reason for your selection of the rate limiter
- devise and present a training activity that uses deliberate practice to improve the identified rate limiter using one of the more contemporary practice types
- justify how the training activity will enhance the rate limiter.



ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 4

Body and movement concepts

What's ahead?

Chapter 4
Body and movement concepts

- **4.1** What are specialised movement sequences and movement strategies?
- **4.2** What are body and movement concepts?
- **4.3** Analysing performance using the body and movement concepts

Key subject matter

- Identify and explore how body and movement concepts interact to develop specialised movement sequences and movement strategies in physical activity. Body and movement concepts are body awareness, space awareness, quality of movement and relationships.
- Analyse and synthesise primary data and secondary data about the influence of motor learning concepts and principles on specialised movement sequences and movement strategies to ascertain the most significant relationships between the motor learning strategy and movement strategies, concepts and principles, and personal performance.
- Justify the development of the motor learning strategy and movement strategies using evidence from primary data and secondary data.
- Implement the motor learning strategy and movement strategies to gather primary data about the outcomes and limitations of decisions.
- Make decisions to maintain or modify the motor learning strategy and movement strategies.
- Justify maintenance or modification of the motor learning strategy and movement strategies using evidence from primary data and secondary data.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What are specialised movement sequences and movement strategies?
- How are specialised movement sequences and movement strategies used in physical activity to both analyse and enhance performance?
- What are body and movement concepts?
- How are body and movement concepts used in physical activity to analyse, judge and enhance performance?
- How are specialised movement sequences, movement strategies and body and movement concepts used in assessment for senior Physical Education?

ISBN 978-1-009-31125-0 Stewart et al.

4.1 What are specialised movement sequences and movement strategies?

Movement sequences

In order for motor learning to occur, the brain must develop the ability to adequately control the body's musculoskeletal system to produce coordinated and timed **movements** in response to the demands of the surrounding environment. Even before birth, the brain is learning to control body movements. To begin with, these are very simple, moving the arm or clenching the fingers. Once born, however, a baby has very poor motor control and the musculoskeletal system is not equipped for the rigours of complex coordinated movements required for survival. Nevertheless, as the infant's musculoskeletal system develops, allowing for stronger, more sustained movements, the brain learns to control the body in new ways. The abilities to roll, sit, stand, walk, change direction, run and jump all develop. As the toddler continues to develop, these movements become stronger, more controlled and fluent. These basic movements are known as **foundational movement skills**. Foundational movement skills also allow for the control and manipulation of objects, allowing for abilities such as writing, bouncing, throwing, catching, kicking and striking to progress.

As basic movement skills and object manipulation are mastered, development continues and these foundational movement skills are linked to create increasingly intricate **motor sequences**. A motor sequence is typically more complex than a foundational movement skill and is required in response to a stimulus in the environment (e.g. moving into position to catch a ball), or to enact a planned order of movements (e.g. the finger movements to play a set piece of music on the piano). Movement sequences are required for the general movements of daily life. Through the day, people move in response to a stimulus in their environment (what is happening around them), and what they need to achieve (a planned action). These motor sequences require the brain to construct a motor program that tells the muscles how to move and comprises smaller subroutines. Motor programs and subroutines have been discussed in Chapter 1.

As motor learning is stimulated in response to the environment a person finds themselves in, then it follows that the motor sequences required for physical activity will develop in response to the activities undertaken by the learner. Consider the learned ability to kick. The movement sequence for kicking only develops if the surrounding environment allows access to a ball. The more access that is gained to that ball, the more sophisticated the motor control over the ball will become. A performer will learn to kick and play with different techniques to achieve different results.

movement a series of actions or activities directed towards a particular end

foundational movement skills basic skills upon which movement sequences and movement strategies are built

motor sequence a combination of fundamental movement skills and movement elements to enable a body and/or objects to move in response to a stimulus; or a planned order of movements

TABLE 4.1 Foundational movement skills can be classified into two groups, depending on whether they assist us to change location or are performed on the spot.

Foundational non-locomotor skills	Foundational locomotor skills
Skills that can be done standing in one spot and prepare us to keep our balance in between transitioning from shape to shape	Skills that allow us to move from space to space
For example: grasping, releasing, reaching, stretching, balancing, twisting, bending, spinning, turning and swinging	For example: rolling, crawling, walking, jogging, running, jumping, hopping, dodging, climbing, skipping, galloping, leaping, tackling and sliding

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 4.1

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: How does environment allow for the development of movement sequences?

Demonstrate and apply

1. To demonstrate how motor learning develops in response to environmental demands, spend 10 minutes using chopsticks to carry and move particular objects; for example, moving blocks and some irregularly-shaped items from one dish to another.
2. At the completion of the time period, give a demonstration of your abilities.

Analyse and synthesise

3. As a class, discuss the difficulties experienced in learning the skill. Were there people in the class who had this skill? When and why did they develop it? Compare the experience of people in the class with that of a four-year-old growing up in a traditional Chinese family.

Demonstrate and apply

4. During your next lesson in a performance environment, select one movement sequence (a technique) from your current physical activity. Experiment with this movement sequence by manipulating how it is performed and using it at new times throughout your performance.

Analyse and synthesise

KEY COGNITION

Consider: think deliberately or carefully about something, typically before making a decision

5. Consider how you manipulated the movement sequence, when it was used, and decide how successful the adaptations were to your performance. Consider how the playing environment may have dictated what you were able to do. Write a brief summary of your findings.

Over time and with practice, motor learning allows the mind to become more accomplished at manipulating these ball skills, as the kicking movement sequence is used across different games and in more complex situations. Kicking movements become more controlled and coordinated and are increasingly completed with the required speed, force and timing. Essentially, movement sequences develop as practice or training allows a performer to become more familiar with their surrounding environment and the exact movements required to be successful within it.

In relation to senior Physical Education, the movement sequences that are specifically associated with a physical activity are termed **specialised movement sequences**. Specialised movement sequences are the techniques that are required to perform in a specific sport, position, activity or event – for example, a forearm pass in volleyball, a roll ball in touch football, or throwing the javelin as a field event.

specialised movement sequence a combination of specialised fundamental movement skills and movement elements particular to a position or an event to enable a body and/or objects to move in response to a stimulus; a planned order of movements

ISBN 978-1-009-31125-0 Stewart et al.

Specialised movement sequence	**An Australian Rules football mark** Practice of the movements below with the right timing and coordination								
Fundamental movement skills	**Running** Practice of the movements below with the right timing and coordination				**Jumping** Practice of the movements below with the right timing and coordination			**Catching** Practice of the movements below with the right timing and coordination	
	Moving upper arms and shoulders	Bending the lower arms at the elbows	Bending and extending the lower leg at the knees	Bending and extending the upper leg at the hips	Bend at the knees, hips, torso and arms to lower centre of gravity	Extend knees, hips, torso and arms to propel the body into the air	Bending at the knees on landing	Extending the arms above the head	Closing fingers and hands to grasp the ball

FIGURE 4.1 Specialised movement sequences combine fundamental movement skills to respond to stimuli in the performance environment, such as an Australian Rules football kicked towards you.

KEY MESSAGE

Foundational movement skills provide the basic movements to coordinate more complex movement sequences.

KEY MESSAGE

Movement sequences are produced using motor programs in response to the surrounding environment and the goal to be achieved.

KEY MESSAGE

Specialised movement sequences in Physical Education are those specific movements related to a sport, position or event.

CHECK-IN 4.1

1. Select five physical activities from those listed in the senior Physical Education syllabus shown below, and for each identify three specialised movement sequences that are associated with the physical activity.

   Aerobic gymnastics (sport aerobics), Australian Rules football, Basketball, Futsal, Netball, Soccer, Touch football, Water polo, Cricket, Softball, Badminton, Tennis, Volleyball

2. Conduct research into the senior Physical Education syllabus to see if the specialised movement sequences you identified are assessed when studying the activity.
3. Provide three different examples of a specialised movement sequence that is specific only to a particular position within a physical activity – for example, shooting in netball for a goal attack or goal shooter.
4. Select a specialised movement sequence from a field event in track and field. In a series of steps, describe the basic motor program required to perform it.

ISBN 978-1-009-31125-0 Stewart et al.

Specialised movement sequences are beneficial in a number of ways in physical activity and Physical Education. First, they provide spectators, players and coaches with a common language to describe specific aspects and movements that relate to an activity. Second, through specific analysis, they allow for enhanced performance of movement through targeted training strategies. These training strategies may look to improve technique to maximise accuracy, speed or power to achieve greater distances, decrease time, or get an implement closer to a target. Third, the quality of specialised movement sequences can be judged to gauge level of performance.

Movement strategies

At the heart of any sport are the basic objectives of the game. These are what participants are trying to achieve through play. For **invasion games**, the basic game objectives can be broken into offensive and defensive objectives. In touch football, for example, the objectives can be broadly described as:

Touch football offensive objectives:

- to score
- to maintain possession
- to advance the ball towards the scoreline.

Touch football defensive objectives:

- to prevent scoring
- to regain possession
- to limit attacking options and territory advantage gained by the opposition.

These objectives can be prioritised in order and are also reflective of the objectives of the majority of invasion games – that is, games such as Australian Rules football, basketball, futsal, football, netball, Oztag, Rugby League, Rugby Union and water polo all share these objectives. The same applies to the game objectives within other physical activity categories, such as **net and court games** and **striking and fielding games**.

As similar physical activities have similar objectives, it follows that the strategies employed to be successful within these games also have similarities, with many strategies being transferable from one physical activity to another. The **principles of play** are a set of fundamental strategical characteristics that are shared by sports with similar objectives or rules of play. The invasion game and net and court principles of play include:

- setting up attack
- defending against attack
- creating, defending and exploiting space
- attacking opposition space and scoring.

While the strategies for striking and fielding games are slightly different due to the differences in game play and objectives, there are also basic similarities between the fundamental strategies used in these games.

Movement strategies are the approaches used within the principles of play to achieve the game objective. These strategies are more specific to the physical activity, and reflect the rules of the game (including number of players and playing space) and the implements used.

invasion games team games whereby the main objective is for participants to invade their opposition's territory in striving to score more points within the allocated time frame

net and court games games in which a player sends an object towards a court or target area that an opponent is defending, trying to make it difficult for the opponent to return the object

striking and fielding games games in which one team can score points when a player strikes a ball (or similar object) and runs to designated playing areas while the other team attempts to retrieve the ball and return it to prevent their opponents from scoring

principles of play fundamental movement strategies used by individuals or teams to effectively adapt to any tactical situation in authentic performance environments

movement strategies the variety of approaches that assist a player or team to successfully achieve a movement outcome or goal; include moving into space to receive a pass or hitting a ball away from opponents to make it difficult to retrieve or return the ball

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 4.2 The similarities between game objectives, principles of play, movement strategies and tactics allow many aspects of games to be transferred access different contexts.

	Game objective	Principles of play (broad movement strategy)	Movement strategy (activity-specific)	Tactic	Specialised movement sequences required
Invasion physical activity					
Basketball	To maintain possession	Setting up attack	Attacking the full court press	Constant movement to space from all players, eyes-up – look to pass	Dribbling, passing (bounce, lob, chest)
Futsal			Providing forward, backward and lateral options to the ball carrier	Eyes-up – look to pass, support move to space, be patient	Dribbling, passing, receiving/ trapping
Netball			Providing the ball to shooters inside the circle	Leading and driving into space with timing	Catching passing (bounce, lob, shoulder, chest), change of direction
Touch football			Providing attacking options using a three-person ruck	Quick dumps, accurate acting half-passes support in motion, angled running lines	Roll ball, acting half-pass/scoop, catching
Net and court physical activity					
Badminton	To move opponent around, creating space to attack	Setting up attack	Force the opponent to the net at the start of a rally	Short backhand serve to the service T	Backhand serve
Tennis			Force the opponent to the back corners of the court	Use a variety of ground strokes to move the opponent	Forehand and backhand
Volleyball			Use different hitter options	Outside and inside hitters both in motion receiving variety of sets to move defensive structure	Finger pass, hit/ spike, tip

ISBN 978-1-009-31125-0 Stewart et al.

If the principles of play and movement strategies highlight what is to be achieved in the physical activity, then the tactics that follow are how to achieve those strategies, and ultimately success. For example, in touch football, if the goal is to score (game objective), to achieve this, a team may set up their attack (principle of play) by advancing the ball towards the scoreline with a three-person ruck (movement strategy). This strategy can be achieved with quick dumps, fast and accurate acting half-passes and support players receiving the ball in motion (tactical application of specialised movement sequences). Table 4.2 demonstrates the relationships between these concepts and the similarities between physical activities.

FIGURE 4.2 A three-person ruck can be used as a movement strategy to set up attack in touch football.

ACTIVE INVESTIGATION 4.1

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: What movement strategies can be identified in physical activity?

Recognise and explain

1. Review the syllabus resources to identify movement strategies that are associated with your current physical activity of study.

Demonstrate and apply

2. Gather 15 minutes of primary data of your performance for your current physical activity of study.

Analyse and synthesise

KEY COGNITION

Analyse: break down or examine in order to identify the essential elements, features, components or structure

ISBN 978-1-009-31125-0 Stewart et al.

3. Analyse the footage and identify any strategies being used to achieve the principles of play. Copy and complete the table below to record your findings and include the specialised movement sequences required to complete each movement strategy.

Principle of play	Movement strategies demonstrated	Special movement sequences demonstrated
Setting up attack		
Defending against attack		
Creating, defending and exploiting space		
Attacking opposition space and scoring		

Evaluate and justify

4. For each movement strategy, make an evaluation of its overall effectiveness by using the descriptors from the syllabus instrument-specific marking guide (ISMG) for 'Demonstrating and applying' – that is, is the strategy 'effective', 'competent' or 'variable' in its application?
5. Justify one element of a movement strategy that requires maintenance in future performances – that is, what is working and needs to stay the same?
6. Justify one modification that could be made to one movement strategy so that it becomes more effective during performance.
7. Justify one modification that could be made to a specialised movement sequence so that it becomes more effective during performance.

4.2 What are body and movement concepts?

body and movement concepts a framework for enhancing movement performance that incorporates four different aspects

Body and movement concepts are a framework for enhancing movement performance. They incorporate four different aspects, which further include a range of more detailed elements that can be used in a number of different ways. The body and movement concepts can be used as:

- adjectives to describe movement
- features to analyse movement
- criteria to judge movement
- target areas to improve movement.

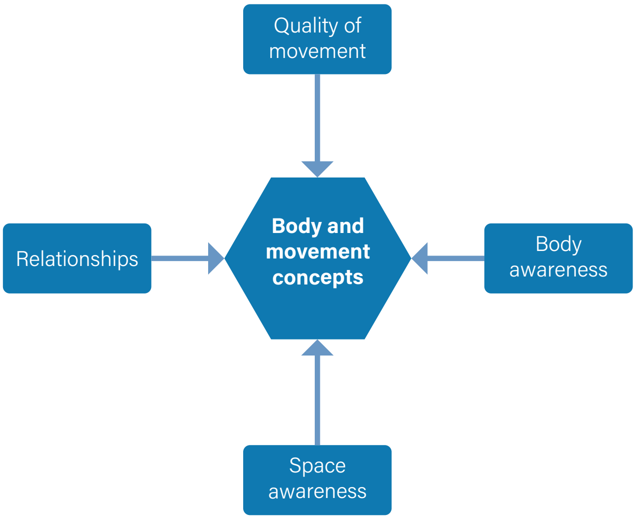


FIGURE 4.3 Four aspects of the body and movement concepts

ISBN 978-1-009-31125-0 Stewart et al.

Quality of movement

Quality of movement refers to how the body moves. The elements associated with quality of movement usually require the application of biomechanical principles to help assess the movement.

> **quality of movement** how the body moves, assessed using biomechanical principles

TABLE 4.3 Elements of quality of movement.

Accuracy	How precise the movement is in relation to the target or objective
Continuity and outcome of movement	How successful the movement is in relation to the next movement or the desired outcome
Effect	How much influence the movement has on the overall performance or outcome
Efficiency	A combination of effort, force development, time and flow in relation to movement completion
Effort	The energy expelled to complete the movement
Flow	How movements in an activity or performance are purposefully sequenced to create a continuity of movement. Flow is usually described as interrupted and bound, or sustained and free.
Force development	How to effectively generate force, absorb forces or direct these forces
Sequence	The order of the movements
Time or speed	The duration of the movement, moving with constant rhythm or whether the participant is accelerating or decelerating

Body awareness

Body awareness can be described as what the body can do, or how the body is moving. It includes elements such as:

- balance
- flight
- stability
- transfer of weight
- weight bearing.

> **body awareness** what the body can do, or how the body is moving

FIGURE 4.4 Balance, stability and transfer of weight are all important body awareness elements of playing a forehand from the baseline in a tennis rally. These aspects will help determine the quality of movement in terms of continuity and outcome.

Space awareness

Space awareness describes where the body can move. **General space** is the playing or performance area. **Personal space** is the direct area surrounding a participant.

> **space awareness** where the body can move
>
> **general space** the playing or performance area available to the performer
>
> **personal space** the direct area surrounding a participant

ISBN 978-1-009-31125-0 Stewart et al.

Space awareness also includes the:

- direction of movement within the space, such as up or down, forward or backward, or left or right
- height of the body in relation to the playing surface or equipment, such as 'low', 'medium' or 'high'
- pathways or lines of movement used through the space, such as straight, curved or zig-zag
- plane through which the movement occurs, such as circular, vertical or horizontal.

Relationships

Relationships are about the performer's interaction and connection with opponents, other players and/or implements and objects. Relationships might be described as close or distant, above or below, or in front of or behind the performer.

Participants may be engaged in a task, working together or apart, working in unison or as opposites. They may be a leader or follower in the activity.

> **relationships** (body and movement concept) an aspect of the body and movement concepts that refers to the performer's interaction and connection with opponents, other players and/or implements and objects

Body and movement concept assessment in senior Physical Education

Specialised movement sequences, movement strategies and the body and movement concepts all form part of the *demonstrate* and *apply* criteria in senior Physical Education. Students should always be applying the body and movement concepts when demonstrating specialised movement sequences and movement strategies to their highest standard for the physical activity being studied.

When students are *demonstrating* the required specialised movement sequences and movement strategies, they should be *applied* showing the aspects of the body and movement concepts. For example, when demonstrating a finger pass *(specialised movement sequence)* to set the volleyball in a front-court setter system *(movement strategy)*, the student should aim to apply the strategy and required set with accuracy and continuity *(quality of movement)*, with balanced and stable execution of the set *(body awareness)*, to the position of the designated hitter *(space awareness)*, by communicating with the hitter and making good contact with the ball *(relationships)*.

TABLE 4.4 The body and movement concepts and sub-elements

Quality of movement	Body awareness	Space awareness	Relationships
How the body moves	What movements the body can perform	Awareness of where the body can move	Connections with objects and other participants
• Accuracy • Continuity and outcome of movement • Effect • Efficiency • Effort • Flow • Force development • Sequence • Time and speed	• Balance • Flight • Stability • Transfer of weight • Weight bearing	• Direction • Levels and planes of movement • Pathways of movement • Using general space • Using personal space	• Interaction with opponents • Interaction with other players • Interaction with implements and objects

ISBN 978-1-009-31125-0 Stewart et al.

While students should always be striving to showcase their best performances at all times when performing across a unit of study, students' physical performance must be supported by visual evidence as part of the assessment instrument. The visual evidence will allow performance to be judged as effective, competent or variable. The supporting visual evidence must:

a. [show the] application of quality of movement and one other body and movement concept

b. when demonstrating two movement strategies from two different principles of play

c. [and] the associated specialised movement sequences to implement these strategies.

More information on the demonstrate and apply criteria in senior Physical Education can be found in Chapter 23 (digital version only) of this textbook.

ACTIVE INVESTIGATION 4.2

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: What movement strategies can be used in assessment as supporting evidence for the demonstrate and apply criteria?

Recognise and explain

1. Review Active investigation 4.1, and any more recent performances of your current physical activity, to decide on two movement strategies that are currently your most effective. *As per syllabus requirements, ensure that the two movement strategies selected are from different principles of play.*

Demonstrate and apply

2. Gather as much additional primary data footage of your performance of the two selected movement strategies as can be achieved.

Analyse and synthesise

KEY COGNITION

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

3. Review the footage and edit your most effective examples of each movement strategy together. Your footage should be up to three minutes long in total, with ample examples of both movement strategies.
4. For assessment, it is also helpful if footage shows the full range of specialised movement sequences that are applied when enacting the movement strategy. Therefore, watch the footage that has been constructed and take an audit of the specialised movement sequences being demonstrated. Does the footage selected show the full range of specialised movement sequences being demonstrated at your highest quality?

Evaluate and justify

5. While the supporting evidence for the demonstrate and apply criteria does not need to be justified when submitted, it is important that the selection of footage reflects your most effective application of the strategies. Therefore, for each section gathered in your footage, make some brief notes justifying why it was included and what aspects make it effective.

ISBN 978-1-009-31125-0 Stewart et al.

Note: In addition to using this footage as part of your supporting evidence for assessment purposes, you may also use one of the two movement strategies identified here in the main folio section of the project. This requires a strategy to be developed to enhance the effectiveness of the movement strategy. If so, then consider completing the following three parts of this active investigation.

6. Justify one element of a selected movement strategy that requires maintenance in future performances – that is, what is working and needs to stay the same.
7. Justify one modification to the selected movement strategy so that it becomes more effective during future performances.
8. Justify one modification that could be made to a specialised movement sequence so that it becomes more effective when used within the selected movement strategy.

4.3 Analysing performance using the body and movement concepts

The body and movement concepts can be used in physical activity to improve performance through enhancing techniques and use of strategy. In chapters 1–3 on motor learning, the concept of rate limiters has been discussed. By using the body and movement concepts to analyse technical, strategical and perceptual qualities about performance, training strategies can be developed to target areas for improved performance.

Game performance assessment instruments (GPAIs) and other primary data collection methods are used to gather data about performance in order to target areas of improvement. This can be done by the performer, or in conjunction with a coach or teacher. While the body and movement concepts, specialised movement sequences and movement strategies all form part of the demonstrate and apply criteria for assessment, the analysis of related primary data is also essential in the devising of strategies for other areas of assessment tasks.

game performance assessment instrument (GPAI) an observational tool to analyse performance in games, using a range of different criteria

Across assessment in senior Physical Education, students are required to devise a variety of strategies that reflect the area of study in the unit. Strategies to be developed include motor learning, biomechanical, psychological, ethics and training strategies. However, each strategy is to be devised in response to analysis of primary data regarding personal performance. The strategy's effectiveness is then justified using primary data about performance after the strategy has been implemented. In this sense, the primary data analysis of the body and movement concepts, specialised movement sequences and movement strategies is essential for a successful assessment response. More information on assessment instruments and responses in senior Physical Education can be found in Chapter 23 of this textbook (digital version only).

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Movement sequences develop in response to the environment that surrounds an individual, and involve the construction of motor plans using foundational movement skills.
- Specialised movement sequences in physical activity are those movements that are associated with a specific activity, position or event. They are the techniques of the sport.
- Specialised movement sequences and movement strategies are assessed using the demonstrate and apply criteria in senior Physical Education.
- Principles of play are generalised strategies that are common to similar physical activities. They assist performers in successfully achieving the objectives of the game.
- Movement strategies are approaches within the principles of play that are more specific to the physical activity. They assist performers in successfully achieving the objectives of the game.
- Body and movement concepts provide a framework for enhancing movement performance.
- Body and movement concepts can be used to describe, analyse, judge and improve performance.
- Body and movement concepts include the four aspects of quality of movement, body awareness, space awareness and relationships.
- Body and movement concepts, specialised movement sequences and movement strategies can all be used to judge physical performance through the collection of primary data, as well as to devise and evaluate strategies that are required in assessment.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Which of the following is not a specialised movement sequence?
   - **A.** Twisting
   - **B.** Passing
   - **C.** Catching
   - **D.** Pitching
2. Which of the following lists the four principles of play identified in the senior Physical Education syllabus?
   - **A.** Setting up attack; breaking from attack; defending space; scoring and winning
   - **B.** Breaking to attack; defending the attack; creating and exploiting space to score; defending and protecting space
   - **C.** Setting up attack; defending against attack; creating, defending and exploiting space; attacking opposition space and scoring
   - **D.** Setting up attack; breaking from attack; creating, defending and exploiting space; attacking opposition space to score
3. Which of the following is not a body and movement concept?
   - **A.** Relationships
   - **B.** Quality of movement
   - **C.** Space awareness
   - **D.** Personal awareness
4. Which of the following is an element of body awareness?
   - **A.** Accuracy
   - **B.** Efficiency
   - **C.** Stability
   - **D.** Flow
5. Which of the following is not assessed in senior Physical Education?
   - **A.** Movement strategies
   - **B.** Specialised movement sequences
   - **C.** Foundational movement skills
   - **D.** Body and movement concepts

ISBN 978-1-009-31125-0 Stewart et al.

SHORT-RESPONSE QUESTIONS

1. Explain the relationship between principles of play and movement strategies using an example from a physical activity.
2. Select an aspect from the quality of movement body and movement concept and use a physical activity example to describe the aspect.

EXTENDED-RESPONSE QUESTION

Review footage of your performance in the physical activity that is currently being studied. Using examples from two movement strategies from the same principle of play, provide a 250-word evaluation that outlines the effectiveness of the two strategies and the effectiveness of the specialised movement sequences demonstrated when applying the strategies. Ensure that you use language from the body and movement concepts when justifying your evaluation.

ISBN 978-1-009-31125-0 Stewart et al.

UNIT 1
TOPIC 2
Functional anatomy and biomechanics in physical activity

Topic 2:
Functional anatomy and biomechanics in physical activity

- **Chapter 5** Functional anatomy and physical activity
- **Chapter 6** Biomechanics in physical activity

Introduction

Being physically educated means developing knowledge in the biophysical, sociocultural and psychological domains that underpin physical activity and using this knowledge to maximise enjoyment, engagement and physical performance for yourself and others.

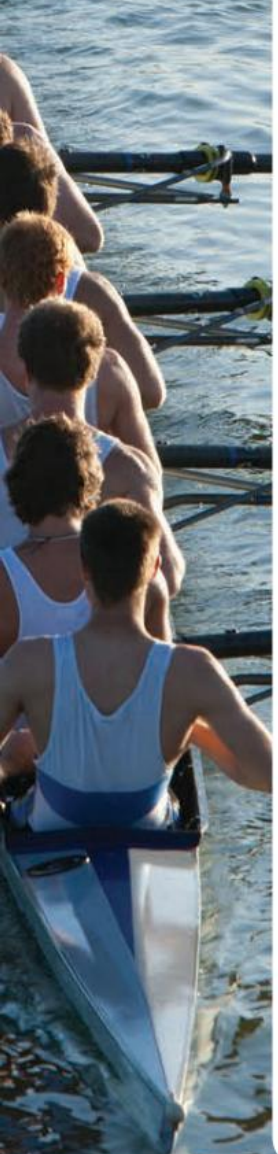
This topic explores functional anatomy and biomechanics as key elements within the biophysical sub-discipline of physical activity. Through an understanding of functional anatomy and biomechanics, we can use a common anatomical language to describe specialised movement sequences in various physical activities. We can use biomechanical analysis to determine the efficiency of movement sequences and, from such analysis, make justified recommendations to optimise skilled performance.

UNIT 1 TOPIC 2
Overview

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 5

Functional anatomy and physical activity



What's ahead?

Chapter 5
Functional anatomy and physical activity

- **5.1** Functional anatomy, biomechanics and optimising performance
- **5.2** The skeletal framework and movement
- **5.3** Describing movement
- **5.4** Production of force by skeletal muscles
- **5.5** Major muscle groups
- **5.6** Muscular analysis

Key subject matter

- Recognise and explain that functional anatomy is the study of the function of muscles and bones in movement.
- Analyse and synthesise primary data and secondary data about the influence of functional anatomy concepts and principles on specialised movement sequences and movement strategies.
- Identify and explore the critical anatomical and joint movements in physical activity.
- Identify and explore isotonic muscle contractions (concentric and eccentric) and isometric muscle contractions in physical activity.
- Recognise and explain that reciprocal inhibition describes the process of muscles on one side of a joint relaxing to accommodate muscle contraction on the other side of the joint in order to produce movement. Reciprocal inhibition involves the use of agonist and antagonist muscles and stabilisers.
- Gather primary data about the influence of functional anatomy concepts and principles on personal performance of specialised movement sequences and movement strategies in authentic performance environments.
- Use secondary data to analyse how functional anatomy concepts and principles can influence performance in physical activity.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- How can knowledge of the functional anatomy of the skeletal and muscular systems provide a common reference to accurately describe specialised movement sequences in physical activity?
- How can knowledge of the functional anatomy of the skeletal and muscular systems assist in the analysis of specialised movement sequences?
- What are the anatomical requirements of specialised movement sequences required by various physical activities?

ISBN 978-1-009-31125-0 Stewart et al.

5.1 Functional anatomy, biomechanics and optimising performance

The human body can produce a wide range of complex movements, using hundreds of synchronised muscular movements simultaneously. Functional anatomy relates (in this chapter) to the study of the functions of muscles and bones in movement. This anatomical understanding allows athletes, coaches and sports scientists to use a common language to describe human movements and the muscles involved in producing specialised movement sequences. In an effort to optimise the efficiency of specialised movement sequences in various sports, scientists and coaches began to apply the laws of physics to the analysis of human movements. This study is known as biomechanics: *bio*, meaning living organisms, and *mechanics*, the study of the action of forces in producing movement. This application of mechanics to human movement has resulted in enhanced performances, not only through improvements in skills and techniques, but also through advances in sporting equipment materials and designs.

For example, biomechanical research has provided tennis coaches with data indicating that the most efficient tennis serve has a ball toss at 150 per cent of the player's height and a racquet angle to the court of 92 degrees at impact. The coach and player can use this data to perfect serving technique. Tennis equipment has been influenced greatly by biomechanical research in recent times. Racquets, for instance, have a larger 'sweet spot' and vibration on impact has been reduced by a broader, stronger frame. Biomechanical research has also significantly improved performances through the development of training techniques and skill modifications that reduce the likelihood of injury. Running styles, for example, can be modified through biomechanical analysis in order to prevent over-use injuries.

The use of biomechanical principles is not confined to sports laboratories and sports scientists. Coaches and athletes who understand the mechanical bases of the phases and subroutines that constitute specific movement sequences, and can analyse these in terms of mechanical principles, will be better able to help performers to enhance efficiency, accuracy, consistency or speed while minimising the risk of injury. This chapter outlines the bases of skeletal and muscular anatomy that can be applied to understanding and analysing human movement during performances in any physical activity.

ENGAGE 5.1

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: Does altering technique immediately improve performance?

Recognise and explain

1. Select a specialised movement sequence from a physical activity in which you are currently engaged. Conduct secondary research to identify any biomechanical principles that are considered 'good' for this technique.

Demonstrate and apply

2. In your next performance of this physical activity, try to apply your research by adjusting your movements to match the biomechanically 'good' execution of the selected specialised movement sequence.

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

3. Analyse the outcome of your performance/s and consider if the changes implemented improved the accuracy, efficiency and consistency of the subroutines related to this movement sequence – that is, did it become more effective and successful?

4. Consider the reasons why such a change could potentially reduce accuracy, efficiency or consistency in the short term.

Human movement and muscular force

In order for an object to change its **motion** or shape, it must be acted upon by a **force**. A force can simply be described as a push or pull in a given direction. When a force is applied to an object, it may cause motion. Motion is the movement that occurs when an object (which could be a human body or body part) has changed its position in space and in time, due to the application of forces. The object may speed up, slow down, twist, rotate, change shape or a combination of these, depending on the magnitude and type of force and where the force is applied to the object.

motion movement that occurs when an object has changed its position in space and in time, due to application of forces

force a push or pull in a given direction

The forces that produce motion in physical activities can be described as being either internal forces or external forces. **Internal forces** are produced within the body by muscles. **External forces** are forces such as gravity, friction and forces exerted by other persons, which may all have an effect on motion. External forces can be classified further into **contact forces** (resulting from contact with other objects, fluids or surfaces) and **non-contact forces** (such as resulting from gravity). The resultant motion produced in physical activities is caused by the interplay of external and internal forces. For instance, a javelin accelerates up to the point of release due to the internal forces generated by the thrower's muscles. After release, external forces act on the javelin. It slows slightly due to friction with the air, begins to fall due to gravity and stops upon striking the ground.

Human movement occurs through the internal force generated by the action of muscles pulling on tendons attached to the skeleton.

FIGURE 5.1 A tennis ball changes in shape, begins to spin and moves forward as a result of the force applied by the racquet.

internal force a force that is exerted by an object and acts on another part of the same object

external force a force that is exerted by an object and acts on a different object

contact force a force applied through direct contact between objects, fluids or surfaces

non-contact force a force that acts on an object without physical contact, such as gravity

ISBN 978-1-009-31125-0 Stewart et al.

5.2 The skeletal framework and movement

The human body has 206 bones, of which 124 are devoted to the production of movement (Figure 5.2). These bones are collectively referred to as the **appendicular skeleton**, as opposed to the bones of the **axial skeleton**, which serve mainly to protect vital organs in the human body and to provide a structure to which the appendicular skeleton can attach and move around. Certain bones in the axial skeleton, such as the ribs and vertebrae, are important areas for muscle attachment and, in conjunction with the bones of the appendicular skeleton, are essential to the production of movement.

appendicular skeleton the bones of the skeletal system that are devoted to the production of movement

axial skeleton the bones of the skeletal system that are mainly devoted to protecting vital organs and providing structure

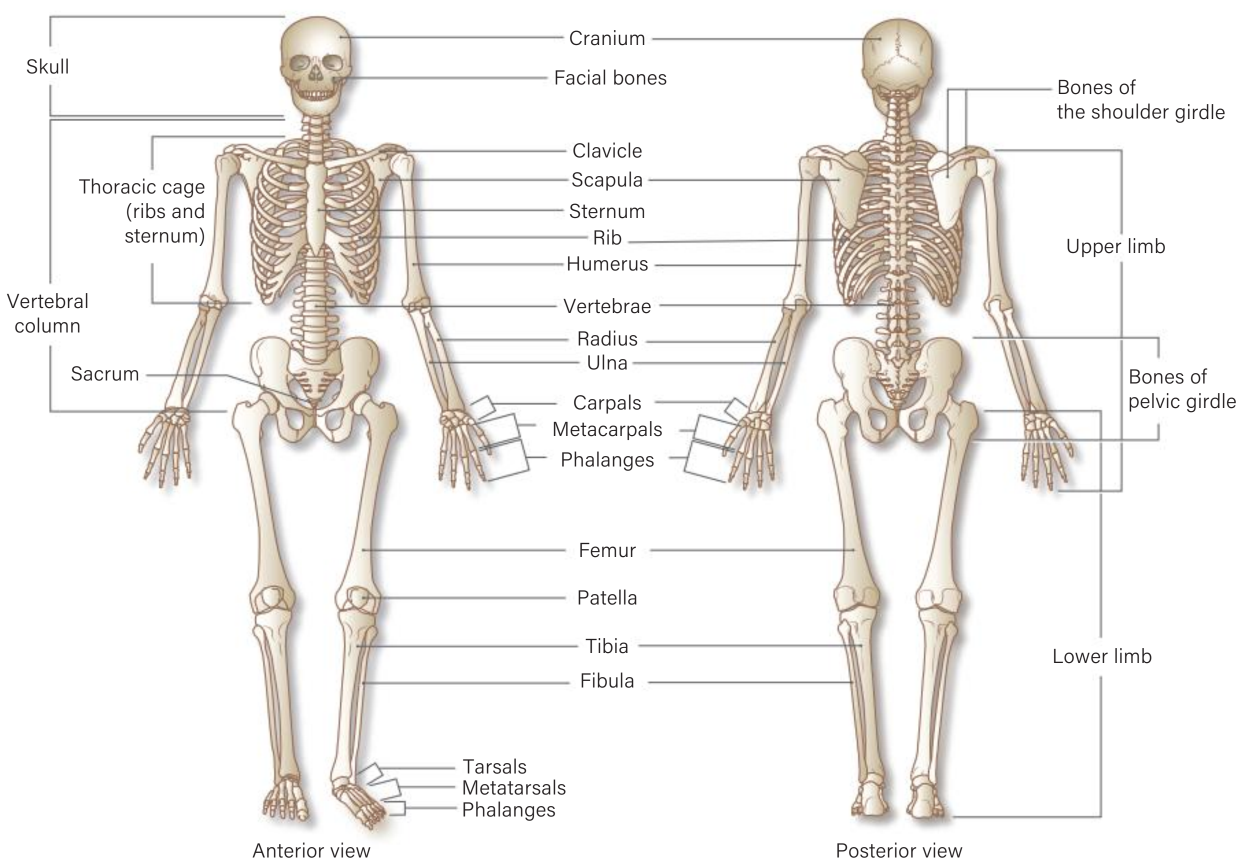


FIGURE 5.2 Major bones of the human skeleton

CHECK-IN 5.1

1. Consider the shape of the bones of the shoulder and pelvic girdles. What functions of these structures are related to their shape?
2. Knowledge of anatomical terminology and the names of bones, muscles and joints allows athletes, coaches and sports scientists to use a common language in describing human movements. Therefore, it is important to be able to name, locate and correctly spell the bones in the human skeleton. Numerous apps, online quizzes and interactive tools can help to learn and recall the names and locations of bones. Find and use one or more of these resources to help your recall of skeletal anatomy.

ISBN 978-1-009-31125-0 Stewart et al.

Allowing for movement

All movements of the skeleton occur where two or more bones intersect. There are several different types of joints in the human body, including fibrous joints, cartilaginous joints and synovial joints. **Synovial joints**, or freely moveable joints, are responsible for allowing movement of the skeleton. These joints are anatomically designed to drastically reduce the amount of friction between bones when they move. Figure 5.3 illustrates the typical structure of a synovial joint. First, the ends of articulating bones are covered by smooth cartilage that prevents them from rubbing together. Similarly, menisci are small pieces of cartilage that sit between the bones to act to cushion the joint. Finally, the area between the bones is enclosed with synovial fluid. This fluid functions to further cushion the end of the bones and acts as a lubricant when movement occurs.

> **synovial joints** freely moveable joints, designed to drastically reduce the amount of friction between bones, and are responsible for allowing movement of the skeleton

There are six categories of synovial joints:

- **Ball-and-socket joints.** These joints produce the greatest range of movement (ROM). As the name suggests, the end of one of the bones that make up the joint is shaped like a ball and this sits inside the cup or 'socket'-shaped end of the other bone. Examples of ball-and-socket joints are the hip joint and the shoulder joint. It is essential that these two joints provide a large ROM, as they are the sites where the axial and appendicular skeletons meet.
- **Hinge joints.** The hinge joints typically only allow a back-and-forth movement, similar to the opening and closing of a door. An example of this is the knee joint. Acting like a hinge, the knee can only allow the leg to bend and straighten back to its original position. Any movements outside this range can lead to damage to the connective tissues supporting the joint. Other examples of hinge joints are the elbow joint, the ankle joint and the joints between the phalanges in the fingers.
- **Pivot joints.** These are joints that allow a rotation movement around a central point. The best example of this involves the top two vertebrae of the spine – the atlas and axis. When shaking the head, the atlas, which is the uppermost vertebra, spins or rotates around a fixed point on the axis, the second vertebra. Another example of a pivot joint is the radio-ulnar joint near the elbow that produces pronation and supination of the forearm.

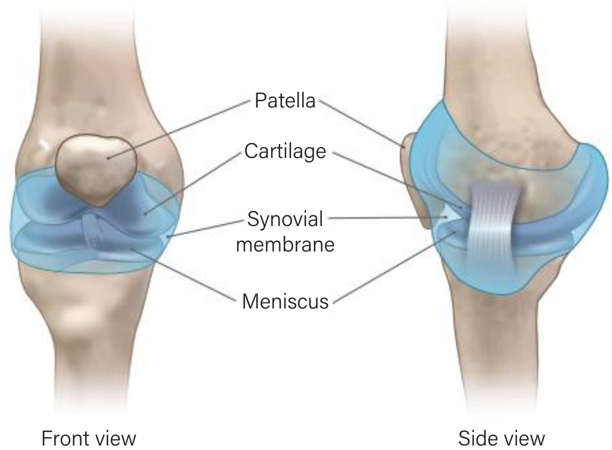
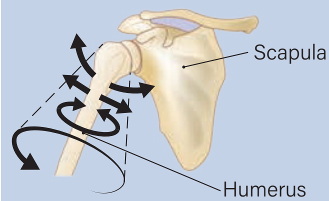
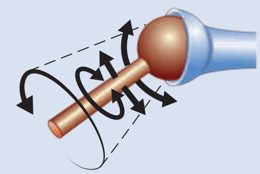
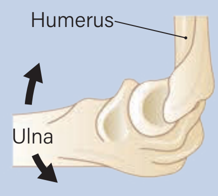
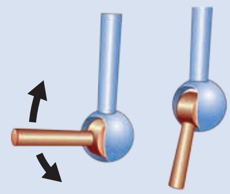
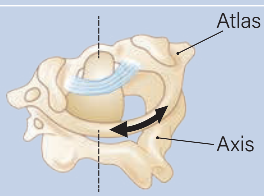
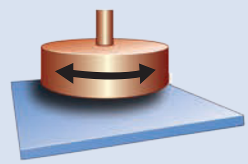
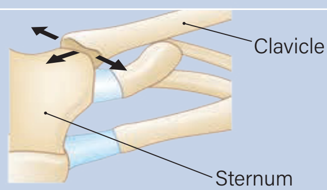
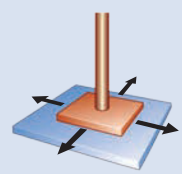
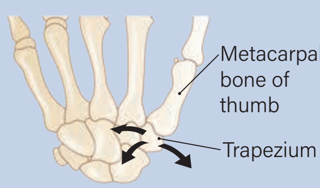
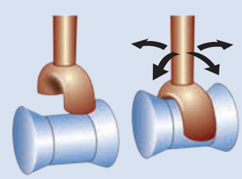
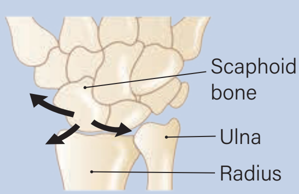
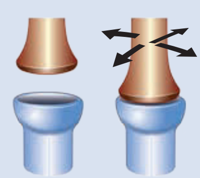


FIGURE 5.3 Structure of a synovial joint

- **Gliding joints.** Gliding joints occur when the joint between bones is a flat or nearly flat surface. This flat surface allows for bones to slide past each other. Unlike other synovial joints, movement at gliding joints does not greatly change the angle between the two bones but alters their position relative to each other. One common example of the gliding joint is the carpal bones in the wrist. When waving the hand from side to side, the small, irregularly shaped carpal bones glide past each other to allow for the movement. Gliding joints also occur between the scapula and clavicle, and between the sternum and clavicle.
- **Saddle joints.** These involve one bone fitting over the end of another that is shaped like a saddle. This type of joint allows side-to-side and back-and-forth movements. The joint between the thumb metacarpal and the trapezium (one of the carpal bones in the wrist) is a saddle joint.
- **Ellipsoidal joints.** This joint is formed between one bone with an oval-shaped end that fits into an elliptical (oval-shaped) bowl on the end of another bone. Like a saddle joint, this type of joint allows side-to-side and back-and-forth movements. The wrist joint is an example of an ellipsoidal joint.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 5.1 Classification of synovial joints

Types of synovial joints		Models of joint movements	Examples
Ball-and-socket joint			• Shoulder joints • Hip joints
Hinge joint			• Elbow joints • Knee joints • Ankle joints • Interphalangeal joints (between the bones of the fingers and toes)
Pivot joint			• Atlas/axis • Radio-ulnar joints
Gliding joint			Joints between: • Clavicle and sternum • Clavicle and scapular • Carpal bones • Vertebrae and ribs
Saddle joint			• Joint at the base of the thumb
Ellipsoidal joint			• Wrist joint • Joints between the fingers and the hand • Joints between the toes and the foot

CHECK-IN 5.2

1. The hip and shoulder joints have a large range of movement.
   a. What type of joints are these?
   b. What is similar about the location of these two joints and the bones they connect?
   c. What structural difference allows the shoulder to move more freely than the hip?
2. The knee and elbow are hinge joints. Make a list of the movement sequences associated with the physical activity that is the focus of your study this term, which involve movements at these two joints.

ISBN 978-1-009-31125-0 Stewart et al.

KEY MESSAGE

The skeleton provides a framework that allows the body to move and provides attachments for tendons and muscles.

KEY MESSAGE

Synovial joints are freely moveable and allow a range of movement to occur.

KEY MESSAGE

Synovial joints are classified into six categories based on the shape and structure of the joint.

Planes of motion

All movements produced by the body occur in one or more of the three **planes of motion**. As seen in Figure 5.4, the frontal plane, the sagittal plane and the transverse plane are imaginary flat surfaces that divide the body equally in two.

planes of motion used to describe motion of the body, they are imaginary flat surfaces that divide the body equally in two through three different planes: the frontal plane, the sagittal plane and the transverse plane

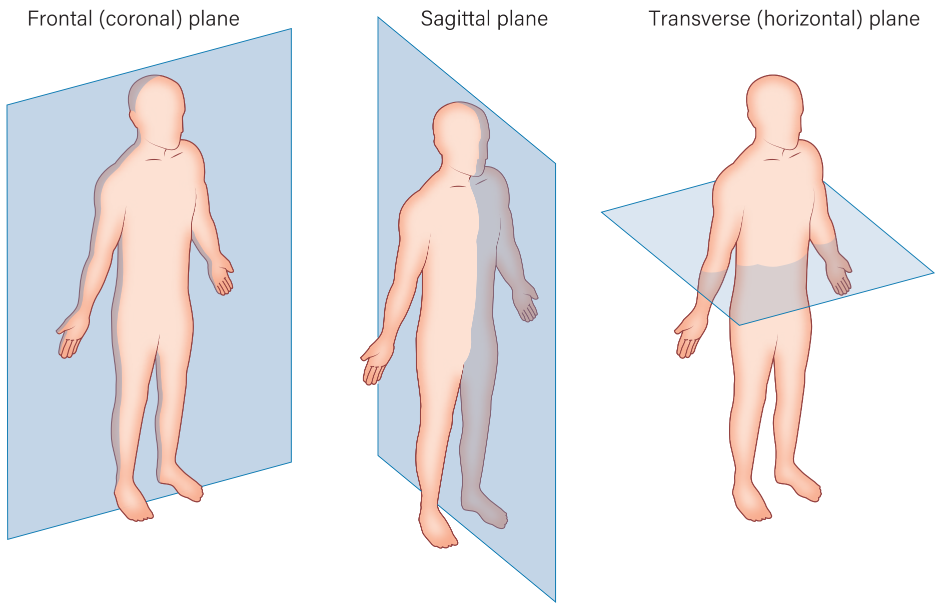


FIGURE 5.4 The three planes of motion

The *frontal plane* (also known as the coronal plane) divides the body into front (anterior) and back (posterior) halves. Movements that involve moving parts of the body side to side occur in the frontal plane. A clear example of this is the star jump, as both the arms and legs are moving in the frontal plane away from and back towards the body.

The *sagittal plane* (also known as the median plane) divides the body into left and right halves. Movements in this plane involve forwards and backwards motion. Running is a good example of movement in the sagittal plane, as both arms and legs are experiencing forwards and backwards motion.

Finally, the *transverse plane* (also known as the axial plane) divides the body into superior (top) and inferior (bottom) halves. Rotational or twisting movements of the body occur in this plane. Passing a rugby ball across the body is an example of such movement.

ISBN 978-1-009-31125-0

5.3 Describing movement

When describing the components of the human body and the vast range of movements it can produce, **anatomical position** is always used as a reference point. The body is said to be in anatomical position when:

- it is upright and facing forward
- the arms are held by the side
- the hands are open with palms facing forward.

> **anatomical position** a set pose of the body that allows common reference points when investigating the body and its systems

FIGURE 5.5 The body in anatomical position

The movements that are produced by muscles occur at the joints. Each movement that can be produced at a joint has been given a name to describe the movement. Using this naming system allows athletes, sports scientists, coaches and Physical Education students to refer to particular movements in a consistent way that can be universally understood.

Flexion and extension

Flexion and extension are joint movements that occur in the sagittal (front and back) plane. **Flexion** occurs when the angle of the joint decreases (i.e., when the joint bends), whereas **extension** occurs when the angle of the joint increases (i.e., when the joint straightens). In some cases, the joint can extend beyond anatomical position; this is called **hyperextension**.

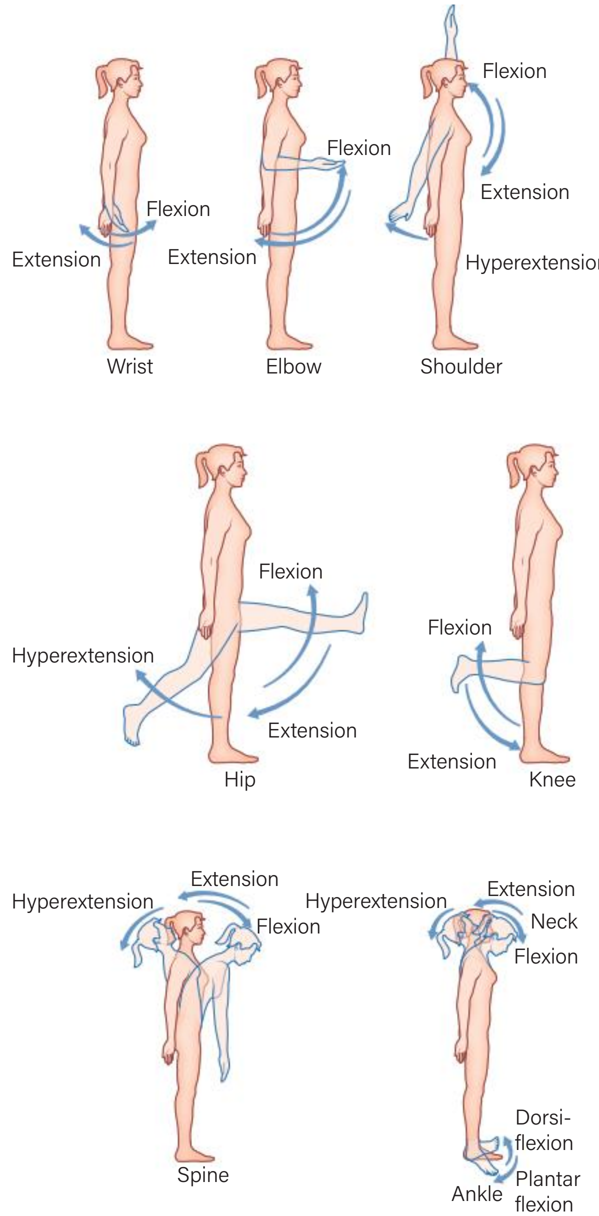


FIGURE 5.6 Examples of flexion, extension and hyperextension

An example of flexion and extension can be seen when spiking a volleyball. During the preparation phase (Figure 5.7), the bicep muscle contracts and bends the arm at the elbow, causing a decrease in the angle (flexion). During the action phase of the spike (Figure 5.8), the triceps brachii muscle straightens the arm and increases the angle (extension).

> **flexion** when the angle of the joint decreases
>
> **extension** when the angle of the joint increases
>
> **hyperextension** when the joint extends beyond anatomical position

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 5.7 Elbow flexion in preparation to spike

FIGURE 5.8 Elbow and shoulder extension during spike execution

Other examples of flexion and extension in the sagittal plane include the extension of the knee joint when jumping, the extension of the shoulder joint when raising the bow hand in archery and the flexion of the hip joint when kicking a ball.

Plantar flexion and dorsiflexion

Flexion and extension of the foot at the ankle joint is known as **plantar flexion** and **dorsiflexion**. A soccer player uses plantar flexion when pointing the toes before kicking the ball. Dorsiflexion is an important movement when running, as it prepares the foot to generate maximum force when striking the ground. When using starting blocks, sprinters begin with their ankle dorsiflexed so they can push off with greater force.

plantar flexion the action of extending the ankle joint downwards, pointing the toes

dorsiflexion the action of flexing the ankle joint upwards, raising the toes

FIGURE 5.9 Plantar flexion of the left ankle in preparation to kick

Abduction and adduction

Abduction and **adduction** are the terms used to describe the movements that occur in the frontal (side to side) plane in reference to the midline of the body. Abduction occurs when movement is away from the midline of the body, whereas adduction occurs when movement is returning towards the midline of the body.

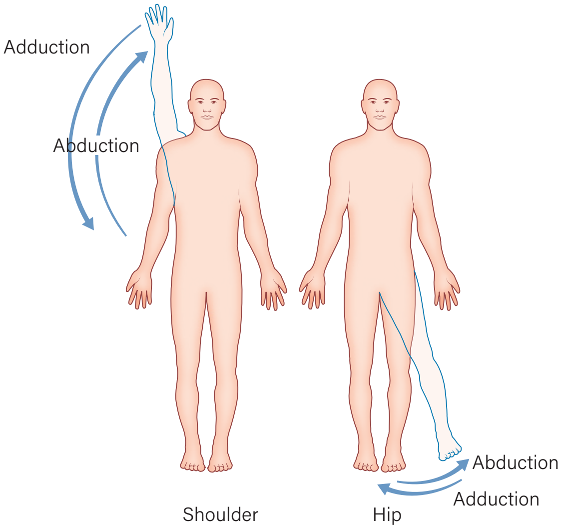


FIGURE 5.10 Examples of abduction and adduction

abduction the movement of a part of the body away from the central part of the body or away from another body part

adduction the movement of a part of the body towards the middle of the body or towards another body part

ISBN 978-1-009-31125-0 Stewart et al.

When a gymnast performs the crucifix position on the rings apparatus, the shoulders are being held in an abducted position (Figure 5.11). Adduction is occurring when the arms are returned to the side of the body, as the movement is towards the midline of the body.

FIGURE 5.11 A gymnast demonstrates strength and control, holding the shoulders in an abducted position.

The downswing motion used by golfers is an example of adduction of the rear shoulder, as it moves the arm back towards the midline of the body. In soccer, abduction of the hips is evident when someone is performing a quick change of direction, whereas passing a ball across the body requires adduction.

Circumduction and rotation

Circumduction is the movement of the arm, leg, hand or fingers in a circular pattern. Circumduction involves the sequential combination of flexion, abduction, extension and adduction. When swimming freestyle, circumduction is used by the shoulder joint.

> **circumduction** the movement of a joint in a circular pattern

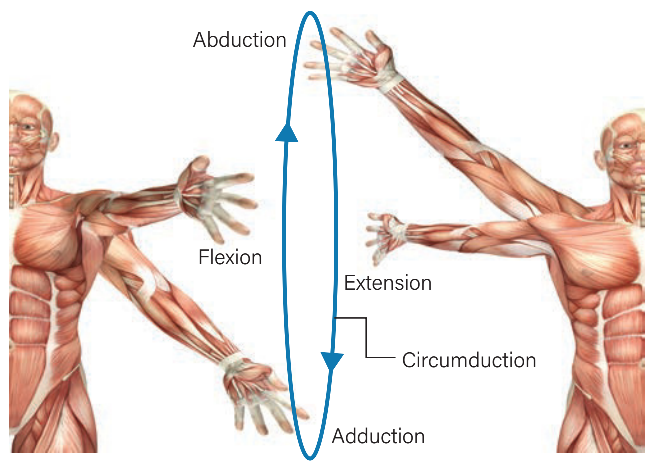


FIGURE 5.12 Example of circumduction

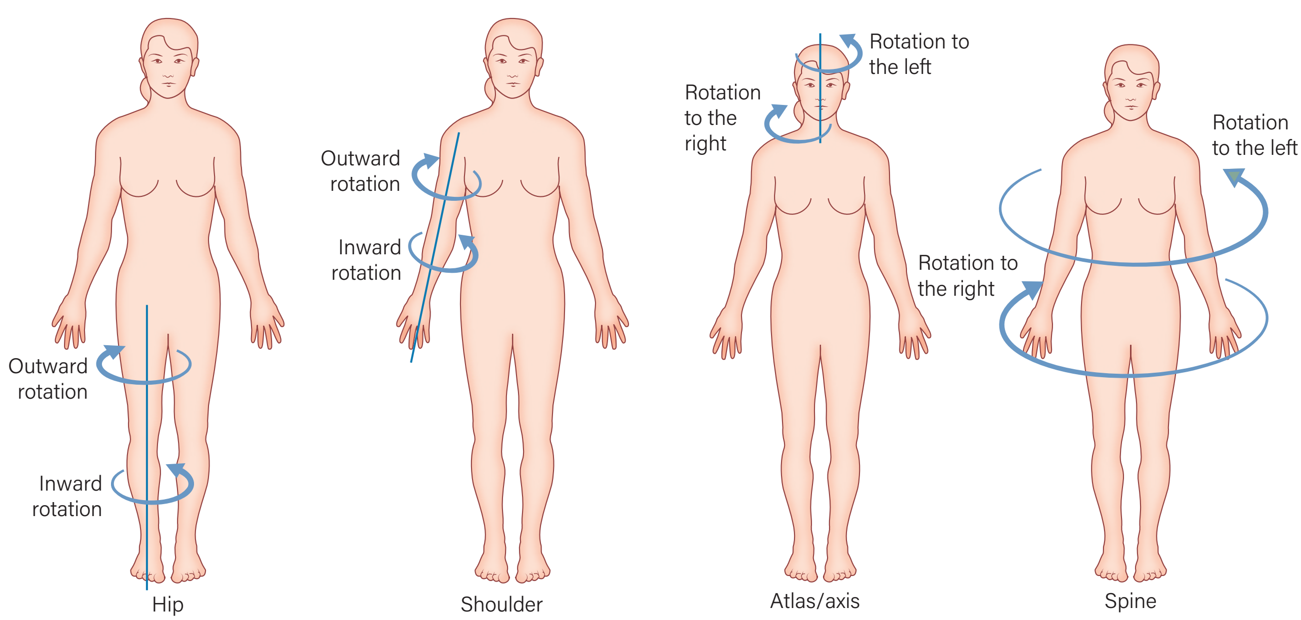


FIGURE 5.13 Examples of rotation

ISBN 978-1-009-31125-0 Stewart et al.

This action is also used in the bowling motion of cricket. In both cases, the far end of the limb is making a wider circular motion than the end closest to the midline of the body. **Rotation**, on the other hand, is the turning of a limb or the spine along its axis. A soccer player turning their leg outward in order to kick with the inside of their foot is a good example of rotation. In contrast to circumduction, the rotation of the leg along its long axis results in the entire limb turning uniformly. Inward (or internal) rotation is when a body part is rotated towards the midline of the body, whereas outward (or external) rotation is when the limb is rotated away from the body.

rotation the turning of a limb or the spine along its axis

FIGURE 5.14 Kicking a soccer ball with the inside of the foot requires rotation of the hip.

Pronation and supination

Pronation and **supination** are specialised rotation movements of the radio-ulnar joints in the forearm. Pronation is the turning movement that results in the palm facing down, whereas supination is the reverse, which causes the palm to face up. Sports that involve the use of a striking implement such as a bat or racquet often use pronation and supination to change grips and produce various shots. Tennis players pronate and supinate the forearm in changing grips from forehand to backhand. In order to apply backspin to the ball, pronation is used when playing a backhand slice. When playing a horizontal bat shot in cricket, a skilled player can control whether a ball is hit in the air or along the ground by using supination and pronation.

pronation rotation of the palm of the hand so the palm faces down

supination rotation of the palm of the hand so the palm faces up

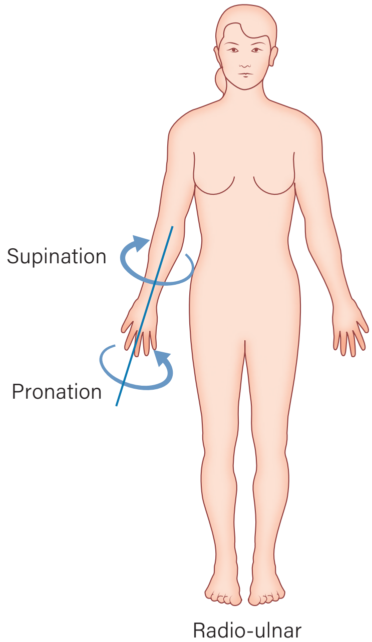


FIGURE 5.15 Pronation and supination

FIGURE 5.16 Pronation of the forearm is required to produce a backhand slice in tennis.

Eversion and inversion

Eversion and **inversion** are actions associated with turning the ankle joint. Inversion occurs when the ankle turns the foot medially so the sole of the foot is facing inwards. Alternatively, eversion occurs when the ankle turns the foot laterally, resulting in the sole of the foot

ISBN 978-1-009-31125-0

facing outwards. Sports that involve changing direction while running at speed utilise these movements. Sudden or forced inversion or eversion of the ankle joint is a common cause of ankle injury.

eversion when the ankle turns laterally so the sole of the foot faces outwards

inversion when the ankle turns medially so the sole of the foot faces inwards

Table 5.2 provides a summary of the major terms used in describing joint movements and the joints at which they occur.

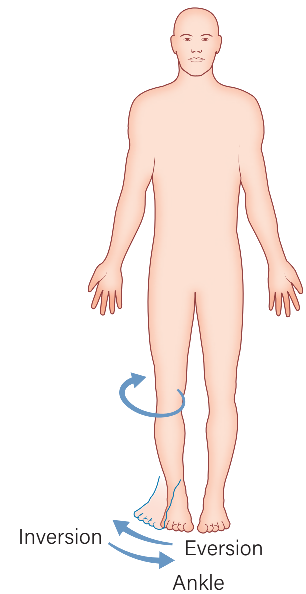


FIGURE 5.17 Inversion and eversion

TABLE 5.2 Summary of terms used to describe joint movements

Movement	Description	Joints at which the movement can occur
Flexion	Decreases the angle at a joint in the forward–backward plane	Shoulder, elbow, wrist, fingers, head, spine, hip and knee
Extension	Increases the angle of a joint from a flexed position back to normal (opposite of flexion)	Shoulder, elbow, wrist, fingers, head, spine, hip and knee
Abduction	Moves a body part away from the midline of the body	Shoulder, hip, wrist, head and spine
Adduction	Returns a body part towards the midline of the body from an abducted position (opposite of abduction)	Shoulder, hip, wrist, head and spine
Circumduction	The movement of a joint in a circular pattern using a combination of adduction, abduction, flexion and extension	Shoulder, hip, wrist and fingers
Rotation	Rotates a bone around a central axis. Rotation can be described as outward or inward rotation.	Shoulder, hip, head, spine and knee (while the knee is flexed)
Plantar flexion	Extends the ankle in order to point the toes downwards towards the ground	Ankle
Dorsiflexion	Flexes the ankle joint in order to point the toes upwards towards the knees (opposite of plantar flexion)	Ankle
Pronation	Rolls the forearm and hand to be facing palm down	Radio-ulnar joint
Supination	Rolls the forearm and hand to be facing palm up (opposite of pronation)	Radio-ulnar joint
Inversion	Turns the sole of the foot inwards	Ankle
Eversion	Turns the sole of the foot outwards (opposite of inversion)	Ankle

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 5.3

1. List an example of a sporting action that requires each of the movements summarised in Table 5.2. Your examples must be different from those used earlier in the text to illustrate each movement. You must be specific, naming not only the movement, but also the joint at which it occurs. For example, the up phase of a push-up is an example of elbow extension.
2. Create a table to record your responses.

ENGAGE 5.2

RECOGNISE & EXPLAIN

ANALYSE & SYNTHESISE

Inquiry question: What movement types are involved in a range of common training and exercise activities?

Recognise and explain

1. Working in pairs, one student replicates or mimics the movements listed in the following table while the other observes. Swap roles so both have the opportunity to observe the movement.
2. Take note of the movements that occur at the listed joints. Copy and complete the table.

Physical movement	Joints involved	Movement type	Plane of movement
Bicep curl	Elbow	Flexion and extension	Sagittal plane
Sit-up	Spine Hips		
Star jump	Hips Shoulders		
Squat	Ankles Knees Hips		
Chin-up	Elbows Shoulders		
Walking on a treadmill	Ankles Knees Hips Shoulders		
Riding an exercise bike	Hips Knees Ankles		
Rowing on a machine	Ankles Knees Hips Spine Shoulders Elbows		

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

3. Analyse each of the movements by completing the table. List the movement types and plane of movement involved during the *effort phase* of each movement.

ENGAGE 5.3

Inquiry question: What movement types are involved in a number of common sporting actions?

Demonstrate and apply

1. Collect video footage of yourself completing the following skills:
   - shooting a basketball free throw
   - kicking a soccer ball with the inside of your foot
   - passing a touch football.

Analyse and synthesise

2. Analyse the movements involved in each of the actions by copying and completing the following tables.

Movement	Joints involved	Joint action		Plane of movement
		Preparation phase	Action phase	
Shooting a basketball free throw	Ankle	Plantar flexion	Dorsiflexion	Sagittal
	Knee	Flexion	Extension	Sagittal
	Hip			
	Shoulder			
	Elbow			
	Wrist			

ISBN 978-1-009-31125-0 Stewart et al.

Movement	Joints involved	Joint action		Plane of movement
		Preparation phase	Action phase	
Kicking a soccer ball (with the inside of your foot)				

Movement	Joints involved	Joint action		Plane of movement
		Preparation phase	Action phase	
Passing a touch football				

3. In groups, discuss the findings of your analysis. Reach a group consensus regarding the movements involved in each action.

5.4 Production of force by skeletal muscles

Skeletal muscles (those attached to the skeleton) produce the force required for movement. Muscles consist of many hundreds of muscle fibres that are grouped in bundles along the length of the muscle. Each muscle fibre contains many contracting units called *myofibrils*. Myofibrils contain two types of protein filaments (myosin and actin) that, when stimulated by a nerve impulse from the brain, can produce contraction along the length of the muscle fibre.

skeletal muscles muscles that are attached to the skeleton in order to produce movement

A single nerve cell (or neuron) does not stimulate the whole muscle to contract. A nerve impulse from the brain will propagate through several neurons before reaching the muscle, and each neuron will stimulate only a number of muscle fibres. A single neuron and the muscle fibres it stimulates is called a *motor unit*. The number of muscle fibres in each motor unit depends on the precision of the movement the muscle is required to produce. For example, the muscles of the eye contain motor units with only a few fibres for every neuron, whereas a large, powerful muscle group such as the hamstrings may have hundreds of fibres per neuron. Depending on the amount of force required, the brain can stimulate the whole muscle or merely sections of the muscle to contract. The more motor units that are stimulated by nerve impulses from the brain, the greater the force of the contraction. Therefore, physical tasks that require small amounts of force will only require the contraction of a small percentage of motor units. If more force is required, the brain stimulates more motor units.

ISBN 978-1-009-31125-0 Stewart et al.

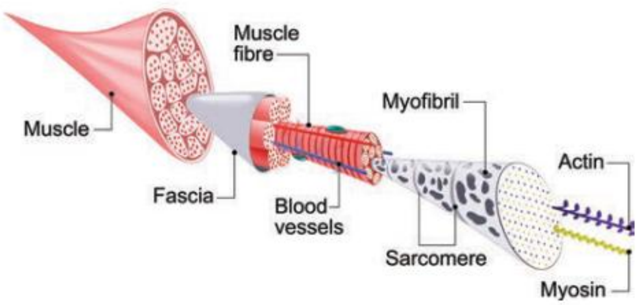


FIGURE 5.18 The basic structure of skeletal muscle

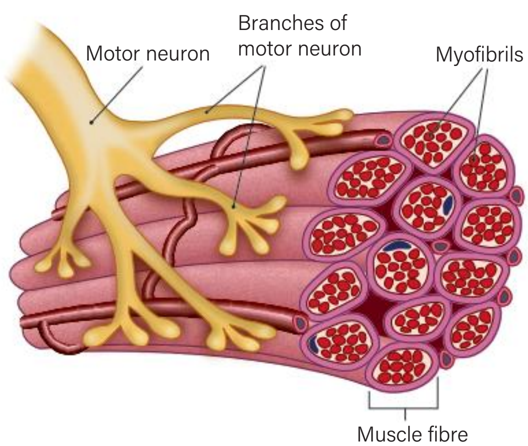


FIGURE 5.19 Motor unit consisting of a motor neuron and a bundle of muscle fibres

Muscles are attached to the skeleton by tendons, and by contracting they pull on the bones to produce **angular motion** at the joints. Muscle fibres can contract with force, but cannot lengthen with force, and therefore are arranged in pairs or groups in order to produce opposite movements. These pairs of muscles are known as **agonist** and **antagonist** muscles. These are muscles that typically produce opposing movements but commonly work together to allow a joint to move efficiently through its full range of motion. The muscle that produces the most force during a muscular contraction is known as an agonist muscle, or the 'prime mover'. The antagonist muscle is the opposing muscle that must relax for the joint to move. Other muscles act as *stabilisers* that work to stabilise the **origin** of the agonist, allowing it to achieve maximum and effective contraction. When the agonist is activated, the nerve impulse to the antagonist is inhibited. For example, when flexing the elbow, the biceps brachii is the agonist muscle and the triceps brachii is the antagonist. When the biceps brachii is contracted during this movement, the muscle feels tense, whereas the triceps brachii is lengthened and relaxed. This process of muscles on one side of the joint relaxing to accommodate muscle contraction on the other side of the joint is known as **reciprocal inhibition**.

angular motion movement around a fixed point or axis of rotation

agonist the muscle that is contracting to produce movement of the skeletal system at the joint

antagonist the muscle that must relax and lengthen during a movement to control or slow down the movement created by the agonist muscle

origin the end of a muscle that is attached to a fixed bone

reciprocal inhibition the process of muscles on one side of a joint relaxing to accommodate muscle contraction on the other side of the joint

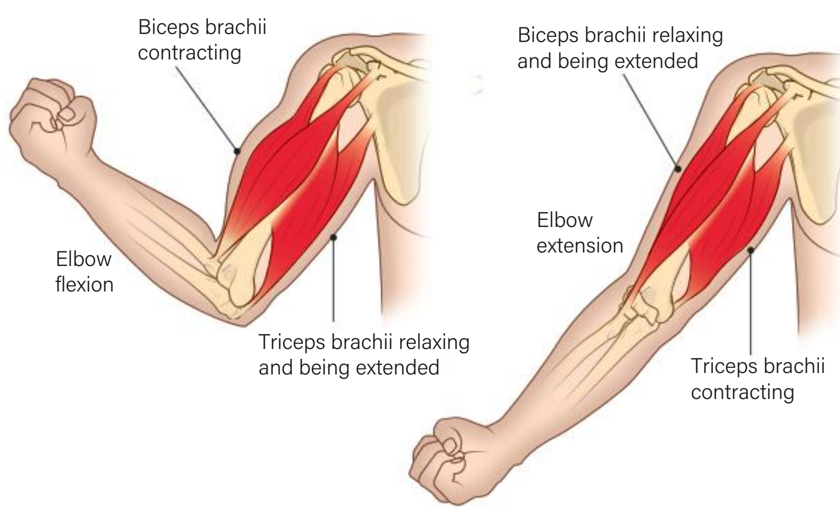


FIGURE 5.20 Action of the biceps brachii and triceps brachii in producing elbow flexion and elbow extension. The biceps brachii acts as the agonist during elbow flexion, while the triceps brachii acts as the antagonist. During elbow extension, the roles of agonist and antagonist are reversed.

ISBN 978-1-009-31125-0 Stewart et al.

With hundreds of individual muscles attached to the skeleton, each with thousands of individually controlled motor units, the coordination of seemingly simple movements such as walking is actually incredibly complex.

Types of muscular contraction

Muscles don't just contract in order to assist in the production of movement. Muscular contractions can be classified into two basic types according to the movement of the muscle during the period of muscular tension: isotonic contractions and isometric contractions.

Isotonic muscle contractions occur when the muscle shortens or lengthens to produce movement. Isotonic contractions can be either concentric or eccentric.

Concentric muscle contractions are produced when a muscle shortens under tension. This type of contraction is used mainly in producing motion against a resistance. For example, the upward action in producing a chin-up utilises a concentric contraction of the biceps brachii. *Eccentric muscle contractions* are produced when a muscle lengthens in a controlled way under tension due to an external force. Eccentric contractions are commonly used in absorbing or controlling external force – particularly the force of gravity. In the downward action of a chin-up, the elbow is extended – an action usually produced by the triceps brachii, but because the action involves lowering the body with gravity, the movement is produced in this case by the controlled lengthening of the biceps brachii. This type of contraction also occurs in absorbing the force of hitting the ground while running.

Isometric muscle contractions (also called static contractions) are produced when a muscle is producing tension but remains the same length. Static contractions are used in stabilising a part of the body in order to resist a force. If a chin-up is held stationary in the halfway position, the biceps brachii are producing an isometric contraction.

FIGURE 5.21 A chin-up involves concentric, eccentric and isometric contractions of the biceps brachii.

KEY MESSAGE

Muscle fibres are arranged into motor units that consist of a bundle of muscle fibres and the nerve cell (neuron) that controls them.

KEY MESSAGE

Muscular contractions can be classified as isotonic or isometric.

KEY MESSAGE

Isotonic muscle contractions can be classified as concentric or eccentric.

ISBN 978-1-009-31125-0 Stewart et al.

5.5 Major muscle groups

Figure 5.22 illustrates the major skeletal muscle groups used in producing the wide range of movements possible in the human body.

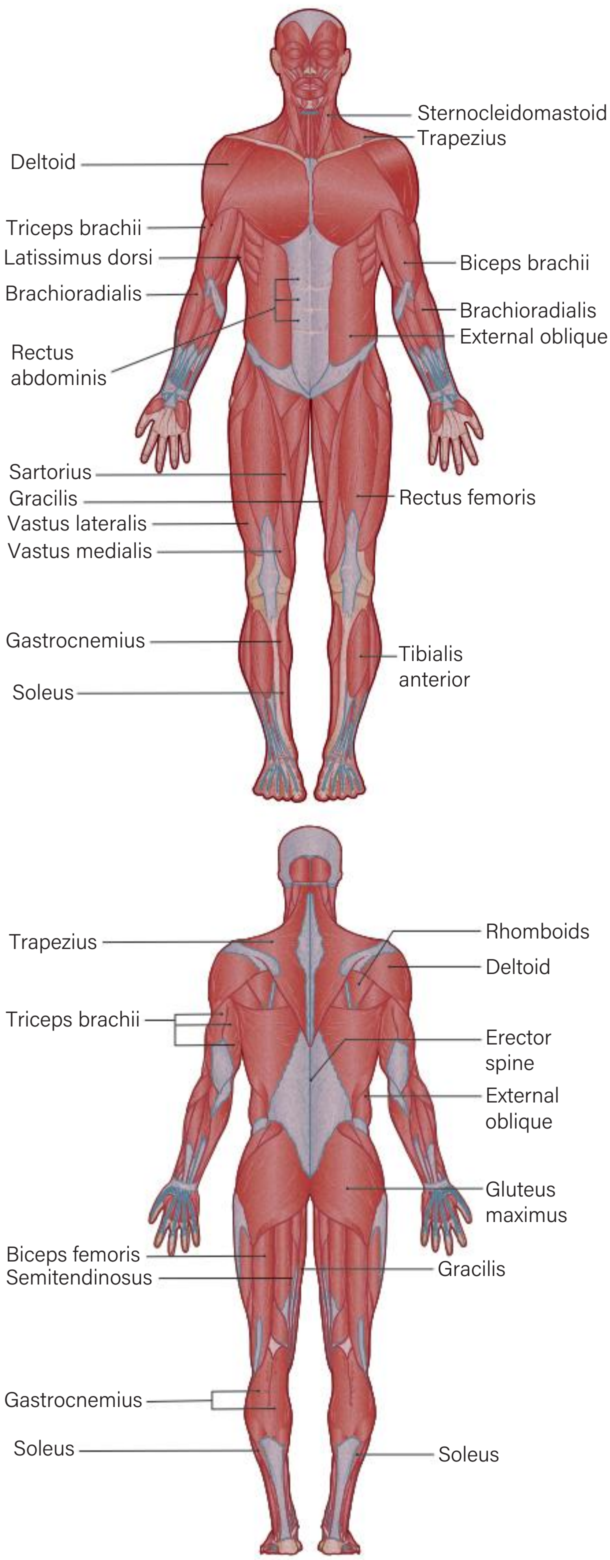


FIGURE 5.22 Major muscle groups

CHECK-IN 5.4

1. Some major muscles are grouped together because they produce similar actions or share **insertion** points. Research and list the muscles that make up the groups known as the hamstrings, the quadriceps and the abdominals.
2. Consider the types of muscular contractions.
   a. What are three activities of daily living that use concentric contractions?
   b. What are three activities of daily living that use eccentric contractions?
   c. What are three activities of daily living that use isometric contractions?
3. Knowledge of anatomical terminology and the names of bones, muscles and joints allows athletes, coaches and sports scientists to use a common language to describe human movements. It is therefore important to be able to name, locate and correctly spell the major skeletal muscles. Numerous apps, online quizzes and interactive tools (including 3D views of individual muscles) can be used to help learn and recall the names and locations of the major muscle groups. Locate and use one or more of these resources to help your recall of muscular anatomy.

Table 5.3 lists specific joint actions, their involvement in a range of physical activities and the major muscles responsible for producing the action. It should be noted that some muscles, because they stretch over more than one joint, can be involved in producing movement at more than one joint. The biceps brachii is an example of this, as it produces movement at both the elbow and shoulder joints.

insertion the moveable end of the muscle that is attached to the bone being pulled

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 5.3 Examples of muscular involvement in a range of physical activities

Action	Examples of movements in various physical activities	Muscle(s)
Closing fingers to grasp (finger flexion)	Sports that involve holding on to an opponent, teammate or piece of equipment, such as a softball bat	Flexor digitorum profundus Flexor digitorum superficialis
Flexing thumb to grasp (thumb flexion)	Gripping a bat	Flexor pollicis longus
Flexing wrist towards palm (palmar flexion)	Chest pass in netball, throwing a cricket ball, overhead serve in volleyball	Palmaris longus Flexor carpi ulnaris Flexor carpi radialis
Extending the wrist towards the back of the hand (dorsiflexion)	Backhand shot in squash and badminton, backhand topspin shot in table tennis, throwing a frisbee	Extensor carpi ulnaris Extensor carpi radialis Extensor carpi brevis Extensor carpi longus
Pronation of the forearm	Topspin forehand in tennis, spin-passing a touch ball, action of top forearm in controlling a pull shot to the ground in cricket	Pronator teres
Supination of the forearm	Bowling off spin in cricket, throwing a cricket ball, pitching in softball	Supinator
Elbow flexion	Maintaining tight grips in a rugby scrum, rock climbing, drawing the bow in archery, kayaking	Biceps brachii Brachialis Brachioradialis (while forearm is pronated)
Elbow extension	Shot-put, pitching in baseball, golf swing, throwing a javelin	Triceps brachii
Shoulder flexion	Pitching in softball, tenpin bowling	Pectoralis major Anterior deltoid Biceps brachii
Shoulder extension	Holding an opponent tightly, such as in a rugby tackle or a judo throw	Latissimus dorsi Teres major Deltoid Triceps brachii
Shoulder abduction	Preparing to serve in table tennis, preparing to spike in volleyball	Deltoid Supraspinatus
Shoulder adduction	Action of the bottom arm in a golf swing, lifting body weight in rock climbing	Pectoralis major Latissimus dorsi Teres minor Coracobrachialis
Hip flexion	Kicking a ball, performing a high kick in sport aerobics	Rectus femoris Sartorius Psoas major Psoas minor Iliacus
Hip extension	Preparing to kick a ball, lifting in a rugby lineout	Gluteus maximus Biceps femoris Semimembranosus Semitendinosus
Hip abduction	Outward movement in a star jump, pitching stride in baseball	Gluteus medius Gluteus minimus Tensor fascia latae

ISBN 978-1-009-31125-0

TABLE 5.3 *(continued)*

Action	Examples of movements in various physical activities	Muscle(s)
Hip adduction	Inward movement in a star jump, kicking a soccer ball with the inside of the foot	Adductor brevis Adductor longus Adductor magnus Pectineus Gracilis
Knee flexion	Swing phase in sprinting, preparing to lift	Biceps femoris Semimembranosus Semitendinosus Gastrocnemius Sartorius
Knee extension	Jumping to block in volleyball, kicking a ball	Rectus femoris Sartorius Vastus intermedius Vastus medialis Vastus lateralis
Ankle plantar flexion	Pushing off the ground while sprinting, pointing the toes while swimming	Gastrocnemius Soleus Plantaris Tibialis posterior
Ankle dorsiflexion	Preparing for foot strike while running, holding position in a ski jump	Tibialis anterior Extensor halluces longus Extensor digitorum longus Fibularis tertius

ENGAGE 5.4

ANALYSE & SYNTHESISE

Inquiry question: What major muscle groups and types of muscular contractions are involved in specialised movement sequences?

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

1. Using a format similar to the example in the table on the next page, analyse the types of muscular contractions involved in one or more movement sequences associated with the physical activity that is the focus of your study. In a small group, select a movement sequence for the purpose of this movement analysis.
2. To do this, you will divide the specialised movement sequence into distinct phases of the motor program. For example, a push-up could be divided into the 'up phase' and the 'down phase', and the leg action in walking could be divided into the 'push phase', 'recovery phase' and 'swing phase.' The movement sequence you choose may have two, three or more distinct phases.

ISBN 978-1-009-31125-0 Stewart et al.

3. Name each of the phases of the movement sequence.
4. Complete your analysis with your group.

Description of movement sequence:		
Phase of movement	Muscle groups involved	Type of contraction (concentric, eccentric or isometric)
Phase 1:		
Phase 2:		
Phase 3:		

5. What are the implications of this analysis for preparing athletes for competition in this sport? What types of activities should be included in training for this sport?

5.6 Muscular analysis

Conducting a muscular analysis of particular movement sequences examines which muscles are working and the type of contractions they are performing. From this, coaches and athletes can determine what kind of exercises are appropriate for developing these muscles.

Steps in conducting muscular analyses

1. Select the movement sequence to be analysed. It is best to select distinct rather than serial movement sequences – for example, a spike in volleyball.
2. Break the movement sequence into phases where only one movement per plane is occurring (e.g. hip flexion is occurring, not hip flexion and hip extension). The number of phases in movement sequences will vary, but most sporting movement sequences can be described in two to five phases. A typical breakdown of phases may include:

- stance phase
- preparatory phase
- movement phase
- recovery phase.

The names given to describe each phase often use sport-specific terminology and may include the name of the body part involved. For example, a baseball pitch is often described in five phases: wind-up, early cocking, late cocking, acceleration and follow-through (Figure 5.23).

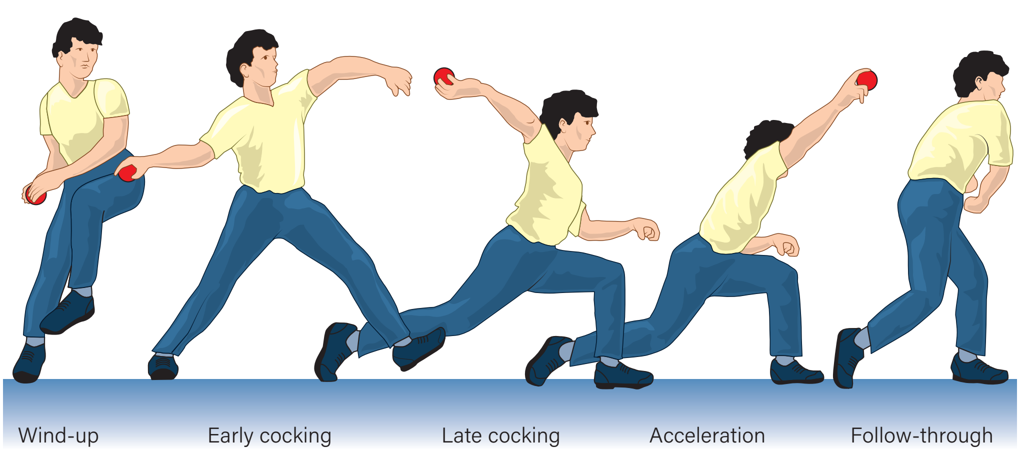


FIGURE 5.23 Phases of a baseball pitch

ISBN 978-1-009-31125-0

3. For each phase, determine the joints at which movements are occurring and the type of movement – for example, shoulder horizontal flexion, elbow extension.
4. For each phase, at each joint, determine the type of muscular contraction that is occurring.

   When the agonist muscles in a movement are developing force while shortening to cause movement, the contraction is concentric. The antagonist muscles must relax to allow the movement to occur. This usually occurs when a body part is moving against gravity or in an acceleration phase.

   When the antagonist muscles in a movement are developing force while lengthening to control or slow down movement, the contraction is eccentric. This usually occurs when a body part is moving with gravity or in a follow-through or recovery phase.

   In the 'up' phase of a push-up, the action of the triceps brachii to extend the elbow is concentric. The triceps brachii is the agonist in elbow extension and is shortening to cause the movement. In the 'down' phase, elbow flexion is controlled by the eccentric contraction of the triceps brachii, which lengthens under force. The triceps brachii is usually the antagonist in elbow flexion, but in this case, it is working eccentrically to control the speed of the 'down' phase.
5. Considering the types of muscle contraction occurring, list the muscles that are under force to produce each movement, at each joint, in each phase. See Table 5.4 for an example of a completed muscular analysis for a 'latissimus pull-down'.

FIGURE 5.24 Latissimus pull-down

TABLE 5.4 Muscular analysis of a latissimus pull-down

Phase	Joint	Movement	Contraction	Muscles
Down	Elbow	Flexion	Concentric	Biceps brachii Brachialis Brachioradialis
	Shoulder	Adduction	Concentric	Pectoralis major Latissimus dorsi Teres minor
Up	Elbow	Extension	Eccentric	Biceps brachii Brachialis Brachioradialis
	Shoulder	Abduction	Eccentric	Pectoralis major Latissimus dorsi Teres minor

KEY MESSAGE

Muscular analysis determines which muscles are working and the type of contraction they are performing.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 5.1

Inquiry question: What specific joint movements, muscles and types of muscle contraction occur in specific movement sequences?

Demonstrate and apply

1. Select a movement sequence from the physical activity that is the current focus of your study. Your teacher may select a less complex movement sequence for your first attempt and then move on to a more complex sequence.
2. Observe class members perform this action. Take notes, recording your initial thoughts about the phases and movements involved.

Analyse and synthesise

3. In small groups, follow the steps involved in conducting a muscular analysis outlined in the previous section. Construct a table similar to Table 5.4 to record your findings.
4. Allow each group to share their findings. Discuss these findings and come to a class consensus about the analysis.

Evaluate and justify

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

5. Based on the analysis, construct a list of exercises that could be included in a training circuit designed to improve the performance of the identified muscle groups. Justify the inclusion of each exercise by discussing how the exercise targets the specific muscles and contraction types identified in the analysis. You may also consider matching the speed of the muscular contractions involved in each phase of the movement sequence.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Functional anatomy in the context of biomechanics is the study of the function of muscles and bones.
- Forces that affect motion in physical activity can be either external or internal forces.
- The skeleton provides a framework that allows the body to move.
- Muscles, through their attachment to the skeleton via tendons, provide the forces for the skeleton to achieve movement.
- Synovial joints are freely moveable and allow a range of movement to occur.
- Synovial joints are categorised by their shape and the type of movements that can occur.
- A common language of anatomical terms is used to describe human movements at the joints, the planes on which movement occurs and the location of structures in the body.
- Internal forces are those produced by the contraction of muscle fibres that consist of many contracting units called myofibrils.
- Muscle fibres are arranged into motor units that consist of a bundle of muscle fibres and the nerve cell (neuron) that control them.
- As the number of motor units stimulated by nervous impulses increases, so does the force produced by the muscle.
- Muscular contractions can be classified as isotonic, which can be concentric or eccentric, or isometric (static) contractions.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. The sterno-clavicular joint is an example of a:
- **A.** gliding joint.
- **B.** hinge joint.
- **C.** saddle joint.
- **D.** ball-and-socket joint.

2. A front somersault is a movement that occurs in the:
- **A.** sagittal plane.
- **B.** frontal plane.
- **C.** coronal plane.
- **D.** transverse plane.

3. The movements that occur in the up phase of a chin-up are:
- **A.** shoulder flexion and elbow flexion.
- **B.** shoulder extension and elbow flexion.
- **C.** shoulder flexion and elbow extension.
- **D.** shoulder extension and elbow extension.

4. Eccentric muscle contractions are produced when a muscle:
- **A.** is under tension, but no movement occurs.
- **B.** lengthens as it relaxes.
- **C.** shortens under tension to produce a movement.
- **D.** lengthens under tension to control a movement.

5. Which of the following muscles contributes to producing shoulder adduction?
- **A.** Deltoids
- **B.** Soleus
- **C.** Latissimus dorsi
- **D.** Rectus femoris

ISBN 978-1-009-31125-0 Stewart et al.

SHORT-RESPONSE QUESTIONS

1. List the movements that are possible at the following joints:
   - knee
   - hip
   - ankle
   - shoulder
   - wrist.
2. List the muscles responsible for the following actions:
   - elbow flexion
   - hip hyperextension
   - shoulder abduction
   - knee extension
   - ankle plantarflexion.

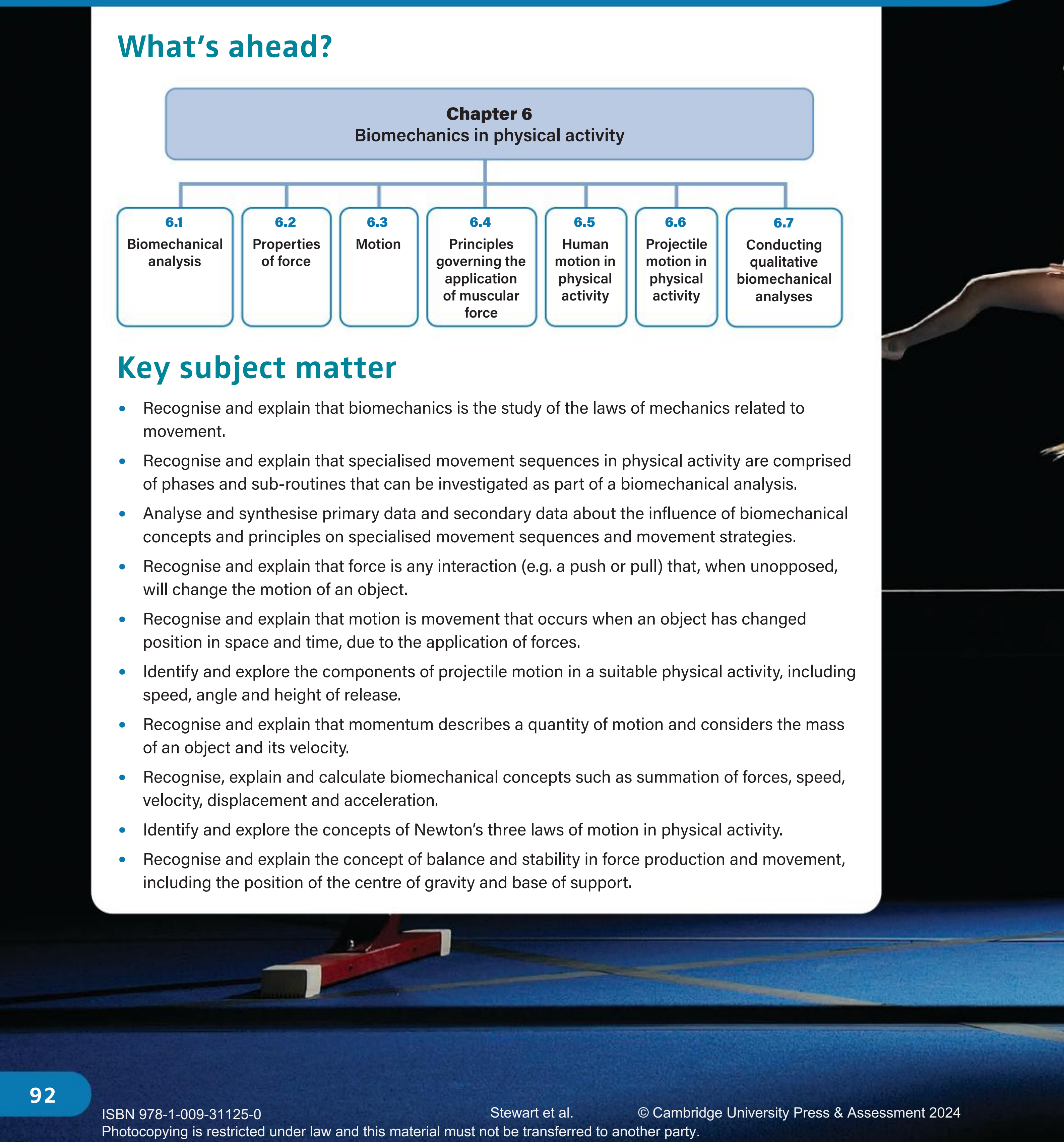
EXTENDED-RESPONSE QUESTION

Select a specific subroutine from a movement sequence involved in the performance of an activity in which you are currently engaged. Complete a muscular analysis of the subroutine using the format outlined in Table 5.4. As only one subroutine is to be analysed, it is likely that the analysis will only involve one phase.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 6

Biomechanics in physical activity



What's ahead?

Chapter 6
Biomechanics in physical activity

- **6.1** Biomechanical analysis
- **6.2** Properties of force
- **6.3** Motion
- **6.4** Principles governing the application of muscular force
- **6.5** Human motion in physical activity
- **6.6** Projectile motion in physical activity
- **6.7** Conducting qualitative biomechanical analyses

Key subject matter

- Recognise and explain that biomechanics is the study of the laws of mechanics related to movement.
- Recognise and explain that specialised movement sequences in physical activity are comprised of phases and sub-routines that can be investigated as part of a biomechanical analysis.
- Analyse and synthesise primary data and secondary data about the influence of biomechanical concepts and principles on specialised movement sequences and movement strategies.
- Recognise and explain that force is any interaction (e.g. a push or pull) that, when unopposed, will change the motion of an object.
- Recognise and explain that motion is movement that occurs when an object has changed position in space and time, due to the application of forces.
- Identify and explore the components of projectile motion in a suitable physical activity, including speed, angle and height of release.
- Recognise and explain that momentum describes a quantity of motion and considers the mass of an object and its velocity.
- Recognise, explain and calculate biomechanical concepts such as summation of forces, speed, velocity, displacement and acceleration.
- Identify and explore the concepts of Newton's three laws of motion in physical activity.
- Recognise and explain the concept of balance and stability in force production and movement, including the position of the centre of gravity and base of support.

ISBN 978-1-009-31125-0 Stewart et al.

- Identify and explore first-, second- and third-class levers in physical activity, including force multipliers and speed multipliers.
- Recognise and explain Bernoulli's principle in suitable physical activities, including topspin, backspin, sidespin and lift forces.
- Gather primary data about the influence of biomechanical concepts and principles on personal performance of specialised movement sequences and movement strategies in authentic performance environments.
- Use secondary data to analyse how biomechanical concepts and principles can influence performance in physical activity.
- Analyse primary data and secondary data to ascertain relationships between the biomechanical strategies, concepts and principles, and personal performance.
- Devise personal biomechanical strategies to optimise performance in physical activity.
- Justify the development of biomechanical and movement strategies using evidence from primary data and secondary data.
- Implement the biomechanical strategies to gather primary data about the outcomes and limitations of the decisions.
- Reflect on primary data and secondary data to evaluate the effectiveness of the biomechanical strategies to achieve a determined outcome.
- Make decisions to maintain or modify the biomechanical and movement strategies.
- Justify maintenance or modification of the biomechanical and movement strategies using evidence from primary data and secondary data.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What are the biomechanical requirements of specialised movement sequences required by various physical activities?
- How can biomechanical analysis contribute to developing strategies to optimise performance in physical activity?
- How can biomechanical data contribute to personal decisions to maintain or modify specialised movement sequences?

ISBN 978-1-009-31125-0 Stewart et al.

6.1 Biomechanical analysis

Biomechanical analysis is an important part of performance enhancement in elite sport. Biomechanical analysis is based on the knowledge and understanding of a range of biomechanical principles that govern the application of force and the motion that occurs as a result of the application of forces. Biomechanists use a range of measurement strategies to analyse specific movement sequences with a view to assisting athletes to develop more efficient movement sequences and avoid potential injuries.

As well as assisting elite athletes, biomechanical analysis can benefit athletes of all ages and skill levels. For example, biomechanical analysis of an athlete's sprint technique may reveal ways to improve the efficiency of the running stride and allow them to gain more speed. There are two types of biomechanical analysis: quantitative and qualitative. **Quantitative analysis** involves collecting performance data that is measurable (defined using numbers). This type of analysis usually involves the use of expensive measurement tools, and therefore is usually only completed for elite athletes. **Qualitative analysis** involves data gathered by observers watching the performance, and therefore is more accessible to all athletes at any level. The quality of this form of analysis is related to the biomechanical and sport-specific technical knowledge and experience of the observer.

Qualitative biomechanical analysis often involves collecting video footage at various stages of the improvement process. This involves an initial filming session, gathering footage of the targeted movement sequence (e.g. the performance of an overhead serve in volleyball). This pre-practice footage is examined and analysed using understandings of biomechanical principles and ideal technique. Based on this analysis, recommendations are made about how to improve the performance. Athletes are then given time to practise, making the necessary adjustments to correct the movement sequence. A second, post-practice filming session is then conducted. The pre-practice and post-practice footage is then compared to determine whether the period of practice was successful. This cycle is repeated until the coach and athlete are satisfied that the movement sequence has become as efficient, accurate and consistent as possible.

quantitative analysis examination of events through measurement and assigning numeric values

qualitative analysis examination of events by recording observations that cannot be measured using numeric values

Section 6.7 of this chapter, 'Conducting qualitative biomechanical analyses', provides a step-by-step guide to completing a qualitative biomechanical analysis, which can be applied to selected specialised movement sequences or subroutines thereof.

KEY MESSAGE

Qualitative biomechanical analysis involves collecting observations of performances and making comparisons with ideal technique.

FIGURE 6.1 Biomechanical analysis at any level can produce enhanced performance outcomes.

ISBN 978-1-009-31125-0 Stewart et al.

6.2 Properties of force

Muscular **forces** can be described and measured in terms of four **properties of force**: magnitude, direction, point of application and line of action.

Magnitude refers to the amount of force that is being applied. The magnitude of a force, measured in newtons (N), is calculated by multiplying the mass (kg) of the object that the force is applied to by the object's rate of acceleration (m/s/s) caused by the force. For example, to accelerate a 2 kg discus at 40 m/s/s requires the application of a force of 80 newtons. It is obvious that objects with greater mass will require larger force to produce the same rate of acceleration. This law of acceleration is known as Newton's second law of motion and is discussed in more detail later in the chapter.

> **force** a push or pull in a given direction
>
> **properties of force** four characteristics that a force possesses: magnitude, direction, point of application and line of action

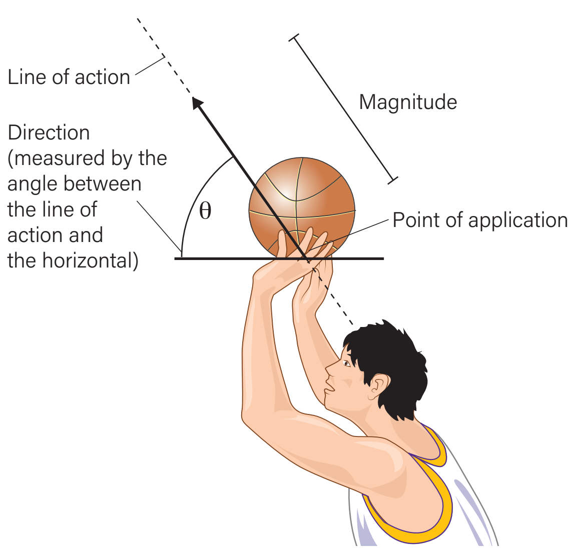


FIGURE 6.2 The four properties of force applied to a basketball shot. Note that the line of action and the direction apply to the force, not to the motion of the basketball.

The *direction* in which a force is applied also affects the resulting motion. In Figure 6.2, the direction is measured as the angle between the line of action of the force and the horizontal.

It is common, particularly in applying muscular force, that more than one force acts to produce movement. Usually, a number of forces act simultaneously to produce the resultant motion. The properties of each of the contributing forces determine the resultant force, which produces the resultant motion. When an object (or the human body) is subject to a number of forces simultaneously, the resultant force is the force that would produce the resulting action if acting alone – in other words, a summation of all contributing forces. So this is a resultant force from multiple contributing forces. An example is illustrated by the action of the pectoralis major muscle. As shown in Figure 6.3, the pectoralis major consists of a number of segments attached to the clavicle (collar bone), the sternum (breastbone) and rib. The segments of this muscle exert force in slightly different directions, but when segments contract together, a resultant force occurs, pulling on the humerus.

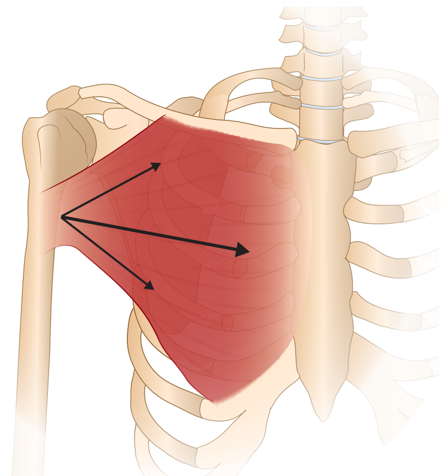


FIGURE 6.3 The pectoralis major muscle, showing the resultant force when top and bottom segments contract

A second type of resultant force comes from analysing the horizontal and vertical components of the direction of the force. For example, the force pushing on the blocks during a sprint start includes a horizontal component (to begin accelerating down the track) and a vertical component (to overcome gravity and move to a more upright posture, avoiding falling forwards).

The *point of application* of a force is the point where force is applied to a body or object. *Line of action* refers to a theoretical line from the point of application of a force, extending in the direction in which the force is acting. The position of the line of action of a force in relation to the *centre of gravity* of an object will have an effect on the type of motion that is produced. The centre of gravity of an object is a theoretical point that represents the centre of the object's mass. (If an object was thrown with spin, it would rotate around its centre of gravity.) If a force is applied to an object through its centre of gravity, it

ISBN 978-1-009-31125-0 Stewart et al.

will cause only **linear motion**. If the force applied to an object does not act through its centre of gravity, it will cause linear and angular motion. For example, when the force of a throw applied to a basketball does not act directly through its centre of gravity (figure 6.2), it causes the ball to not only move, but also to rotate with backspin (which in this case may cause a 'friendlier bounce' from the rim if the shot misses, meaning one that 'sits up' to give the attacking team another chance.).

linear motion movement of an object from one place to another

KEY MESSAGE

Muscular forces can be described and measured in terms of magnitude, direction, point of application and line of action.

CHECK-IN 6.1

1. Free throw success in basketball is improved by adding a little backspin to the ball. Describe how this is achieved with reference to line of application of force and point of application of force.
2. Use the principles of force application to explain why sprinters are advantaged by using a crouch start.
3. When performing a crouch start, what are the movements occurring at the ankle, knee and hip joints the moment after the gun goes off? What muscles are the agonists in these movements?

6.3 Motion

Motion is another word for movement. Motion occurs as a result of force acting or having acted on an object (which may be a human body). A force may change an object's motion by speeding it up, slowing it down, changing its direction or causing it to spin. The motion of an object (possibly the human body) that occurs in physical activity is often described in terms of **displacement** (how far the object has moved), **velocity** (how fast and in what direction the object is moving) and **acceleration** (whether the object is getting faster or slowing down).

displacement the distance and direction an object has moved from one point to another

velocity how fast and in what direction an object is moving

acceleration an increase or a decrease in the velocity of an object caused by an applied force

FIGURE 6.4 Soccer strikers may intentionally apply force to the ball that does not act directly through its centre of gravity, thus applying rotation that causes the ball to curve in the air.

Types of motion

There are two types of motion: *linear motion* and *angular motion*. Linear motion is the type of motion that moves an object (possibly a human body) from one place to another. This can occur in two ways. An object can move from one place to another in a straight line, which is called **rectilinear motion** (e.g. a snooker ball rolling along the table), or an object can move from one place to another in a curved line, which is called **curvilinear motion** (e.g. the flight path of a javelin through the air). The distance covered by an object moving from one point to another is known as *displacement*. For instance, a 100 m sprinter at the halfway point of a race has a displacement of 50 m.

Angular motion is the type of motion that involves rotation around a fixed point or **axis of rotation**.

rectilinear motion movement of an object from one place to another in a straight line

curvilinear motion movement of an object from one place to another in a curved line

axis of rotation an imaginary line around which a body or object rotates

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 6.5 Angular motion of a gymnast around the high bar

FIGURE 6.6 Angular displacement of the thigh at the hip joint while kicking an Australian Rules football can be up to 150 degrees.

TABLE 6.1 Examples of types of motion

Rectilinear motion	Curvilinear motion	Angular motion
• The motion of bike and rider while cycling • A tenpin bowling ball rolling down the lane	• The flight path of a javelin • The motion of the body while long-jumping	• A front somersault • Action of the shoulder joint in swinging a golf club

This type of motion is sometimes called *rotary motion*. Some examples are performing a front somersault, the action of the body in a circular discus sling and the action of the hip joint while sprinting.

In fact, almost all the motion that muscles can produce at the joints is angular motion. One bone rotates around another at a joint that acts as the axis of rotation. Because angular motion does not involve moving from one place to another, displacement is not measured in metres. Angular displacement is a measure of how many degrees of rotation have occurred between a body part or an object's starting position and its final position. For example, rotating the arm in a full circle represents an angular displacement of 360 degrees around an axis of rotation at the shoulder joint. The Greek letter theta (θ) is used to represent angular displacement.

Some physical activities such as gymnastics and diving include very complex series of angular motion. Twisting somersaults, for instance, represent simultaneous angular motion around two axes of rotation.

Motion of the human body

The angular motion at our joints can be transformed into linear motion (rectilinear or curvilinear). For example, walking is performed by pushing off the ground and then rotating one of our hip joints forwards. This causes our body to overbalance. Balance is regained each time a foot hits the ground. Force exerted by our muscles causes angular motion at the joints, and combined with the effects of gravity, is transformed into the linear motion (more specifically, a continuous series of smaller curvilinear movements) of the whole body moving forward. In another example, the circular discus-slinging technique uses angular motion of the trunk and limbs to produce the angular spinning action of the discus and its curvilinear flight path (Figure 6.7).

ISBN 978-1-009-31125-0

FIGURE 6.7 Discus slinging translates the angular motion of the joints into the curvilinear flight path of the discus.

As is the case in most physical activity, linear motion of our whole body or a projectile propelled by our body occurs because of the angular motion produced at our joints by muscular force. Human motion is complex and comprises combinations of linear and angular motion to produce movement sequences. The movements we choose to initiate are in response to environmental cues such as prevailing winds in golf or the position of other players or the ball in volleyball.

Linear velocity and acceleration

Linear velocity, which is commonly referred to as speed, is a measure of how fast an object is moving and is defined as the rate of change of an object's displacement. In other words, velocity measures how far an object moves in a given time period. Velocity also includes the direction of motion, but in most contexts in this course, the direction may not be specified. The velocity of a car is commonly measured in kilometres per hour (km/h). A car travelling at 80 km/h moves 80 km after one hour, 160 km after two hours and so on. Linear velocity in physical activity is usually measured in metres per second (m/s). Some fast bowlers in cricket can release the ball at 44.5 m/s, which is approximately 160 km/h.

Linear velocity is calculated by dividing the displacement of an object by the time it takes to travel that distance.

$$\text{velocity (m/s)} = \frac{\text{displacement (m)}}{\text{time (s)}}$$

$$\text{or in abbreviated form } v = \frac{d}{t}$$

For example, a 100 m runner who takes 10 seconds to complete the distance has an average velocity of 10 m/s (100 m ÷ 10 s = 10 m/s).

This is considered an average velocity because of variations to the sprinter's velocity that may have occurred during the race. A more accurate indication of velocity may result from calculating average velocity for each 10 m section of the race.

Linear acceleration is a measure of how quickly velocity is changing. In other words, acceleration is how quickly an object is slowing down or speeding up. Linear acceleration is calculated by dividing the change in an object's velocity by the time it takes for the change to occur.

$$\text{acceleration (m/s/s)} = \frac{\text{final velocity} - \text{initial velocity (m/s)}}{\text{time (s)}}$$

$$\text{or in abbreviated form } a = \frac{v_2 - v_1}{t}$$

Linear acceleration is measured in metres per second per second (m/s/s or m/s^2). A sprinter who is capable of accelerating at 2 m/s/s from the beginning of the race, after three seconds of gaining 2 m/s of velocity every second, will be running at a velocity of 6 m/s.

As a positive value for acceleration represents an increase in velocity, a negative value represents a decrease in velocity or deceleration. A pole vaulter will show a negative acceleration (getting slower) on the way up to the bar until maximum height is reached, and a positive acceleration (getting faster) on the way to the mat. An object with an acceleration of 0 m/s/s is neither slowing down nor speeding up, but rather remaining at a constant velocity, or at rest.

One example of the application of the principles of linear velocity and acceleration is in sprint analysis. By calculating average velocity and acceleration over each 10 m interval of a 100 m sprint race, the athlete may identify training priorities. For instance, if it is found that velocity decreases over the final 10 m, it may indicate that the athlete should train towards maintaining top velocity for 100 m. The athlete may find that maximum velocity is not reached until the 70 m mark, indicating a need to work on explosive strength and acceleration.

ISBN 978-1-009-31125-0 Stewart et al.

Angular velocity and acceleration

As for linear motion, it is possible to calculate velocity and acceleration for angular motion. The difference is that in linear motion displacement is measured in metres, whereas in angular motion it is measured in degrees.

Angular acceleration, as is the case with linear acceleration, is a measure of how quickly velocity (in this case, angular velocity) is changing – in other words, how quickly an object in angular motion is speeding up or slowing down.

Calculations of angular velocity and acceleration are very useful, for example, in the analysis of an individual's golf swing. An individual player's height, arm span, angular acceleration of swing and final angular velocity of the club head will all contribute to how fast the ball will come off the club. These measurements can be used to make adjustments to swing technique towards producing maximum ball velocity with control.

TABLE 6.2 Calculating linear displacement, velocity and acceleration

Linear motion	Calculation	Example
Displacement	Linear displacement (*d*) measured in metres (m)	The distance over which a sprint race is contested
Velocity	Linear velocity (*v*) = displacement (*d*) divided by time (*t*); measured in metres per second (m/s)	The average velocity of a sprinter running 100 m in 11 seconds is 9.1 m/s.
Acceleration	Linear acceleration (*a*) = change in velocity ($v_2 - v_1$) divided by time (*t*); measured in metres per second per second (m/s/s)	A sprinter who goes from standing to 10 m/s in five seconds is accelerating at 2 m/s/s.

KEY MESSAGE
Linear motion occurs when an object moves from one place to another.

KEY MESSAGE
Angular motion involves rotation around an axis.

KEY MESSAGE
Human motion is created by the angular motion of bones moving at the joints.

CHECK-IN 6.2

1. For the following physical activities, provide examples of the types of motion that can occur.
   a. Shot-put
   b. Downhill skiing
   c. Basketball
   d. Tennis
   e. Sport aerobics
2. For each activity in question 1, select one type of motion identified and outline the linear and angular velocity and acceleration required for this movement.
3. Consider the physical activity that is the focus of your study this term. List the types of motion involved in the various aspects of this physical activity, and when and where they occur.

ISBN 978-1-009-31125-0

ENGAGE 6.1

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: What implications for training can be determined from an analysis of sprinting velocity over 100 metres?

Demonstrate and apply

1. You will be calculating the average velocity and acceleration from data collected during a 100 m sprint performed by a Physical Education student in competition. The table below shows the cumulative time, in the second column, for each 10 m interval of the 100 m sprint, listed in the first column.

Distance interval	Cumulative time	Time for distance interval	Average velocity	Average acceleration
0–10 m	1.72 s			
10–20 m	3.16 s			
20–30 m	4.49 s			
30–40 m	5.76 s			
40–50 m	6.98 s			
50–60 m	8.14 s			
60–70 m	9.38 s			
70–80 m	10.72 s			
80–90 m	12.08 s			
90–100 m	13.41 s			

2. Complete the steps below.

   a. Column 3: Calculate the time taken to sprint each 10 m distance interval by subtracting the previous cumulative time. For example, if the time taken from 0–40 m was 9.9 seconds and from 0–30 m was 7.8 seconds, the time taken for the distance interval 30–40 m was 2.1 seconds.

   b. Column 4: Calculate the average velocity (in metres per second) for each distance interval using the formula:

$$v = \frac{d}{t}$$

   For example, if the time taken for the distance interval 30–40 m was 1.5 seconds, the average velocity is 10 m ÷ 1.5 seconds = 6.67 m/s.

   c. Column 5: Calculate the average acceleration for each interval by dividing the change in velocity (velocity for the interval – velocity for the previous interval) by the time taken for the interval.

$$a = \frac{v_2 - v_1}{t}$$

   For example, if the velocity for the interval 0–10 m was 5 m/s (10 m in 2 seconds), the average acceleration for the interval is:

   (5 m/s – 0 m/s) ÷ 2 = 2.5 m/s/s.

   If the velocity for the interval 10–20 m was 5.21 m/s (10 m in 1.92 seconds), the average acceleration for the interval is:

   (5.21 m/s – 5 m/s) ÷ 1.92 = 0.11 m/s/s (which represents an increase in velocity, i.e. acceleration).

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

3. Using this data, create a line graph of velocity against each interval of the 100 m sprint.
4. At what distance in a 100 m sprint does research recommend that elite sprinters reach top velocity? How did the subject of this data compare to this recommendation?
5. Based on the subject's 100 m sprint data, what are the possible training implications for planning training activities for this athlete? Consider the implications of the rate of acceleration and speed maintenance in this performance. What training activities do you recommend based on this analysis?
6. You may consider collecting this data for yourself and each member of your class and calculating class average top velocities as a point of comparison.
7. You may also consider using a spreadsheet to do the calculations and create a chart (graph) for the data. It could be interesting to research the 10 m split-time data for an elite sprinter and plot this graphically against your data as another point of comparison.

6.4 Principles governing the application of muscular force

The relationship between muscular force and the motion it causes can be described and predicted using a number of the laws and principles of physics. This section outlines the general principles governing the application of muscular force. Coaches and performers can apply these principles in order to refine performance techniques rather than relying just on copying the technique of champion performers or refining performances through trial and error.

Newton's laws of motion

Sir Isaac Newton (1642–1727) is credited with many important developments in science and mathematics. Among his achievements was the development of three **laws of motion**, which define the relationships between force and motion.

Newton's laws of motion three laws that define the relationship between force and motion

Newton's first law of motion: The law of inertia

Newton's first law of motion (the law of inertia) states that a body will continue in its state of rest or constant velocity in a straight line unless it is acted upon by an external force. In other words, an object will not move or change the way it is moving until a force causes it to do so. Forces may cause an object to speed up, slow down, change shape, change direction or start to rotate. In a simple example, a golf ball will remain stationary on a tee until it is struck by a club. This tendency to remain at rest or in the same state of motion is known as *inertia*, which can be considered as an object's resistance to changing its state of motion. Inertia is sometimes difficult to realise because of the effects of the force of gravity and of air resistance. An example can be seen in the slinging of a discus. The discus will not move until the muscles of the thrower provide a force to start its motion. After the discus is slung, it does not remain in the same motion because

ISBN 978-1-009-31125-0

the force of gravity acts to pull it to the ground and air resistance acts to slow it down. The law of inertia could be well illustrated in deep space where, with low gravitational force and no air resistance to overcome the inertia of an object after it has been set in motion, it will continue in the same direction at the same velocity.

The amount of inertia that an object possesses is determined only by its *mass*. The more mass an object has, the more inertia it has, and the larger the force that will be required to change its state of motion. Figure 6.8 shows a rugby scrum about to pack. If the combined mass of the players on the left is 900 kg, as opposed to a 700 kg opposition, the heavier pack – because it possesses more inertia – will be more difficult to move. In all situations in physical activity where athletes attempt to change the motion of an object (including their body), inertia must be overcome in order to cause such a change.

FIGURE 6.8 In a Rugby Union scrum, both teams attempt to overcome the inertia of the opposition.

Newton's second law of motion: The law of acceleration

How quickly an object will speed up or slow down (accelerate) depends on two factors: the size of the force acting to overcome the object's inertia and the mass of the object. Newton's second law of motion (the law of force, mass and acceleration) tells us that the acceleration of an object will increase if the amount of force that is applied to it is increased. In other words, a larger force will cause greater acceleration than a smaller force. For example, the shot-putter who can produce the most muscular force will be able to speed up the shot more quickly and should (depending on direction and line of action) therefore put the shot further than other competitors. Furthermore, Newton's second law of motion also tells us that if the mass of an object is increased, the acceleration caused by the same force will decrease. Objects with a larger mass require more force to accelerate them at the same rate as lighter objects. If the same force is applied, a 4 kg shot will accelerate more rapidly than a 5.3 kg shot and, if the direction and line of action of the force is the same, will go further.

The second law of motion gives us the relationship between the mass of an object, the force applied to it and the resulting rate of acceleration, represented by the formula:

$$F = ma$$

where F is the force applied in newtons, m is the mass of the object in kilograms, and a is acceleration in metres per second per second. To accelerate a 4 kg shot-put at 20 m/s/s requires a force of 80 N ($4 \times 20 = 80$ newtons). A sprinter on a weights program to improve leg strength may increase the amount of force they can apply to the ground, which would increase their acceleration; however, if the weights program also caused an increase in body mass, some of the gains in force would be used in accelerating the newly acquired body mass.

Newton's third law of motion: The law of action–reaction

Newton's third law of motion (the law of action–reaction) states that for every action there is an equal and opposite reaction. For every force applied by one body on another, there is an equal force acting in the opposite direction, applied by the second object on the first. In a simple example, a long-jumper applies downward force onto the ground, i.e. the Earth, which in turn applies an equal force upwards, propelling the jumper into the air. Figure 6.9 shows the equal and opposite forces involved in the take-off in long-jump. Because of the large mass of the Earth compared with the jumper, there is no perceptible movement of the Earth caused by the jumper's force on it.

The presence of equal and opposite forces in more complicated movements, involving a number of forces acting simultaneously – such as a twisting somersault dive – becomes more difficult to analyse.

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 6.9 Newton's third law: The downward action force produced by the long-jumper's leg muscles on the Earth, shown by the red arrow, results in an upward reaction force by the Earth on the jumper, shown by the blue arrow, that is equal in magnitude and opposite in direction.

CHECK-IN 6.3

1. For each of Newton's laws, list three specific movement sequences from various sports that nicely illustrate the principle.
2. It has been determined that, in his world record run, Usain Bolt applied a pushing force of 817 N to the blocks at the start. He weighs 94 kg. Calculate his acceleration as he left the blocks.
3. Discuss the application of each of Newton's laws with movement sequences specific to the physical activity that is the focus of your study this term.

Momentum and force application

Momentum is considered to be a measure of the amount of motion possessed by an object in motion. The momentum of an object in linear motion is calculated by multiplying an object's velocity by its mass. The letter p is used to represent momentum.

$$\text{momentum} = \text{mass} \times \text{velocity}$$

or, in abbreviated form

$$p = mv$$

momentum the amount of motion, calculated as mass times velocity, possessed by an object

The linear momentum of a moving object can be changed by altering either its mass or its velocity. In most physical activities, it is more common that mass remains constant and velocity is altered. If the velocity of an object is increased, there will be a proportionate rise in momentum (if velocity is increased by 10 per cent, momentum will increase by 10 per cent).

FIGURE 6.10 Sumo wrestlers attempt to build both body mass and velocity in order to increase their momentum.

The inertia of an object is related to its mass, and its momentum is its mass multiplied by its velocity, so momentum is related to inertia and velocity. If two objects of the same mass are travelling at different velocities, the faster object will possess the greater momentum and will require more force to stop. For example, long-jumpers attempt to increase the speed of the run-up, thus increasing their momentum and lengthening their jump. Conversely, if two objects are travelling at the same velocity, but are of different masses, the heavier object will possess the greater momentum and will require more force to stop. For example, it is harder to catch a cricket ball than a tennis ball travelling at the same velocity.

When objects collide, momentum is transferred between them. The principle of conservation of momentum means that the total momentum of the objects before and after the collision remains the same. This means that when bat strikes a ball, there is a transfer of momentum via the forces between them, whereby the bat slows and the ball accelerates.

A heavier cricket bat will produce more momentum, thus hitting the ball further, provided the batter can apply enough muscular force to swing the heavier bat at the same velocity. If the batter does not maintain the same swing velocity because they chose a bat that is too heavy, their swing will be late – particularly in response to faster bowlers. Conversely, batters using a bat that is too light may be tempted to swing too fast, causing problems with accuracy and timing. The distribution of the mass of a striking implement (whether it is heavier at one end or the mass is equally distributed along its length) will also have an effect on building momentum.

ISBN 978-1-009-31125-0 Stewart et al.

Momentum and Newton's second law of motion

In many physical activities, athletes attempt to build the largest amount of momentum that is possible (without the loss of accuracy or timing). In order to achieve this, force must be applied over the longest possible time. In fact, the greater the amount of time for which a force is applied, the greater will be the final velocity of the object to which the force is applied. On the other hand, in absorbing force, such as catching a hard ball or landing after a somersault in gymnastics, force must be absorbed over the longest possible time in order to lessen the impact and avoid possible injury. The application of force over a given time is known as *impulse*, which is the product of the force applied (F newtons) and the time over which the force is applied (t seconds) so impulse equals Ft, with units of newton-seconds (Ns). A force of 100 N acting for two seconds (200 Ns) on an object will produce the same final velocity as a force of 200 N acting for one second (200 Ns) on the same object.

By substitution of a (acceleration) into the $F = ma$ equation (Newton's second law of motion), and rearranging, it can be demonstrated that impulse is proportional to the change in an object's momentum – that is, if the impulse applied to an object is increased, the object's momentum will be increased. The mathematics of this rearrangement are shown below. The Greek letter delta (Δ) is used to represent 'change in'. Starting with:

$$F = ma$$

because acceleration is change in velocity over time, we can substitute for a to get:

$$F = \frac{m\Delta v}{t}$$

This can then be rearranged to

$$Ft = \Delta mv$$

and, as Ft represents impulse and mv represents momentum, impulse is equal to change in momentum.

This is known as the impulse–momentum relationship, where changes in an object's momentum are equal to the impulse (force × time) applied to it.

This relationship has a number of implications for athletes who wish to increase (or decrease) the momentum of their own body or an object. In order to increase the momentum of a body, the performer must increase the amount of force applied or increase the time over which the force is applied, or increase both, or increase one while sacrificing a small decrease in the other. In any attempts to increase momentum, coaches and athletes must also analyse the effects of increases in impulse on losses in timing and accuracy.

CHECK-IN 6.4

1. Consider the actions of throwing a javelin and pitching a fast ball in softball. In both these actions, the objective is to accelerate an object to the maximum possible velocity on release. Discuss the following questions with regard to producing maximum velocity in these actions.
   a. What aspects of the technical performance of these actions ensure that force is applied over the longest possible time (without suffering losses in timing or accuracy)?
   b. How important is building the momentum of the object prior to the release of the object?
   c. What does Newton's third law of motion imply for the production of maximum acceleration?
2. What specific training techniques help produce maximum acceleration and velocity?
3. Construct a list of sports where building momentum is important. In each case, consider what is done to apply force over the longest period.
4. Increasing the mass of a striking implement such as a baseball bat could result in transferring more momentum to the ball when it is struck. What factors limit the success of merely using a heavier implement to transfer more momentum to an object?

ISBN 978-1-009-31125-0 Stewart et al.

Summation of forces

> **summation of forces** the total resultant force produced by the coordinated actions of a group of muscles contracting together or in sequence

Almost all muscular force applied during physical activity occurs as a result of the coordinated action of many muscle groups. The resultant force is the sum of smaller forces applied by individual muscle groups (**summation of forces**). When a muscular force is applied with the intention of producing a maximum effort, such as in a javelin throw, each individual muscle group must begin to move at the instant that the previous muscle group is moving at maximum velocity. The release velocity of a javelin, for instance, will be at the velocity of the last body part in contact – in this case, the thrower's hand. With each muscle group beginning its action at the point of maximum velocity of the previous group, a maximum total force is achieved. Figure 6.11 uses shot-putting to illustrate how timing the beginning of the action of each muscle group to coincide with maximum velocity of the previous group achieves maximum total force.

If each muscle group contracts too early (as is common in over-anxious athletes) or too late (as is common with athletes who are fatigued or beginners learning a new skill), the total summation of forces will be reduced. Sometimes athletes, in an attempt to apply maximum force, contract each muscle group too early and mistime the action. For instance, trying to hit a forehand tennis shot with maximum force may result in the ball being hit inaccurately – a fault particularly common in beginners.

Physical activities that require the production of maximum force often involve as many muscle groups as possible in an attempt to sum the largest possible force. A baseball pitch begins with the action of the legs and trunk, followed by the shoulder and elbow, and finally the wrist and fingers. Most actions requiring maximum velocity are initiated by the larger, stronger muscles, such as the muscles of the trunk and thighs, in order to overcome inertia. After the movement has been initiated by these slower muscles, the weaker but faster muscles of the limbs complete the action. In some physical activities, the total action of all muscle groups from the stronger, slower muscles to the weaker, faster muscles occurs in such rapid succession that it is almost simultaneous. This explosive action of groups of muscles is evident in activities where maximum velocity is required in a short space of time, such as a chest pass in netball or hitting a baseball.

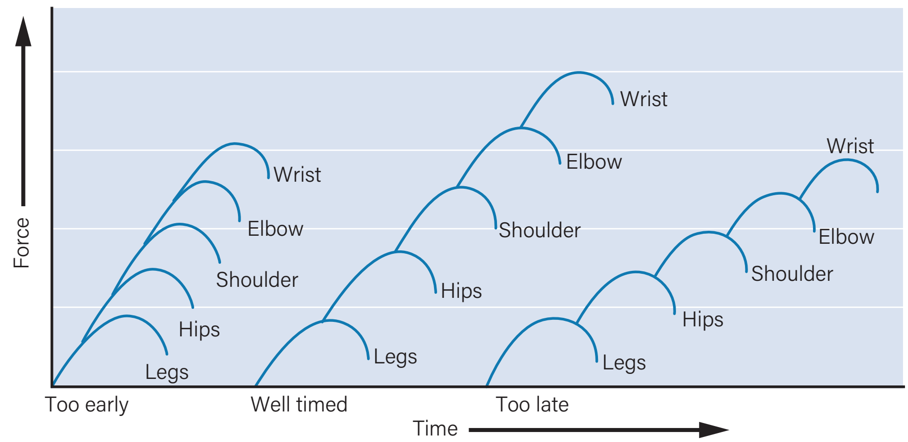


FIGURE 6.11 The effect of timing on gaining the maximum summation of force applied by the muscles involved in shot-putting

> KEY MESSAGE
> Newton's three laws of motion govern the movement of objects in relation to forces applied to them. They also govern the motion of objects to which a force is not being applied.

> KEY MESSAGE
> Momentum is a measure of the amount of motion possessed by an object and can be transferred from one object to another.

> KEY MESSAGE
> Most muscular actions in physical activities involve the summation of the force applied by a number of muscle groups acting together or in sequence.

ISBN 978-1-009-31125-0

ENGAGE 6.2

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: How do forces sum to produce maximum velocity of a thrown implement?

Demonstrate and apply

1. In a table similar to the one below, collect data regarding the throwing distance achieved from three different throwing positions.
2. Choose one of more students in your class as subjects to complete the throwing trials. Each subject completes three trials, trying to throw a tennis ball as far as possible, from three throwing positions:
   - standing with the back against a solid wall, no step
   - kneeling
   - standing side on, taking one step into the throw.
3. For each subject, calculate the average throwing distance achieved from each throwing position.

Subject	Against wall			Kneeling			Standing side-on		
	Trial 1	**Trial 2**	**Trial 3**	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 1**	**Trial 2**	**Trial 3**
	Average:			Average:			Average:		
	Trial 1	**Trial 2**	**Trial 3**	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 1**	**Trial 2**	**Trial 3**
	Average:			Average:			Average:		
	Trial 1	**Trial 2**	**Trial 3**	**Trial 1**	**Trial 2**	**Trial 3**	**Trial 1**	**Trial 2**	**Trial 3**
	Average:			Average:			Average:		

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

4. Consider the following questions.
   a. Which throwing position produced the highest average distance for each subject?
   b. Which position produced the lowest average distance for each subject?
   c. What were the factors that limited throwing distance in each of the positions that produced the lowest two results?
   d. Explain why the throwing position that produced the highest average distance allowed forces to be summed with consideration to timing and impulse.

ISBN 978-1-009-31125-0 Stewart et al.

Body levers

Muscular force is applied to the bones of the skeleton, which form a system of **levers**. The bones, acting as body levers, are examples of simple machines that can change the way a force is applied. For example, a golf ball can be moved much further by using the leverage provided by a golf club than by throwing it. The golf club acts as a lever. A lever is a rigid structure that rotates about an axis, to which a force can be applied and which then applies a force to an object. In the human body, the bones are used as the rigid arm of the lever, rotating at the joints. Muscular force (effort) is applied to the bones which then apply a load force in order to move a load such as a shot-put or merely the mass of the body itself. The components of a lever system are shown in Figure 6.12, and consist of:

- a *lever arm* such as a metal bar, also just called the 'lever'
- a *fulcrum or pivot point* – the point or axis of rotation of the lever (provided by a joint in the body)
- an *effort point* – the point on the lever where effort (or force) is applied (provided by muscles in the human body)
- a *load point* – the point on the lever where a load is located, where the lever applies a force to it, and where its gravitational force (or other resistance force) acts on the lever; also called the resistance point
- an *effort arm* – the distance from the effort point to the fulcrum
- a *load arm* – the distance from the load point to the fulcrum, also called the resistance arm.

lever a simple machine consisting of a rigid arm, a fulcrum (pivot point), an effort point and a load point

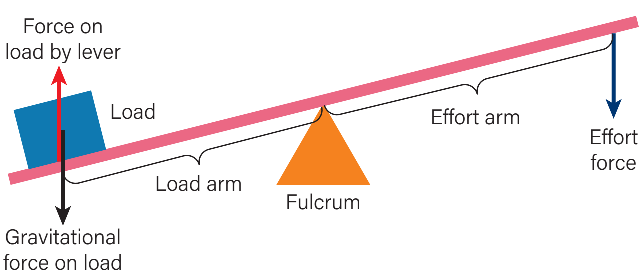


FIGURE 6.12 The parts of a lever system, where the arrows represent forces and the lever arm is shown as the pink bar. Not shown here is the gravitational force on the load, which opposes the load force.

In figure 6.12 the lever is being used to overcome the gravitational force on the load – this is also called the resistance force. For the load to move, the force on it by the lever must exceed the gravitational force. Other types of forces may resist the force applied by the lever, such as the force of friction. In sports science, the resistance force may be the focus, and the force applied by the lever might not be shown in diagrams.

There are three types or classes of lever, which are determined by the location of the effort point, load point and fulcrum on the lever arm. These three classes of lever can provide *mechanical advantage* through multiplying force or speed:

- A lever can increase the amount of load that can be moved, i.e. the amount of resistance force that can be overcome, becoming a *force multiplier*.
- A lever can increase the velocity at which the load can be moved, becoming a *speed multiplier*.

First-class levers

In a first-class lever, the fulcrum lies between the force point and the load point. A claw hammer and a pair of scissors are examples of this type of lever.

In a first-class lever, the position of the fulcrum in relation to the effort point and load point determines whether it provides the advantage of multiplying speed or multiplying force. If the effort arm (the distance from the effort point to the fulcrum) is longer than the load arm (the distance from the load point to the fulcrum), the lever acts as a force multiplier. Figure 6.13 shows the use of a claw hammer as a first-class lever, producing a force multiplier. The nail that cannot be moved by hand can be moved with the force-multiplying lever of the claw hammer. In this case the resistance force is provided mainly by friction.

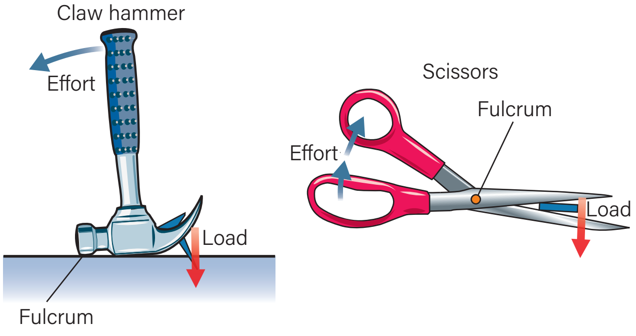


FIGURE 6.13 Examples of first-class levers – claw hammer and scissors

If the load arm of a first-class lever is longer than the effort arm, the lever acts as a speed multiplier. Figure 6.14 shows how oars in a sweep boat are used as first-class levers in producing a speed multiplier. The boat could not be moved at the same velocity by rowers using their own arms instead of the oars.

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 6.14 An oar is a lever with a load arm longer than the effort arm, so it acts as a speed multiplier.

In the human body, an example of a first-class lever can be found in the action of extending the forearm, such as when throwing a ball. Figure 6.15 shows elbow extension using the action of the triceps brachii as an example of a first-class lever. The load is provided by the mass of the ball and arm, and the effort is provided by the action of the triceps brachii. The fulcrum (the elbow joint) lies in between the effort point and the load point, but because the fulcrum is very close to the effort point, the load arm is much longer. This first-class lever will therefore act as a speed multiplier.

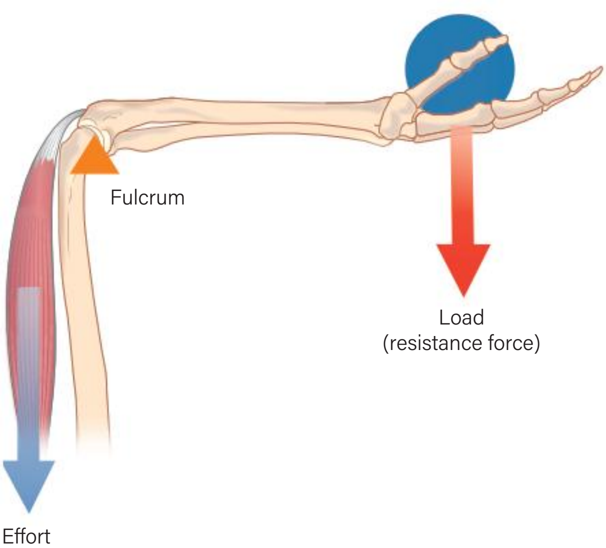


FIGURE 6.15 A first-class lever is seen in the action of the triceps brachii producing extension of the elbow. Note that the load arrow is the resistance force; the force of the hand on the ball is not shown.

Second-class levers

In a second-class lever, the effort point lies in between the fulcrum and the resistance point. A bottle opener and a nutcracker are examples of this type of lever.

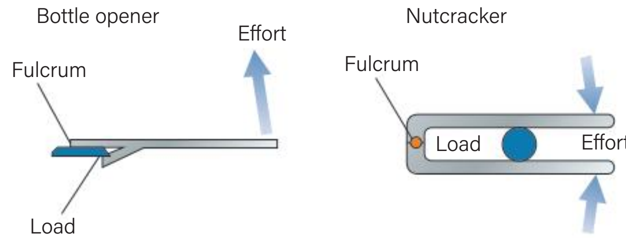


FIGURE 6.16 Examples of second-class levers

Because of the arrangement of a second-class lever, the effort arm is always longer than the resistance arm, therefore producing a force-multiplying effect. Figure 6.17 shows how a wheelbarrow produces a force-multiplying effect, as the effort arm is significantly longer than the resistance arm. A load that could not easily be lifted by hand is easily raised in the wheelbarrow. Second-class levers are force multipliers.

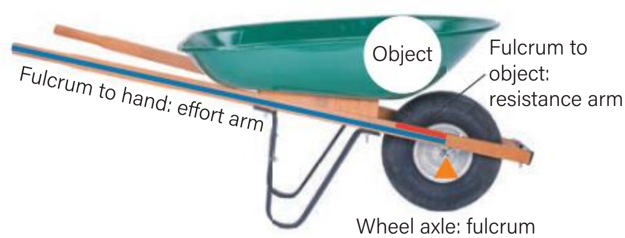


FIGURE 6.17 A wheelbarrow is a second-class lever and so acts as a force multiplier.

In the human body, an example of a second-class lever can be found in the action of the gastrocnemius (calf muscle) in raising the heel off the ground. The ball of the foot acts as the fulcrum, the resistance is provided by the weight of the body and the force is provided by the gastrocnemius acting on the heel. The effort arm is longer than the resistance arm, therefore producing a force multiplier.

FIGURE 6.18 Raising the heel off the ground demonstrates a second-class lever.

ISBN 978-1-009-31125-0 Stewart et al.

Third-class levers

In a third-class lever, the effort point is in between the fulcrum and the load point. A baseball bat and a fishing rod are examples of third-class levers.

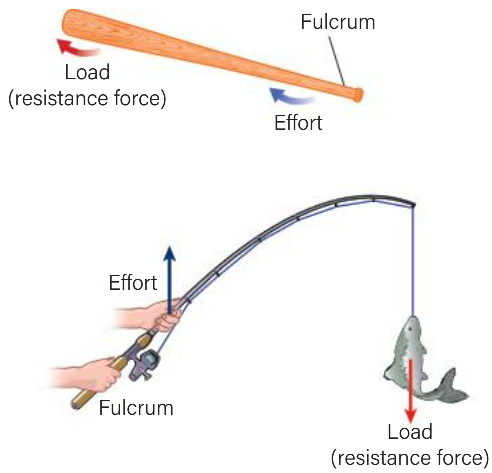


FIGURE 6.19 Examples of third-class levers

Because of the arrangement of a third-class lever, the resistance arm is always longer than the effort arm, therefore the lever acts as a speed multiplier. With a long resistance arm, a fishing rod is used to produce a speed advantage. A small upwards movement of the 'effort' hand in the diagram above yanks the fish quickly up by a greater distance, out of the water. Another advantage of a rod is that the sinker could not be cast nearly as far throwing it by hand. Third-class levers are speed multipliers.

In the human body, third-class levers are by far the most common. An example of a third-class lever acting in the body is the action of the quadriceps in kicking a ball. The knee joint acts as the fulcrum, force is provided by the quadriceps acting on the top of the tibia, and the load is the mass of the lower leg and the ball (see Figure 6.20). The resistance arm is longer than the effort arm, therefore the lever acts as a speed multiplier.

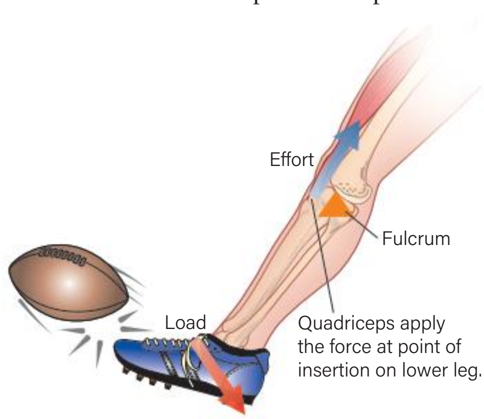


FIGURE 6.20 Kicking a ball demonstrates a third-class lever.

Leverage in physical activity

The human skeleton is made up predominantly of a series of third-class, speed-multiplying levers. Because the resistance arm is longer than the effort arm in third-class levers, the human body is quite efficient in the production of fast movements. The compromise is that the human body is less suited to lifting heavy weights — large amounts of muscular force are required to move heavy loads.

An example considering the whole human arm as one third-class lever shows how the muscular force (the effort) to lift heavy objects can be reduced. The fulcrum is at the shoulder joint and muscles in and around the shoulder attach to the humerus to apply the effort force. The resistance point is the hand, and so the resistance arm of the lever is the direct, straight-line distance from shoulder joint to the hand. If the arm is extended, the resistance arm is long, and the effort force must be great. If the elbow is flexed to bring the hand close to the shoulder, the resistance arm of the lever system is short and the muscular effort is less. So a weight-lifter's muscular effort in the shoulder can be reduced by lifting heavy objects as close as possible to the midline of the body.

In situations where maximum speed is required, such as throwing a fast ball, it is also helpful to consider the human arm as one lever. A throwing action is initiated with a short resistance arm, which is lengthened progressively during the action. In the case of pitching a baseball, the action begins with the elbow bent, thus shortening the resistance arm and allowing the inertia of the arm and the ball to be overcome with more force, and therefore greater acceleration. As the throwing action progresses, the elbow is extended, lengthening the resistance arm and allowing greater speed to be produced. Considering the forearm as a separate lever then shows how the effort force of the triceps brachii (Figure 6.15) can add to the speed of the pitched ball.

The resistance arm in many striking sports is lengthened by the use of a bat or racquet. The longer the implement, the greater will be the velocity of the hit. A longer golf club will, in theory, hit a ball further than a shorter club. However, as the length of the resistance arm of a lever system increases, so does the amount of force required to accelerate it. If a golfer progressively used longer and longer clubs, a point would be reached where the golfer could not generate the force required to accelerate the club effectively. This would result in losses in both the distance and accuracy of the shot. The selection of the length of a striking implement must be matched by the player's ability to produce the force required to accelerate the longer lever (and also possibly the larger mass). Stronger players can obviously choose longer and larger striking implements. This discussion also

ISBN 978-1-009-31125-0 Stewart et al.

illustrates the role that strength training can play in producing maximum velocity.

In situations where accuracy is of great concern, often the resistance arm is reduced in length, producing a more controllable hit. Examples of this principle can be seen in a range of physical activities. In playing a forehand volley in tennis, for instance, players often shorten the resistance arm of the lever by bringing the elbow closer to the body, creating greater control. Wedge clubs in golf are shorter than those used for gaining distance, and players sometimes move their hands lower down the grip to gain even more control over the shot.

KEY MESSAGE

Bones act as levers in producing actions in physical activity.

KEY MESSAGE

Levers in the body provide a mechanical advantage by acting as speed multipliers or force multipliers.

ENGAGE 6.3

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: How do body levers act to give a speed or force advantage when producing movement?

Demonstrate and apply

1. Choose an action or series of actions associated with the physical activity that has been your current focus – for example, kicking a drop kick in Rugby League. Analyse the action in terms of the class (or classes) of body lever that act as speed or force multipliers. In order to do this, you may collect performance footage of the movement sequence during class.

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

2. Analyse the footage by doing the following.
   a. Divide the action into any distinct phases or subroutines that occur in producing it. This may be helped by finding secondary sources that demonstrate the sequence breakdown. In the example of the drop kick, the kicking leg is first bent backwards at the hip while the knee is flexed, then swung forward at the hip, and finally extended at the knee with the ankle plantar flexed to contact the ball.
   b. Determine the joints that enable each individual action in each phase.
   c. For each action, determine the relative length of the effort arm (the distance from the effort point — the insertion of the muscle producing the force to the moving joint that acts as the fulcrum) and the resistance arm (the distance from the load point to the joint). The load in many actions may be the mass of a body segment being moved, in which case the load point is the centre of gravity of a limb (such as the whole arm) or a part of a limb (such as the forearm).
3. Determine the class of lever by locating the positions of the fulcrum, effort point and load point.
4. Consider the following questions.
   a. Do the relative lengths of the force and resistance arms change during the total action?
   b. Is there more than one class of lever operating?
   c. How does this leverage arrangement advantage the performance of the action?
   d. How could this information be useful to coaches or to you as a Physical Education student?

ISBN 978-1-009-31125-0 Stewart et al.

6.5 Human motion in physical activity

Human motion is produced by the interplay of the internal force of muscles contracting and pulling on the skeleton and external forces such as collisions, pushes, pulls, gravity and friction. Because muscles apply force to the skeleton, which moves at the joints between the bones, the resulting motion of body parts is, for the most part, angular motion. This angular motion can then be translated into linear motion of the whole body or an object set in projectile motion by the body. This section examines some of the principles involved in the application of force in producing human motion in physical activity.

Stability and balance

Balance is the ability – whether moving or stationary – to remain in a stable position. Balance plays an important role in almost all physical activities. Some activities require the performer to remain stationary, such as in archery or trap shooting. This is known as **static balance**. Sports such as basketball and hockey require **dynamic balance** where the performer has to remain balanced while moving. Both static and dynamic balance may involve the absorption of external force, such as in contact sports like wrestling or soccer.

A person's stability is determined by the position of their **centre of gravity** in relation to their base of support, and the direction of internal and external forces that are acting on their body. The following principles can be applied to increase a performer's stability in physical activities.

- To achieve static balance, the centre of gravity should be held directly over the base of support, so that the weight force (which is always vertical) is directed towards it. The base of support is defined as the area between the points of contact with the ground. When the vertical line through the centre of gravity is moved outside the area of the base of support, the performer becomes unstable, because their weight force is not directed at the base of support and will cause the body to rotate towards the ground.
- When a static balance is required in a sport like judo, the centre of gravity is kept centred over the base of support, making it more difficult for the body to be unbalanced by the opponent. When a performer needs to maintain balance while being acted on by external force, such as in a rugby tackle, balance is improved by moving the centre of gravity towards the oncoming force and lengthening the base of support. In some activities, the centre of gravity is deliberately moved towards the edge of the base of support, creating a more dynamic position in preparation for movement. Sprinters, for instance, move their centre of gravity forward in the set position in order to assist their start.
- A more stable position is achieved by increasing the size of the base of support. A wrestler is more difficult to unbalance while on their hands and knees than while standing. Target sports, such as pistol shooting, require a stable but comfortable position. This is achieved by widening the base of support by positioning the feet about shoulder-width apart. In activities that require quick movement from a stable position, such as receiving a tennis serve, the base of support is again comfortably widened, but weight is distributed on the balls of the feet with the knees slightly flexed. In

balance the ability to remain in a stable position, whether moving or stationary

static balance the ability to maintain a stationary balanced position

dynamic balance the ability to maintain balance while moving

centre of gravity the point from which the weight of an object may be considered to act

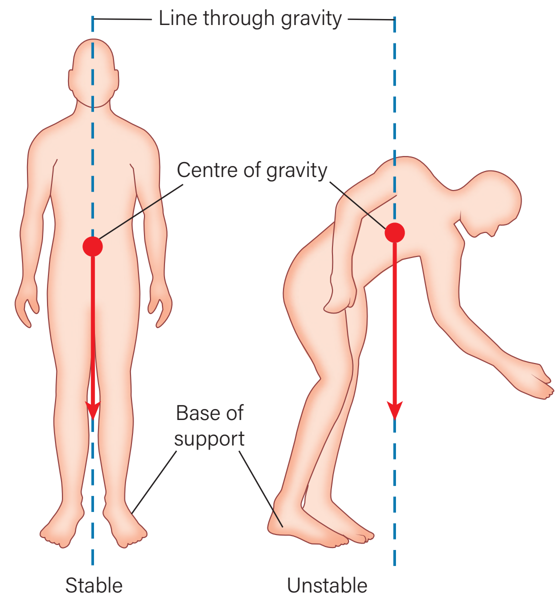


FIGURE 6.21 As the line of the centre of gravity is moved outside the base of support, the gravitational force on the body (red arrows) is no longer directed at the base, so stability is reduced.

ISBN 978-1-009-31125-0 Stewart et al.

preparation to move, performers often 'unweight' into a ready position by extending the knees and slightly raising the centre of gravity. This position is slightly less stable but allows for quick movement into another position. The amount of friction between the supporting surface and the body's base of support will also affect stability. In some activities, sport shoes – such as sprinter's spikes – are designed to increase friction and therefore increase stability. In other activities, shoes are designed to reduce friction to allow more dynamic balances – such as ice skates or tenpin bowling shoes.

- Lowering the centre of gravity towards the base of support increases stability. After rebounding in basketball, players often widen their base of support and lower their centre of gravity to achieve a stable position and ensure ball retention.
- If a part of the body or piece of equipment is moved away from the base of support, stability is reduced. This movement causes the centre of gravity to move away from the centre of the base of support in the same direction. Moving another body part in the opposite direction can compensate, leaving the centre of gravity over the base of support.

FIGURE 6.22 To remain stable, the tenpin bowler extends the leg backwards to compensate for the movement of the arm and the bowling ball.

- Increases in body mass aid stability. Increases in mass cause an increase in inertia and greater forces are required to cause movement. This principle is used to great effect in sumo wrestling. In other contact sports where stability is important, such as Rugby League, increases in body mass must be balanced with requirements for agility and speed. When an external mass is added to the body – for example, picking up a shot-put in preparation to throw – the centre of gravity moves towards the added mass. In the case of the shot-putter, the opposite arm is positioned to compensate as well as lowering the centre of gravity in preparation for the put.

In many situations in physical activities, these principles are used in various combinations to produce the particular type of balance required, or are used to unbalance the opposition. Where dynamic balance is required, good footwork allows the performer to be in the correct balanced position to be able to efficiently apply or absorb force.

KEY MESSAGE

Stability is determined by the position of a person's centre of gravity in relation to their base of support and motion.

CHECK-IN 6.5

1. What actions can be taken by a player in a contact sport to maintain stability during contact?
2. Using an example from the physical activity you are currently studying, explain how stability is achieved and why this is important for the success of your performance.

6.6 Projectile motion in physical activity

An object that is propelled into the air is known as a **projectile**. Many physical activities involve applying force to an object in order to propel a projectile. Once in the air, the path the object takes will be determined by the direction and size of the force that propelled it, the effect of gravity and the effect of lift and drag forces caused by the air. The flight path of an object propelled into the air is called **projectile motion**. Some examples in physical activities are a tennis ball that has been struck by a racquet, a discus thrown by an athlete or the human body itself while high jumping. This section examines some of the principles involved in producing projectile motion in physical activity.

projectile an object that is propelled into the air

projectile motion the flight path of an object propelled into the air

ISBN 978-1-009-31125-0 Stewart et al.

Projectile motion

When an object (which could be the human body) is propelled into the air, the shape of the flight path (or trajectory) it will follow is described as a parabola, if air resistance and lift forces are negligible. This motion is best explained by separately examining the horizontal and vertical components of an object's motion. Consider the motion of a cricket ball that is hit in the air and over the boundary rope for six runs. Vertically, the ball, under the influence of gravity, will lose vertical velocity to a point where it reaches maximum height. At this point, it will begin to fall towards the ground, increasing its velocity until it hits the ground. Horizontally, the ball, influenced by its inertia at the point of being struck, will continue at close to the same velocity until hitting the ground, where the force of friction acts upon it to stop its motion.

The distance covered by an object in flight will be determined by a number of factors that occur at the point of release (or the point of being struck). These are the relative height of the point of release, the relative height of the point of landing, the angle of release, any aerodynamic lift forces due to its shape or spin, drag forces due to air resistance and the velocity of the object at the point of release.

- The higher an object is released above the ground, the further it will travel. Taller athletes in field events hold a slight advantage over shorter athletes.
- If the objective of an activity is to gain maximum distance of a projectile, such as in long jump or javelin, the object must be released at an angle to the horizontal that will give the maximum horizontal distance. This angle is known as the *optimum angle of release*. In an environment without air, where the flight of an object is not influenced by air resistance or lift forces, the optimum angle of release is 45 degrees. In reality, optimum release angles are generally less than 45 degrees, due to air resistance, optimum joint angles to produce maximum muscular force, lift forces and the release point above the ground. Table 6.3 lists the optimum angle of release used in throwing events.

TABLE 6.3 Optimum angles of release in throwing events

Throwing event	Optimum angle of release	Influence of air resistance and lift forces
Shot-put	35–40°	Little influence
Hammer	45°	Little influence
Discus	30–40°	Good technique utilises lift force to advantage
Javelin	28–35°	Good technique utilises lift force to advantage

- If the height of the release point is not at the same level as the landing point, as is often the case while playing golf, angles of release will have to be varied to produce the best result.
- The higher the velocity of an object at the point of release, the more momentum it will possess, and therefore the further it will travel. Athletes must

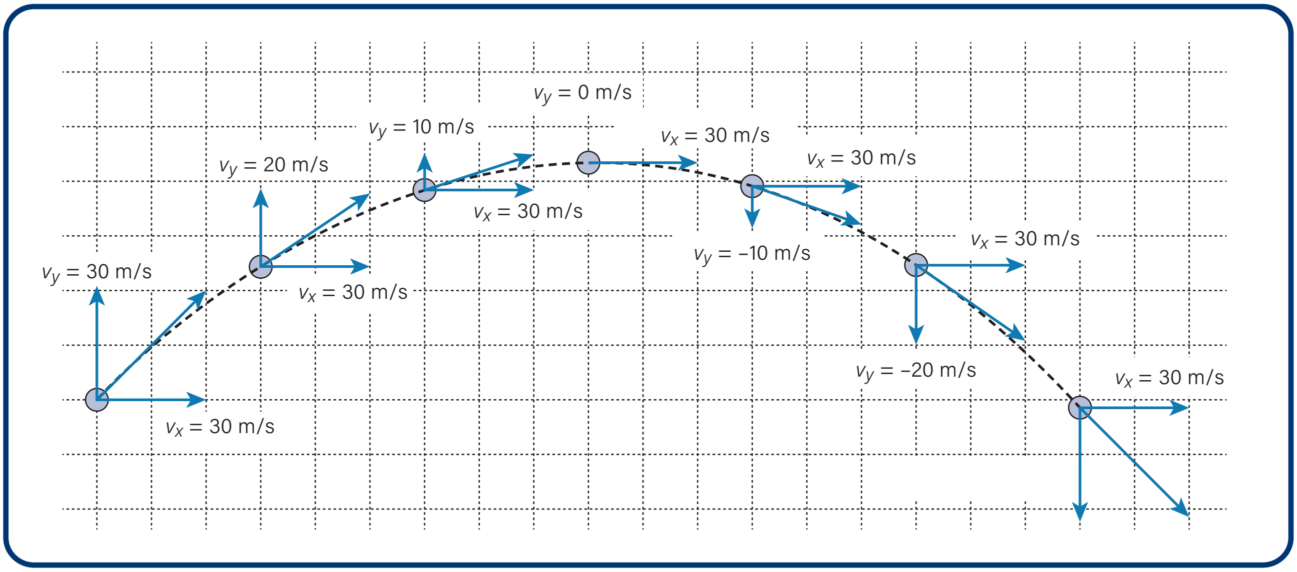


FIGURE 6.23 The vertical and horizontal components of projectile motion

ISBN 978-1-009-31125-0 Stewart et al.

ensure, however, that good technique is maintained in the attempt to produce maximum velocity. In many activities, a low angle of release is required in order to reduce the time that the projectile remains in the air rather than attempting to gain maximum distance. A netball pass, for instance, has less chance of being intercepted by the opposition if its trajectory is low and fast. If a lower angle of release is required, release velocity must be increased to ensure that the object travels the distance to the intended target.

CHECK-IN 6.6

1. Consider examples of physical activities that involve projectile motion of an object. How do the principles that govern the application of force (discussed in detail earlier in this chapter) impact on producing the desired trajectory?
2. Consider an example of a physical activity that involves the projectile motion of the human body itself. What actions are performed in this activity to ensure that the desired motion is achieved?

Drag and lift forces

The velocity of a projectile may be influenced by air resistance. When an object moves through the air, friction between the air and the object causes drag forces, which will slow the object down. The amount of friction is influenced by the frontal area and the shape of an object as it moves through the air. A more streamlined shape produces less friction with the air, and therefore less drag. The effect of air resistance on a well-thrown javelin is very small compared with the air resistance acting on a shuttle. Drag forces produced by air resistance may influence the shape of the trajectory of some objects. Figure 6.24 shows the effect of air resistance on the trajectory of a shuttle in a defensive clear shot. As air resistance is high due to the shuttle's feathers and its mass is low, even when hit hard, the air resistance causes it to slow down quickly.

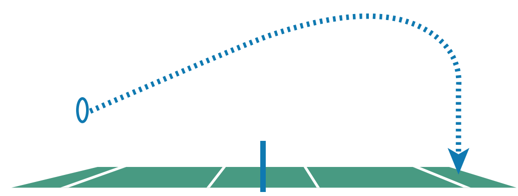


FIGURE 6.24 The effect of high air resistance on the trajectory of a shuttle

The trajectory of an object may also be influenced by lift force. The shapes of some objects as they move through the air cause the air to move faster over the object than underneath it. This results in an area of low pressure above the object, causing a lift force. This phenomenon is known as **Bernoulli's principle**. It is named after Daniel Bernoulli, who first described the variations in pressure that occur when fluids flow over various surfaces. A discus in flight provides a good example. When thrown at a slight angle to the horizontal, as illustrated in Figure 6.25, the discus produces a lift force that will resist the force of gravity and extend the distance of the throw. If the discus was thrown with poor technique, such as in a tumbling motion, no lift force would be generated, air resistance would be increased and the total distance

Bernoulli's principle the trajectory of an object moving through a fluid may be influenced by lift or Magnus forces

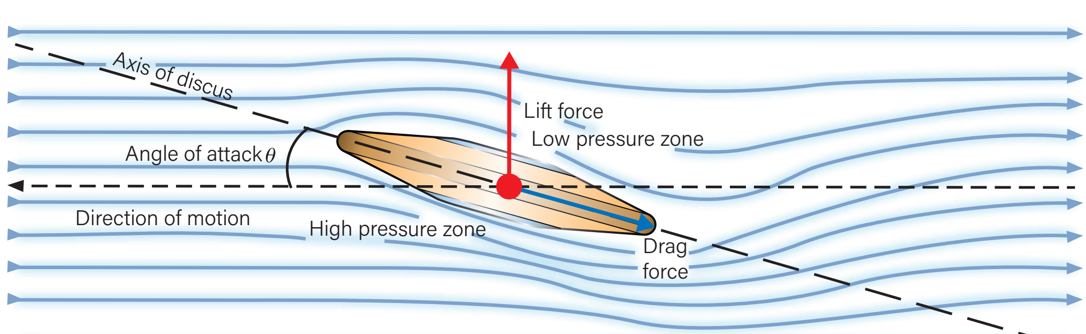


FIGURE 6.25 A well-thrown discus tilts upwards as it meets the air at an angle called the *angle of attack*. The air flow over the top surface is faster and creates a low pressure zone. The air flow under the bottom surface is slower and creates a high pressure zone. This pushes the discus up (the lift force). This is Bernoulli's principle.

ISBN 978-1-009-31125-0 Stewart et al.

covered would be reduced. Correct technique in taking advantage of lift force and reducing drag is very important in events such as discus and javelin.

The effect of spin on projectiles

Another application of Bernoulli's principle, regarding changes in pressure that occur as objects move through a fluid, involves objects that are spinning. If an object is spinning as it moves through the air, the spinning motion will produce forces that may alter the object's flight path. Topspin will cause a ball to drop faster, sidespin will cause it to curve to one side and backspin will cause a ball to lift. This effect occurs because, as a ball spins while moving through the air, it creates a difference in air pressure on either side of the ball. The ball will be pushed towards the side with the lowest pressure. This force is also known as a **Magnus force** (or Magnus effect), which operates in the direction of the spin around the front of the ball as it travels. A ball with less mass will be more influenced by Magnus force. For instance, a spinning table tennis ball will move quite markedly, whereas the effect of Magnus force on a spinning shot-put is negligible. Figure 6.26 illustrates the production of Magnus force as a ball spins through the air.

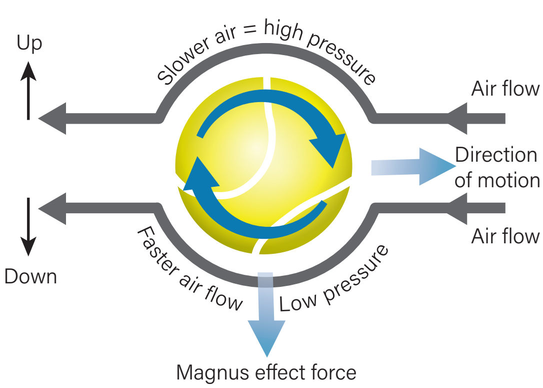


FIGURE 6.26 The production of Magnus force by a ball moving through the air while spinning with topspin as viewed from the side. A ball with topspin will dip down in its trajectory.

Spin is used to alter flight paths in many physical activities that involve a ball. A topspin shot in tennis causes the ball to drop, which lets the player to put more speed on the shot and still allow the ball to land in the court. Sidespin is used in activities such as baseball, cricket and table tennis to make the ball curve to one side and hopefully deceive the opposition player, forcing an error. In cricket, however, the ball 'swinging' or curving in the air occurs more as a result of the effect of drag forces that act on the stitching of the ball and over one side of the ball that has been rubbed to maintain a smoother surface than the other. In other activities, such as golf, players attempt to reduce sidespin to avoid 'hooking' or 'slicing' the ball (however, very skilled golfers can deliberately impart sidespin to guide the ball's flight past obstacles).

> **Magnus force** (or Magnus effect) when the pressure difference created on either side of an object moving through air or fluid causes the object to move towards the area of low pressure and away from the high-pressure area

Impact and rebound

When a spinning object bounces off a surface, the spin will have an effect on the angle at which the ball rebounds off that surface. The angle of rebound of a ball that is not spinning will in theory be equal to the angle at which it hit the surface. The rebound angle, however, is in reality affected by the friction between the ball and the surface it strikes, the hardness of the surface, how fast it is spinning and the elasticity of the ball.

When a ball strikes a surface with backspin, increased friction between the ball and the surface acts in the direction of the spin, causing an increase in the angle of rebound. Fast bowlers in cricket apply backspin to the ball, causing the ball to rise sharply when it hits the pitch.

When a ball with topspin strikes a surface, decreased friction between the ball and the surface acts in the direction of the spin, causing a reduction in the angle of rebound. This is evident in table tennis, as a ball with topspin will stay low after bouncing. This effect is not always obvious, as friction, drag and trajectory all affect the angle of rebound. For example, a topspin shot in tennis may bounce higher because the Magnus effect has caused the ball to drop sharply, increasing the angle at which the ball hits the court.

A ball with sidespin will cause the ball to rebound in the direction of the spin. The material from which a ball is made will contribute to the effect of spin on the angle of rebound. For example, if a spinning cricket ball lands on its stitches, friction between the ball and the pitch is increased and the angle of rebound will increase. In all cases, an increase in the angular velocity of the spin will result in greater deviations in the angle of rebound.

> KEY MESSAGE
>
> Projectiles follow a flight path or trajectory known as a parabola. Many factors can affect the trajectory of an object.

ISBN 978-1-009-31125-0

FIGURE 6.27 Backspin causes an increase in the angle of rebound. The lengths of the black arrows show the size of the friction force.

ENGAGE 6.4

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: What is the effect of various types of spin on the flight of a table tennis ball and what must players do to counter the effects of spin on the ball?

Demonstrate and apply

1. Using table tennis balls and bats, try applying variations in spin on the ball:
   a. topspin b. backspin (slice) c. sidespin.

Analyse and synthesise

KEY COGNITION

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

2. What is the effect on the flight path of the ball when various types of spin are applied? Redraw Figure 6.26 with the ball spinning in the opposite direction to represent the effect of backspin. Draw a second diagram to represent the effect of sidespin, showing the view of the ball from above.
3. What happens when a ball with heavy topspin strikes a vertical bat?
4. What must the receiving player do to counter the effect of topspin?

KEY MESSAGE

Drag and lift forces influence the trajectory of objects.

KEY MESSAGE

Bernoulli's principle explains lift and Magnus forces that affect the trajectory and rebound of objects.

6.7 Conducting qualitative biomechanical analyses

The following is a step-by-step guide to completing a qualitative biomechanical analysis. These steps can be applied to the specific biomechanical principles, discussed in detail in the previous sections of this chapter, that govern the production of particular specialised movement sequences with a view to improving movement efficiency, accuracy, consistency and/or speed.

ISBN 978-1-009-31125-0 Stewart et al.

Steps in conducting qualitative biomechanical analyses

Step 1 Identify a specialised movement sequence or subroutine for analysis. This selection is most likely based on identifying sequences that require modification in order to increase movement efficiency, accuracy, consistency and/or speed. It is often easier to analyse subroutines rather than analyse complete movement sequences.

Step 2 Describe the ideal technique of the movement sequence. Use available research on websites, in coaching manuals or journals, or talk to coaches to deepen understanding of the specialised movement sequence.

Step 3 Identify the purpose or goal of the movement sequence. This is the desired outcome or measure of success of the skill. This may be more difficult to determine for some skill sequences than for others. Generally, it is easier to determine the mechanical goal of skills with an outcome that is measured objectively, such as in track and field, where there is a single objective. Other skills may have several purposes. The goal of a volleyball serve is to make it difficult for the opposition to set up an attack or win the point outright. The mechanical goal involves both speed and accuracy. The mechanical goal of a tennis serve may involve speed, spin and accuracy. In determining the mechanical goal of a particular movement sequence, consider the requirement for one or more of the following:

- speed
- accuracy
- strength
- power (explosive strength)
- amount of force required
- force/accuracy balance
- energy efficiency
- imparting spin
- adherence to technical rules.

Step 4 Identify the key biomechanical principles that govern the production of the movement sequence and allow mechanical goals to be realised. Depending on the nature of the movement sequence, this may include:

- principles of force application
- Newton's laws of motion
- impulse and momentum
- summation of forces
- leverage
- transfer of momentum
- stability and balance
- drag and lift forces.

Explain the application of key biomechanical principles to the performance of the movement sequence.

Step 5 Record personal performance. Determine the best position to record video footage. Consider the plane on which the movement sequence occurs. Video should be recorded perpendicular to this plane. In some cases, video footage may be required to be taken in two planes. For example, analysis of a sprint start may benefit from footage taken from the side and front. Capture the required pre-practice footage.

Step 6 Evaluate the performance of the movement sequence through comparison with the ideal technique. Some video software applications allow analysts to view ideal and the subject's movement sequences side by side synchronised in time. Identify strengths and weaknesses in the movement sequence or related subroutines that require correction. This list of weaknesses could be prioritised if many errors are evident. Explain the effect of identified errors on the quality of performance using the previously identified key biomechanical principles (step 4).

Step 7 Make a recommendation for a training strategy. Devise a training strategy(ies) to improve identified and prioritised errors or inefficiencies in the execution of subroutines. Justify how the strategy(ies) serve to address specific biomechanical issues using primary (video evidence) and secondary (research) data.

Step 8 Allow a period of practice for the athlete to apply devised training strategies and work on correcting the identified errors.

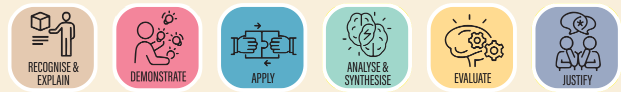
Step 9 Capture post-practice footage. Compare pre-practice and post-practice footage to evaluate whether the period of practice was successful in regard to improving the execution of the movement sequence or related subroutines. Identify specific outcomes and limitations of the strategies.

ISBN 978-1-009-31125-0 Stewart et al.

Step 10 Make recommendations regarding possible modifications to or maintenance of the training strategy.

These steps can be applied using one or a number of the specific biomechanical principles, discussed in detail in this chapter, that govern the production of particular specialised movement sequences with a view to improving movement efficiency, accuracy, consistency and/or speed.

ACTIVE INVESTIGATION 6.1



Inquiry question: How can qualitative biomechanical analysis be used to identify and correct errors in specialised movement sequences for enhanced performance?

The final activity in this unit involves the application of your understanding of functional anatomy and the principles of biomechanics to conduct a qualitative biomechanical analysis. Such analysis allows you to identify errors, devise possible training strategies to increase movement efficiency, accuracy, consistency and/or speed, and evaluate the effectiveness of such strategies.

To complete this task, you will be using the 10 steps outlined in section 6.7, 'Conducting qualitative biomechanical analyses.'

Recognise and explain

1. Complete steps 1–4 to begin your analysis.

Demonstrate and apply

2. Complete step 5 of the analysis process by recording footage of your selected specialised movement sequence.

Analyse and synthesise; evaluate and justify

3. Complete steps 6 and 7 to evaluate the sequence through analysis; and then devise and justify a strategy to improve the technique biomechanically.
4. If time permits, complete the biomechanical analysis process by completing steps 8–10.

You may be required to publish your findings as a report. Use the following as the heading and subheadings of your report:

Biomechanical analysis of: [Physical activity / Specialised movement sequence / subroutine(s)]

Subject: [Name of the athlete]

- Ideal technique
- Purpose of the movement sequence
- Key biomechanical principles
- Performance data [video or still photos]
- Performance evaluation [may include video/still images]
- Training strategy recommendations
- Post-practice performance data [video or still photos]
- Recommendations for maintenance or modification of training strategies

You should consider publishing your findings in a multimedia format, including annotated video footage.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Biomechanical analysis is based on the knowledge and understanding of a range of biomechanical principles that govern the application of force and the motion that occurs as a result of the application of forces.
- Quantitative biomechanical analysis involves collecting performance data that is measurable (defined using numbers).
- Qualitative biomechanical analysis involves data gathered by observers watching the performance and making comparisons with ideal technique.
- Muscular forces can be described and measured in terms of magnitude, direction, point of application and line of action.
- Motion is another word for movement.
- Linear motion occurs when an object moves from one place to another.
- Linear motion can be rectilinear or curvilinear.
- Angular motion involves rotation around an axis.
- Linear velocity is the displacement of an object in a given amount of time.
- Angular velocity is the angular displacement around an axis in a given amount of time.
- Linear acceleration is a measure of how quickly the velocity of an object is changing.
- Angular acceleration is a measure of how quickly the angular velocity of an object or body segment is changing.
- Newton's first law of motion (the law of inertia) states that a body will continue in its state of motion unless it is acted upon by a force.
- Newton's second law of motion (the law of acceleration) states that the acceleration of an object is directly proportional to the amount of force acting upon it and inversely proportional to its mass – that is, as force is increased, acceleration will increase by the same factor and as mass is increased, acceleration will decrease by the same factor. This is summarised in the formula $F = ma$.
- Newton's third law of motion (the law of action–reaction) states that for every action there is a reaction equal in force and opposite in direction.
- Momentum is a measure of the amount of motion possessed by an object. Momentum is the product of an object's mass and its velocity ($p = mv$).
- The concept of impulse can be used to better understand momentum using Newton's second law of motion. Impulse is the product of force and the time over which it is applied. The greater time over which a force is applied, the greater will be the momentum change of the object.
- Most muscular actions in physical activities involve the summation (or adding together) of the force applied by a number of muscle groups acting in sequence. Actions in physical activities that require maximum velocity are initiated by larger, stronger muscles and completed by less strong, but faster muscle groups.
- Bones act as levers, providing a mechanical advantage in producing actions in physical activity. If the resistance arm of a lever system is longer than the effort arm, the lever acts as a speed multiplier. Conversely, if the resistance arm is shorter than the effort arm, the lever acts as a force multiplier.
- Stability is determined by the position of a person's centre of gravity in relation to their base of support. Changes to the size and alignment of the base of support can increase stability. The centre of gravity can be moved towards an oncoming force to increase stability.
- Projectiles follow a flight path or trajectory known as a parabola. Many factors can affect the trajectory of an object.
- Drag and lift forces influence the trajectory of objects. Air resistance is an example of a drag force.
- Bernoulli's principle explains lift and Magnus forces that affect the motion of objects.
- Spin and friction affect the rebound of objects from solid surfaces.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. The time taken to complete a 10 km run could be calculated by:
   - **A.** dividing the distance covered by average velocity.
   - **B.** multiplying distance covered and average velocity.
   - **C.** dividing average velocity by distance covered.
   - **D.** maximum velocity achieved by distance covered.
2. Angular velocity is measured in:
   - **A.** degrees per revolution.
   - **B.** degrees per second per second.
   - **C.** degrees per second.
   - **D.** metres per second per second.
3. Which of the following will not result in an increase in the velocity of an object?
   - **A.** Increasing the time over which force is applied to the object
   - **B.** Increasing both the force applied and the time over which it is applied to the object
   - **C.** Doubling the force applied to an object and halving the time over which it is applied
   - **D.** Doubling the force applied to the object
4. The action of the gastrocnemius in raising the heel while the balls of the feet are still on the ground is an example of a:
   - **A.** first-class lever with a longer resistance arm.
   - **B.** first-class lever with a longer effort arm.
   - **C.** second-class lever.
   - **D.** third-class lever.
5. Which of the following explains why a tennis ball struck with heavy topspin causes the ball to drop?
   - **A.** The spin of the ball as it moves forward causes air to flow more slowly under the ball, which results in an area of low pressure under the ball.
   - **B.** The spin of the ball as it moves forward causes air to flow faster under the ball, which results in an area of low pressure under the ball.
   - **C.** The spin of the ball as it moves forward causes air to flow more slowly under the ball, which results in an area of high pressure under the ball.
   - **D.** The spin of the ball as it moves forward causes air to flow faster under the ball, which results in an area of high pressure under the ball.

SHORT-RESPONSE QUESTIONS

1. What are the four properties of force? How do these properties relate to achieving maximum distance in a javelin throw?
2. How does summation of forces operate in producing the action of hitting a softball for a home run?
3. What factors affect the distance that a ball will travel once it leaves the hand or bat?
4. What is momentum? Provide and explain one example in sport where the momentum of an object (which could be the body) is built up over time to improve the outcome of the action.

EXTENDED-RESPONSE QUESTIONS

1. Explain in detail the biomechanical factors that need to be considered by an individual in the selection of a striking implement (such as a cricket bat or a tennis racquet) that is used to impart maximum velocity to a ball.
2. The following points outline some sound coaching advice that was given to young, beginning long-jumpers regarding their run-up approach.
   - Sound technique on the approach can increase the length of a jump.
   - Use a 12–19 stride run-up. Experienced and conditioned athletes may find that they can benefit from a longer approach.
   - Accelerate gradually to full speed. This, however, needs to be consistent.
   - Choose your preferred foot with which to begin your run-up. Many athletes begin the run with their left foot forward.

ISBN 978-1-009-31125-0 Stewart et al.

- Lean forward in the early strides of the run-up.
- After a few strides, you should be in a fully upright sprinting position.
- It is important to keep accelerating through the board, to convert your maximum controlled horizontal velocity into vertical velocity.
- The penultimate (second-last) stride differs from the rest as you prepare to jump. This stride should be longer, the foot placed flat on the ground and the knee and ankle flexed to lower your centre of gravity. There should be a visible lowering of your whole body.
- The last step is shortened to help maintain your speed. Your foot should be out in front of your body and flat on the ground. Extension of the knee begins, raising the centre of gravity.
- Stay relaxed and try to remember the long–short rhythm of the last two strides.

Justify the validity of this advice using your knowledge of biomechanical principles with particular attention to the principles governing the application of force.

FIGURE 6.28 Sprinters aim to accelerate to maximum velocity as quickly as possible.

ISBN 978-1-009-31125-0

UNIT 2

Sport psychology and equity in physical activity

Unit 2:
Sport psychology and equity in physical activity

- **Topic 1: Sport psychology in physical activity**
  - Chapter 7
  - Chapter 8
  - Chapter 9
- **Topic 2: Equity — barriers and enablers**
  - Chapter 10
  - Chapter 11
  - Chapter 12
  - Chapter 13
  - Chapter 14

Unit description

In Unit 2, students engage with concepts, principles and strategies about two topics.

In Topic 1, students recognise and explain the concepts and principles about sport psychology through purposeful and authentic learning in and about a selected physical activity. In physical activity, students explore body and movement concepts and demonstrate specialised movement sequences and movement strategies.

Students apply concepts to specialised movement sequences and movement strategies in authentic performance environments to gather data about their personal application of sport psychology and body and movement concepts. Students analyse and synthesise relationships between the sport psychology demands in physical activity and personal and team performance. Students then devise a psychological strategy to optimise performance in physical activity.

Students evaluate the effectiveness of the psychological and movement strategies and justify using primary data and secondary data.

In Topic 2, students recognise and explain the concepts and principles about equity in physical activity. In a range of physical activities, students explore barriers and enablers to gather data about the influence on equity.

Students analyse data to synthesise relationships between the barriers and enablers in physical activity, and engagement and performance to identify an equity dilemma. Students then devise an equity strategy in response to the dilemma to optimise engagement and performance in physical activity.

Students evaluate the effectiveness of the equity strategy on engagement and performance, and justify using primary data and secondary data.

ISBN 978-1-009-31125-0 Stewart et al.

Unit objectives

Objectives	Activity icons
1. Recognise and explain sport psychology and equity concepts and principles about selected physical activities.	
2. Demonstrate specialised movement sequences and movement strategies in selected physical activities.	
3. Apply concepts to specialised movement sequences and movement strategies in selected physical activities.	
4. Analyse and synthesise data to devise strategies about sport psychology and equity.	
5. Evaluate sport psychology, equity and movement strategies.	
6. Justify sport psychology, equity and movement strategies.	
7. Make decisions about and use language, conventions and mode-appropriate features for particular purposes and contexts.	

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

ISBN 978-1-009-31125-0

UNIT 2

TOPIC 1

Sport psychology in physical activity

Topic 1:
Sport psychology in physical activity

- **Chapter 7** Motivation and confidence to optimise physical performance
- **Chapter 8** Arousal levels, attention and concentration to optimise physical performance
- **Chapter 9** Team dynamics and cohesion to optimise group performance

Introduction

Being physically educated is being concerned with developing knowledge in the biophysical, sociocultural and psychological domains that underpin physical activity and utilising this knowledge to maximise enjoyment, engagement and physical performance for yourself and others. The physically educated become advocates for both the social and physical importance of being physically active.

This unit topic explores the link between thoughts, feelings and behaviour towards learning in both individual and team-based performances. Sport psychology is a key element within the sociocultural and psychological sub-disciplines of physical activity. Through an understanding of social psychology, the physically educated can work to enhance performance and the enjoyment experienced through physical activity. They can identify the psychological underpinnings of social learners and apply relevant psychological concepts to improve physical performance.

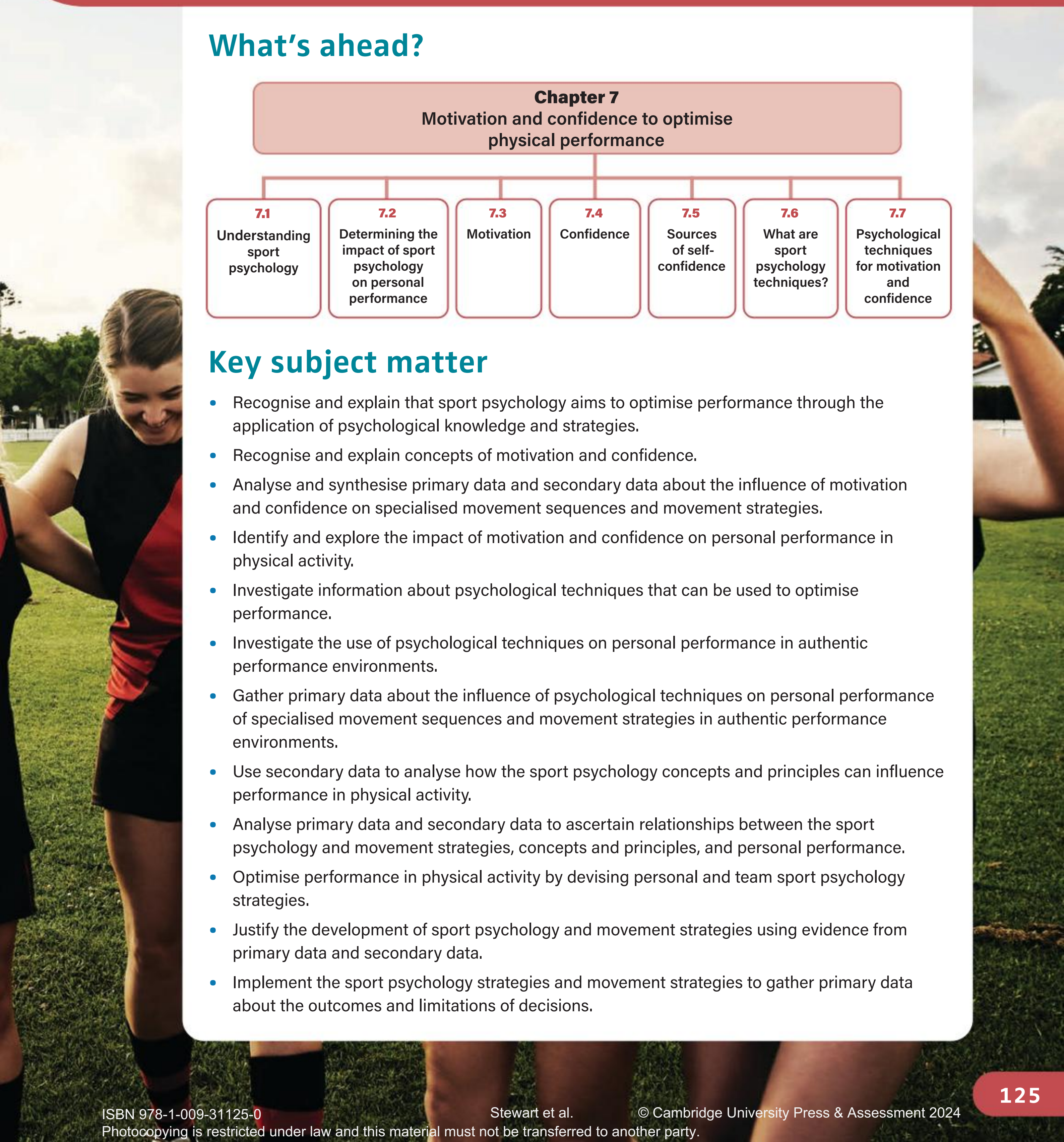
They learn to identify relevant psychological responses before, during and after both individual and team-based performances. Furthermore, they can practise and refine a range of strategies to influence their thoughts and control their physical responses to learning.

UNIT 2 TOPIC 1
Overview

ISBN 978-1-009-31125-0
Stewart et al.

CHAPTER 7

Motivation and confidence to optimise physical performance



What's ahead?

Chapter 7
Motivation and confidence to optimise physical performance

- **7.1** Understanding sport psychology
- **7.2** Determining the impact of sport psychology on personal performance
- **7.3** Motivation
- **7.4** Confidence
- **7.5** Sources of self-confidence
- **7.6** What are sport psychology techniques?
- **7.7** Psychological techniques for motivation and confidence

Key subject matter

- Recognise and explain that sport psychology aims to optimise performance through the application of psychological knowledge and strategies.
- Recognise and explain concepts of motivation and confidence.
- Analyse and synthesise primary data and secondary data about the influence of motivation and confidence on specialised movement sequences and movement strategies.
- Identify and explore the impact of motivation and confidence on personal performance in physical activity.
- Investigate information about psychological techniques that can be used to optimise performance.
- Investigate the use of psychological techniques on personal performance in authentic performance environments.
- Gather primary data about the influence of psychological techniques on personal performance of specialised movement sequences and movement strategies in authentic performance environments.
- Use secondary data to analyse how the sport psychology concepts and principles can influence performance in physical activity.
- Analyse primary data and secondary data to ascertain relationships between the sport psychology and movement strategies, concepts and principles, and personal performance.
- Optimise performance in physical activity by devising personal and team sport psychology strategies.
- Justify the development of sport psychology and movement strategies using evidence from primary data and secondary data.
- Implement the sport psychology strategies and movement strategies to gather primary data about the outcomes and limitations of decisions.

ISBN 978-1-009-31125-0 Stewart et al.

- Reflect on primary data and secondary data to evaluate the effectiveness of sport psychology and movement strategies to achieve a determined outcome.
- Make decisions to maintain or modify the sport psychology strategies and movement strategies.
- Justify maintenance or modification of the sport psychology and movement strategies using evidence from primary data and secondary data.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What is sport psychology?
- How is sport psychology used in modern athlete development?
- Which concepts, strategies and principles underpin sport psychology approaches?
- How are sport psychology strategies implemented and how is their effectiveness measured?
- How can sport psychology assist in maximising performance during physical activity?
- What psychological strategies are available to enhance motivation and confidence of a performer?

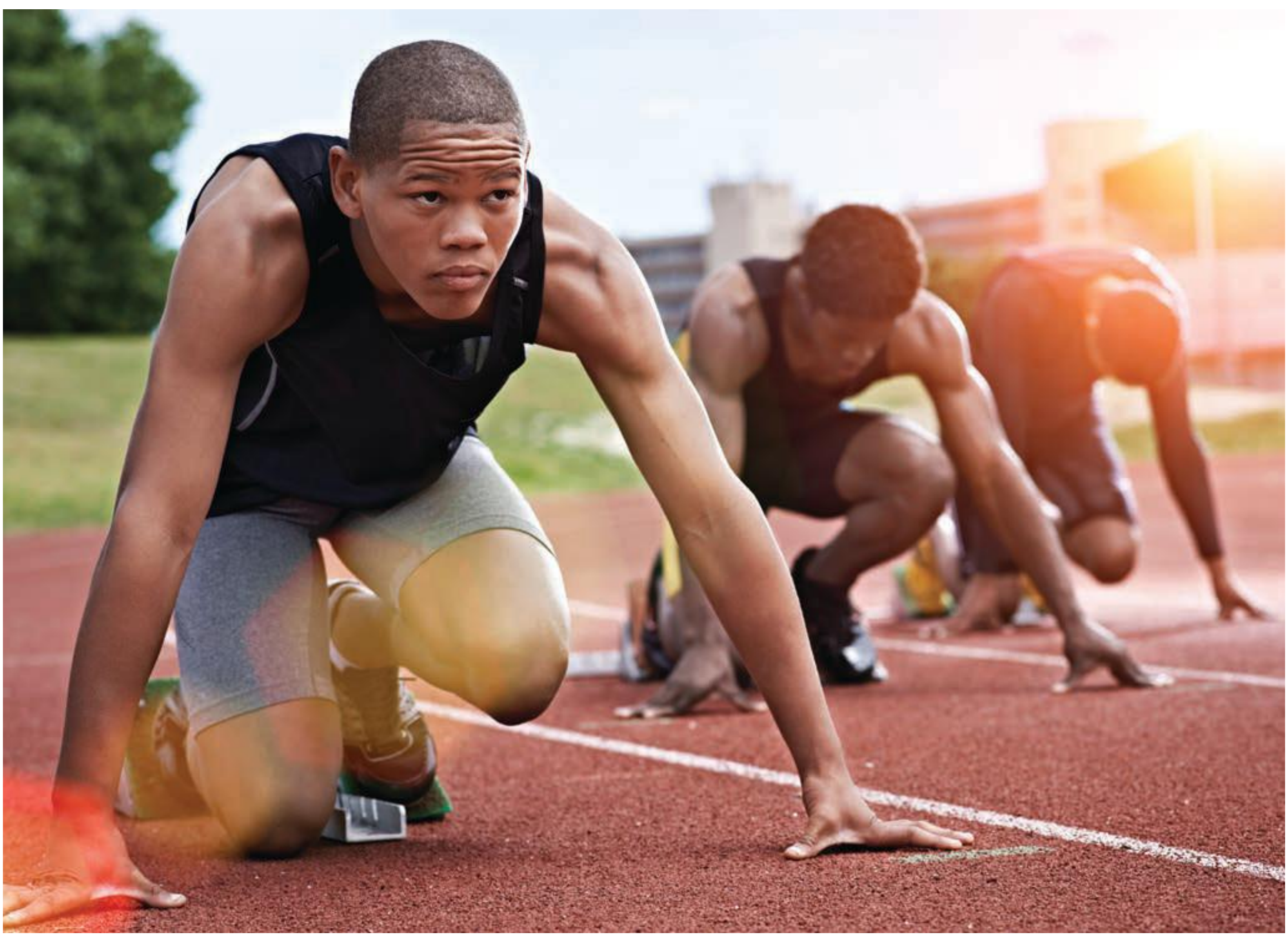


FIGURE 7.1 An athlete's mindset will often determine the standard of performance they will produce.

ISBN 978-1-009-31125-0 Stewart et al.

7.1 Understanding sport psychology

Psychology is the study of how thought influences behaviour. In relation to physical activity, behaviour can be considered the physical movements or sporting actions being performed. The study of the human mind and how it relates specifically to physical performance is known as **sport psychology**.

> **psychology** the study of how thought influences behaviour
>
> **sport psychology** the study of the human mind and how it relates specifically to physical performance

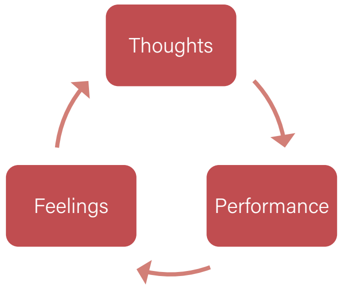


FIGURE 7.2 Thoughts, feelings and performance are linked.

The mental aspects that have the largest influence on optimising sport performance are motivation, confidence, arousal, attention and concentration, and team dynamics. Learning which stimuli affect these elements and developing techniques to control them is the functional application of sport psychology. Simply put:

- motivation = the desire to be successful
- confidence = the belief concerning the ability to be successful
- arousal level = the readiness to perform (immediate state of body and mind)
- attention and concentration = the ability to focus on relevant cues
- team dynamics = functioning as a group to achieve a common goal.

7.2 Determining the impact of sport psychology on personal performance

Sport psychology aims to optimise an athlete's performance through influencing their thoughts. Along with physical conditioning, skill development and tactical awareness, psychological training is essential in an athlete's progression to peak performance. Specifically, sport psychology techniques can be used by athletes and coaches to:

- improve performance – an athlete can learn skills to assist with regulating thinking and emotional responses, train their attention, and foster more successful team norms and environments
- restore performance – setbacks such as performance slumps, injury and training stress can be overcome more effectively by implementing psychological techniques. This occurs through the development of resilience and coping skills and helping teams resolve conflicts in a positive way.
- promote and support well-being – an athlete will train more effectively if they have good mental health. Psychological skills can help an athlete develop and maintain mental fitness, and manage difficult transitions throughout life.

Tracking an athlete's state of mind in the key mental aspects of motivation, confidence, arousal, attention and concentration, and team dynamics is vital to determining both readiness to perform and effectiveness of psychological techniques. Most athletes routinely undergo regular physical fitness testing to measure strength, speed and VO_2 max. Similarly, there are a range of psychometric tests that can be used to measure an athlete's mental fitness. These include the Sport Competitive Anxiety Test (SCAT), the Test of Performance Strategies (TOPS) and the Competitive State Anxiety Inventory-2 (CSAI-2).

ISBN 978-1-009-31125-0 Stewart et al.

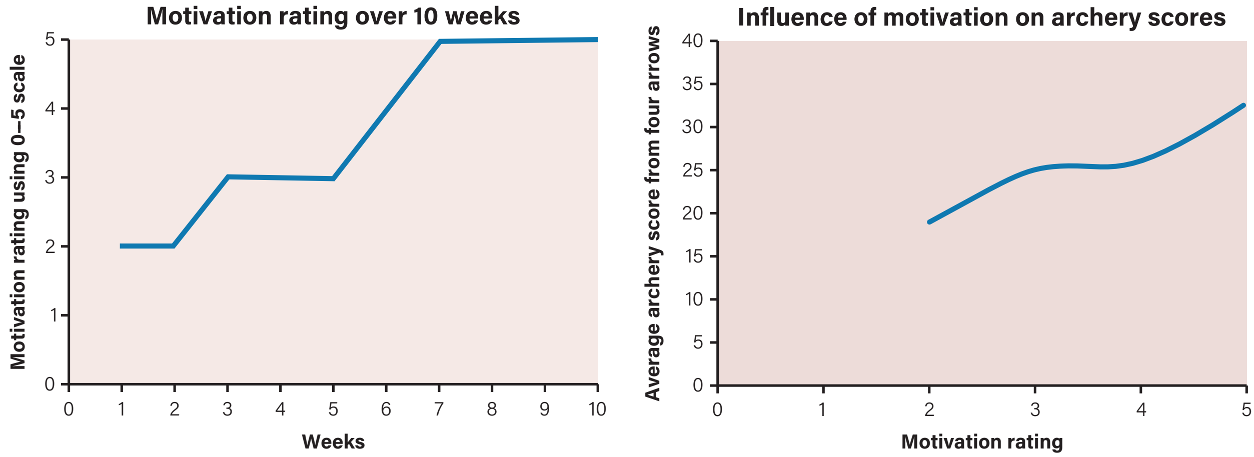


FIGURE 7.3 Correlation between motivation rating and archery score

> **KEY MESSAGE** Sport psychology studies the links between thoughts, feelings and performance.

> **KEY MESSAGE** Sport psychology can be used to improve performance, restore performance and improve and support well-being.

> **KEY MESSAGE** An athlete's state of mind can be regularly tested to support their training and performance.

Throughout this resource, rating scales have been developed to help track mental state when engaging in physical performance. Figure 7.3 shows graphical representations that synthesise correlations between motivation and performance (using the motivation rating scale in Table 7.4, p.132).

7.3 Motivation

An athlete's **motivation** reflects the intensity and direction of the effort they are willing to apply to a task. The direction of effort refers to the situations that they seek out, approach or are attracted to. The intensity of someone's motivation refers to how hard they are willing to work to achieve the given task. A low level of motivation may be characterised by a competitor who is distracted or less interested when engaging in physical activity. Consequently, they will not gain the same performance benefits from training and are less likely to be successful during competition.

> **motivation** enthusiasm for doing something; the direction and intensity of effort

Furthermore, athletes with low levels of motivation may also experience increased stress and anxiety, leading to strained relationships with those around them. The level and causes of motivation of an athlete can differ due to both their internal drive and environmental factors. Sporting motivation reflects an athlete's desire to experience situations of competence, autonomy and relatedness.

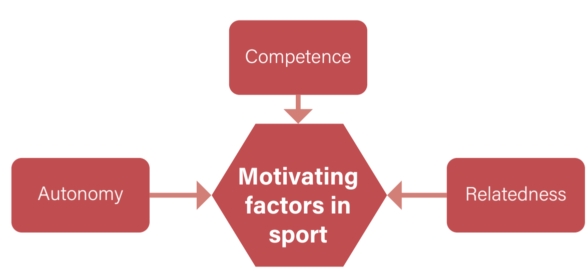


FIGURE 7.4 Factors affecting motivation towards sport can be categorised into three interconnected areas.

ISBN 978-1-009-31125-0 Stewart et al.

Competence is the perceived ability to succeed at a task. Competence ensures that motivation remains high, particularly when supported by feedback indicating skill mastery or that improvement is occurring. It is typical for motivation to be highest when an athlete is learning a new skill. Think of a beginner golfer trying to lower their handicap. Although this could be a frustrating stage, the initial learning experiences will involve the quick mastery of simple skills or strategies such as club choice and shot selection. This rapid improvement in ability indicates an increase in competence, and consequently higher levels of motivation. However, after the initial improvement, the golfer's handicap and subsequent perceived ability begin to plateau. New sources of motivation are needed to maintain the required effort to learn the more complex skills and strategies required for further improvement. Poor performances and an inability to improve build a perception of low competence for a performer – that is, they question their ability to be successful. Low levels of competence have a negative effect on motivation levels.

competence the ability to do something well

autonomy the ability to make your own decisions without being controlled by anyone else

relatedness where social acceptance reinforces the motivation for participation

Autonomy refers to the athlete feeling as if they have an influence on the decisions impacting on their performance. The main reason people begin and continue with a new physical activity is that they find it rewarding. Specifically, they feel a sense of autonomy regarding the intensity and direction of the effort they apply. Having input into the composition of a performance, whether at training or during a match, increases motivation, whereas being dictated to by a coach or domineering members of a team diminishes motivation.

Maintaining motivation in physical activities is also influenced by being able to share experiences with others. **Relatedness** involves situations where social acceptance reinforces participation. Although having strong *team cohesion* is a perfect example of this, relatedness is not limited to team sports. Athletes competing in individual sports build a sense of community with coaches, training partners, officials and even competitors. Not feeling welcome or accepted in a performance environment is very detrimental to motivation.

TABLE 7.1 Examples of motivating factors

Sport	Competence	Autonomy	Relatedness
Golf	• Lowered handicap • Par or sub-par results • Performing well against others	• Choosing when and where to play • Deciding strategy for approaching a hole	• Discussing performance with playing partners • Sharing experiences after the game
Sport aerobics	• Improved strength and endurance • Mastery of difficult combinations in routine • Successful performance	• Influencing choreography • Choosing when and where to train	• Feeling part of a team • Feeling welcome in the gym or training environment
High jump	• Improved ability to clear previously unattainable heights	• Selection of heights to attempt during training • Selection of start height in competition	• Sharing success of reaching personal bests with training partners and coaches • Receiving acknowledgement from competitors for clearing challenging heights

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 7.1

1. Define the term 'motivation.'
2. Feeling like you have a say in how you perform is an example of which category of motivation?
3. Explain why motivation levels may be high when a golfer is:
   a. scoring under par for a hole
   b. selecting a tee-off time that suits their weekend schedule
   c. successfully recovering from a wayward drive
   d. first learning a new skill.
4. Categorise the following golfers' positive experiences as influencing their feelings of competence, autonomy or relatedness.
   - Being greeted by locals at the golf club
   - Posting footage of a successful long putt on social media
   - Choosing which club to use
   - Improving the accuracy of a specific golf club
5. Identify an individual sport and a team sport towards which you currently have low motivation. Analyse your past experiences and provide an example that diminished your motivation in each category: competence, autonomy and relatedness.

Intrinsic motivation and extrinsic motivation

The level of competence, autonomy and relatedness experienced by an athlete determines their level of motivation. These three dimensions of motivation are influenced by a very broad range of factors that are specific to each individual. What motivates or demotivates a performer is uniquely personal. However, it is useful in sport psychology to investigate these factors in terms of being intrinsic or extrinsic.

Intrinsic motivation reflects the drive of an athlete to compete purely for the enjoyment of the experience. Intrinsic motivators include feelings of satisfaction when learning or improving skills, feelings of accomplishment when completing an event and feelings of stimulation when participating.

Extrinsic motivation involves factors beyond enjoyment that drive an athlete to succeed. Extrinsic motivators may be self-determined or determined by others. Self-determined extrinsic motivation involves athletes completing tasks or working towards outcomes that they feel are valuable, but not necessarily enjoyable. On the other hand, extrinsic motivators determined by others rely on the need to attain external rewards as the focal point for an athlete's effort and persistence in an activity. These rewards can be material – like money, sponsorship or trophies – or perceived, like fame, recognition, social status or improved lifestyle.

Most sportspeople are motivated by a combination of both intrinsic and extrinsic motivators, and therefore could be placed on a continuum between the two extremes (see Table 7.3). Understanding what intrinsic and extrinsic factors motivate and demotivate an athlete is essential when looking to increase and maintain motivation. A person who is primarily motivated intrinsically might find it hard to rise to big occasions, like grand finals, when rewards are on offer, and they may even perform poorly due to the increase in pressure. A person who is primarily motivated extrinsically may struggle to retain motivation when they are on a losing streak, injured, suffer defeat in big matches or miss team selection, or in 'normal' round matches when there is little at stake. When athletes are motivated by a good balance of intrinsic and extrinsic factors, they can find it easier to maintain high levels of motivation and are able to engage a wide variety of motivational techniques to optimise their performances.

intrinsic motivation participating in an activity purely for the enjoyment of the experience

extrinsic motivation participating in an activity for reasons other than enjoyment

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 7.2 Intrinsic and extrinsic motivators

Intrinsic motivators		Extrinsic motivators	
Motivation to learn	• Learning how to draw and fade shots in golf • Learning a new sport aerobics routine • Learning how to serve over-arm in volleyball	**Motivation to achieve a valued outcome**	• Being selected in a representative team • Putting for an eagle in golf
Motivation to accomplish	• Improving a personal best in triple jump • Executing a new set play in touch football • Creating a new sequence in aerobics	**Motivation to complete a valued process**	• Doing Pilates to improve your core strength for Australian Rules football • Doing resistance training to improve swimming
Motivation to feel stimulation	• Enjoying the adrenaline rush when playing Australian Rules football • Finding the music choices in aerobics classes enjoyable	**Motivation to prove yourself to others**	• Not wanting to feel guilty about missing training • Going to the gym to improve your attractiveness to other people
		Motivation to attain external praise or reward	• Winning trophies or prizes • Receiving praise • Not coming last in a competition

TABLE 7.3 Motivation as a continuum

Type of motivation	Extrinsic motivation ⟵			⟶	Intrinsic motivation
Motivating factors	Praise and reward	Prove yourself to others	Complete a valued process	Achieve a valued outcome	Knowledge Accomplishment Stimulation
Source of motivation	External	Somewhat external	Somewhat internal	Internal	Internal

ENGAGE 7.1

Inquiry question: What factors affect motivation to perform in physical activities?

Demonstrate and apply

1. Participate in a chosen physical activity for a single lesson.
2. Before the lesson, rate your motivation towards participating in this physical activity using the motivation rating scale in Table 7.4.
3. Complete the physical activity and rate your motivation again.

Analyse and synthesise

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

4. List all factors that influenced your motivation during the performance.
5. Identify at least two cause-and-effect relationships between your performance and your motivation – for example, I dropped the ball a lot in the first half (cause), my perceived competence decreased and I stopped trying (effect).

Evaluate and justify

6. Write a sentence justifying which factor (competence, autonomy, relatedness) had the most influence on your motivation.

TABLE 7.4 Motivation rating scale

		Level of motivation	Description
Low	0	Amotivated	• You have no desire to perform. • You are not concerned with negative repercussions from not participating.
	1	Competing through obligation	• You are only competing through obligation, *to satisfy a commitment made by, or to others.* • You believe your preparation has been inadequate to produce a successful performance. • You wish to avoid negative repercussions of not participating; *success is not a priority, only a minimum level of participation*.
	2	Competing for the benefit of others	• You are participating to allow others the opportunity to be successful. • You believe your training and preparation will not allow you to improve your own performance. • You seek social approval for participating; *success for self is not a priority – however, your level of performance cannot be detrimental to the overall success of others*.
	3	Competing to produce performance successfully	• You are trying to complete the task successfully while remaining within your comfort zone. • You believe your training has not allowed you to perform outside of your comfort zone or produce a performance beyond that typical for you. • You are trying to avoid the disapproval of other stakeholders that could result from a poor performance, so are striving to produce a performance on par with other comparable results.
	4	Competing to maintain a high-level performance	• You are trying to maintain a high standard of performance in an environment in which you are comfortable. • You believe your training and preparation have positioned you well to repeat past successful performances with the possibility of slight improvement. • You want other stakeholders (competitors, coaches and spectators) to approve of your performance and/or seek to replicate or better your personal best.
High	5	Competing to produce best performance	• You are trying to accomplish an outcome that you value highly and have been working towards (e.g. flawless routine or a new personal best), which may be performed in a new or challenging environment. • You believe your training and preparation have positioned you well to perform at a higher level and are committed to producing a performance that reflects this. • You want the people you care most about (friends, family and coaches) to be proud of your performance and will gain a large amount of personal satisfaction if this high level of performance is achieved.

ISBN 978-1-009-31125-0 Stewart et al.

KEY MESSAGE

Competence, autonomy and relatedness are all key to developing motivation.

KEY MESSAGE

Motivating factors can be placed on a continuum from intrinsic to extrinsic sources.

KEY MESSAGE

Most sports require a combination of both intrinsic and extrinsic motivating factors.

7.4 Confidence

Confidence is considered the most influential psychological factor in differentiating between successful and unsuccessful performances of athletes. Specifically, confidence refers to the belief an athlete has that they will complete a task successfully (e.g. a putt in golf) or attain a certain favourable outcome (e.g. a high score in an aesthetics routine). Furthermore, an athlete's confidence is influenced by their **self-belief** and **self-efficacy** for the task they are completing. Self-belief is the athlete's general trust in and acknowledgement of their abilities. Self-efficacy is the extent to which they feel prepared to successfully complete a specific task. For example, a tennis player may have high self-belief when starting a tournament and feel as though they can win. They would also have high self-efficacy when playing in earlier rounds, as they are coming up against players they have beaten before and feel they can beat again. However, their self-efficacy may decrease during the finals when faced with a higher ranked opposition.

confidence the quality of being certain of your abilities or of having trust in people, plans or the future

self-belief a person's trust in their own abilities

self-efficacy a person's belief that they can be successful when carrying out a particular task

FIGURE 7.5 A successful tennis player, such as Aryna Sabalenka, may have high self-belief at the start of a tournament.

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 7.2

1. In your own words, explain the link between confidence, self-belief and self-efficacy.
2. Imagine that your teacher has organised a competition against a Year 8 class in the physical activity that is the current focus of your study.
   a. What factors would influence your self-belief during this performance?
   b. What factors would influence your self-efficacy during this performance?
   c. Evaluate the benefit that competing in such a competition would have for your level of confidence.

A performer who believes they are well prepared for the task or event will feel more confident and have a greater chance of completing a successful performance. High confidence results in an athlete:

- having positive thoughts about their ability
- being more likely to remain calm and composed during competition
- being more positive when faced with setbacks
- having increased levels of concentration regarding completing the task at hand
- applying more effort to their performance
- being able to implement strategies that allow them to control the situation at hand.

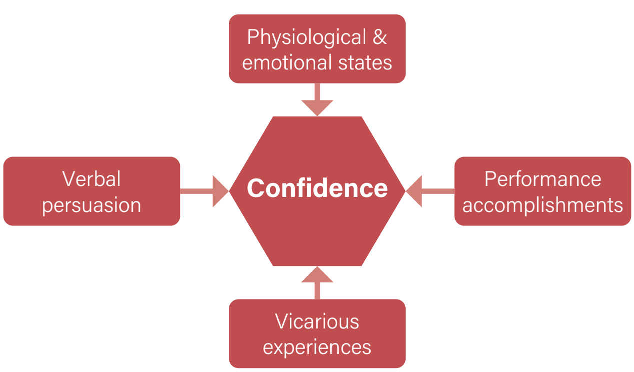


FIGURE 7.6 Verbal persuasion, vicarious experiences, performance accomplishments, and physiological and emotional states all contribute to confidence.

7.5 Sources of self-confidence

According to Bandura's theory, self-confidence in sport can be attributed to one of the following four major sources:

- performance accomplishments
- vicarious experiences (including imagery)
- verbal persuasion
- physiological states and emotional states.

Although these sources are not mutually exclusive, they can vary with regard to the influence they have for an athlete's confidence.

Performance accomplishments refer to the influence that positive outcomes have on one's level of confidence. Experiencing success when completing a physical task is the biggest influence on an athlete's confidence. The more successful an athlete is, the more confident they are going to be. Success does not necessarily relate to winning but could also refer to the mastery of a skill or noted improvements in performance. When a skill is performed successfully, an athlete's confidence is increased and they are more likely to challenge themselves in a more difficult task. Someone performing in sports aerobics will often learn a new routine in stages. Once the first stage is mastered, they will be more confident to challenge themselves by adding more stages to their routine.

Alternatively, poor performance can lead to a substantive reduction in confidence levels. For example, if a softball batter is continually striking out, they may lose confidence and seek expert coaching or give up the sport altogether.

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 7.7 A softball batter who continually strikes out and loses confidence is an example of performance accomplishments having a negative influence on an athlete.

Vicarious experiences refer to watching someone else perform. Observing someone model the mastery of the skill, either live or on screen, can boost an athlete's belief in their own ability. Self-modelling can be achieved through watching recorded footage of performances or through the use of mental imagery. Viewing their own successful performance will enhance an athlete's belief that they can replicate that success in other situations. The modelling of success by other people, such as a coach or training partner, can also lead to an increase in confidence. This impact is strongest if the people being observed are someone close to the athlete and someone considered to be of similar ability.

vicarious experiences knowledge or information about a skill or behaviour derived from viewing the performance

Verbal persuasion involves the reinforcement of the ability to be successful at a task. Coaches and teammates will often remind athletes of reasons they should feel confident through comments such as 'You're playing well – keep it up' or 'You can do this, just like you did in practice'. During a triathlon, a coach can enhance confidence through providing positive feedback about the athlete's form and split times. Likewise, an athlete can repeat positive encouragement to themselves regarding their belief in their ability. The key to verbal persuasion is to focus on the positive outcome for the performance – for example, keep in touch with the leaders – and avoid referring to the negative outcomes – for example, don't fall behind.

ISBN 978-1-009-31125-0 Stewart et al.

Source of confidence for a swimmer before a final

Performance accomplishments
- Improvements in swim times during training
- Strong swim against opponents during the heat swims

Vicarious experiences
- Viewing a strong heat swim with the coach
- Imagining a successful performance that includes a good start, efficient stroke and finishing on a full stroke
- Seeing a club member win a final
- Seeing a training partner swim a personal best

Verbal persuasion
- Positive encouragement from the coach regarding starts, split times and stroke length
- Encouragement from club members
- Positive self-talk

Physiological and emotional state
- Feeling fit and free of injury
- Feeling prepared and energised
- Feeling excited about the race
- Feeling relaxed and anticipating a good result

FIGURE 7.8 Sources of confidence for a swimmer

The *physiological and emotional state* of an athlete can also improve confidence during an event. Following a successful heat swim, it is quite common for a swimmer being interviewed to comment on how great their body feels. Identifying these positive physiological states enhances their confidence leading into the finals. Alternatively, an athlete who is identifying negative physiological states such as injury or fatigue will be less confident. Likewise, the emotional states of an athlete can influence confidence. Feelings of excitement, anticipation, calm, elation and preparedness will enhance levels of self-confidence. Athletes experiencing positive emotional states are more likely to give maximum effort, take risks and react positively to setbacks. Alternatively, negative emotional states that involve feeling sad, tense or fearful of failure will result in lower self-confidence. The effects of the negative emotional state could include a lack of effort or an unwillingness to take risks and a readiness to give up.

FIGURE 7.9 A swimmer reviewing footage of a race

CHECK-IN 7.3

1. Explain the relationship between thoughts, feelings and performance.
2. Make a list of five things about which you have confidence and five about which you lack confidence.
3. Select one item from each list in question 2 and explain what experiences may have led you to develop these confidence levels.
4. Analyse all the skills in your current physical activity and categorise them as 'skills I am confident with' and 'skills with which I lack confidence.'

ISBN 978-1-009-31125-0 Stewart et al.

Optimising self-confidence

The four aspects of self-confidence highlight the advantages that confidence brings to performance outcomes. However, it is important to strike a balance between being **under-confident** and being **over-confident**. Being under-confident is exemplified by a low belief in one's ability to achieve success in a task and is a key contributor to experiencing failure. For example, if a dancer believes they are going to forget or 'stuff up' part of their routine, they actually help cause this to happen when performing. This is known as a negative **self-fulfilling prophecy** and is associated with having negative thoughts and negative self-talk; it obviously leads to lower overall success.

> **under-confident** a low level of confidence that is detrimental to performance
>
> **over-confident** a high level of confidence that is detrimental to performance
>
> **self-fulfilling prophecy** something you cause to happen by saying and expecting that it will happen

Over-confidence is an exaggerated belief in one's ability and will make an athlete more prone to failure. A golfer who is over-confident may overestimate their ability to hit a shot over a hazard and take an approach that is too aggressive, which leads to a poor outcome. Similarly, a touch football team that is over-confident against a lower ranked team may make poor decisions and take unnecessary risks, shifting away from the structured game plan. 'Impossible passes' due to over-confidence can bring about errors and poor completion rates that unnecessarily invite the opposition into the match. Additionally, being over-confident may lead an athlete to under-prepare, both physically and mentally, for a competition – either during the warm-up or the preceding training sessions. They may even fail to put in enough effort when competing. A swimmer who has regularly been successful in their races may underestimate their opponents and neglect to complete their proper preparation leading up to an event.

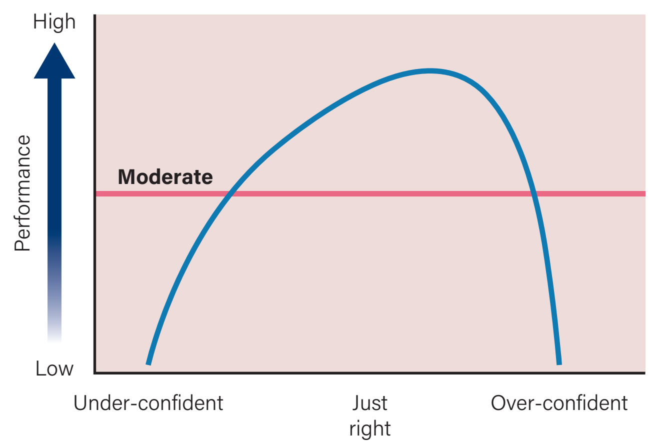


FIGURE 7.10 The relationship between confidence and performance

The optimal level of confidence that produces peak sporting performance can be located between under-confident and over-confident. This is a level of confidence that ensures an athlete can maintain appropriate levels of effort and concentration to achieve goals without being overwhelmed by the task. More specifically, as confidence increases, so does performance – but only to a certain point. The optimal level of confidence is found slightly closer to the over-confident side. This will allow athletes to continue to challenge themselves to reach their potential.

> KEY MESSAGE
>
> Confidence is considered the most influential psychological factor in determining success.

> KEY MESSAGE
>
> According to Bandura's theory, there are four sources that will determine self-confidence.

> KEY MESSAGE
>
> Best performances occur when confidence is optimal and there is a balance between under- and over-confidence.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 7.5 Confidence rating scale

		Level of confidence	Description
Low	0	**I believe there is absolutely no chance** of being successful.	• You feel overwhelmed by the performance requirements. • You believe you can't be successful even if you try your hardest.
	1	**I believe there is not much chance** of being successful.	• You feel like you are out of your depth in this performance environment. • You believe that you required much more preparation to be successful. • You believe that you will not be successful without a lot of luck or assistance from teammates or other external factors.
	2	**I believe there may be a chance** of being successful.	• You are feeling good but have not experienced much success in this environment before. • You believe you are slightly unprepared and feel anxious. • You have received positive encouragement but believe external factors will need to play a substantial part in your success.
	3	**I believe I am more than likely** to be successful.	• You are feeling good about competing and have had experience competing in similar performance environments. • You believe you have prepared well but feel nervous about competing. • You have received positive encouragement but believe external factors will need to play a part in your success.
	4	**I strongly believe** I can be successful.	• You are feeling fit and healthy and have had previous success in similar performance environments. • You believe you have had a good preparation and feel excited about competing. • You have received positive encouragement from others and feel energised and excited about performing. • You believe you can out-perform your opponents and can visualise a successful performance.
High	5	**I am totally certain** I can be successful.	• You are feeling fit and healthy and have been very successful in this environment before. • You believe you have had a perfect preparation, feel excited and anticipate success. • You have received a lot of positive encouragement from others and feel relaxed about competing. • You can easily visualise being successful against your opponents.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 7.2

RECOGNISE & EXPLAIN ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What sources of confidence have the most impact on performance?

Recognise and explain

1. Explain the relationship between confidence and performance.

Analyse and synthesise

2. Evaluate your confidence levels towards your current physical activity using the criteria in Table 7.5.
3. Collate primary data by conducting a survey of 10 other class members. Record their level of confidence and their yes/no responses to the following questions.
   a. Have you experienced success in this (or similar) physical activity (performance accomplishments)?
   b. Have you visualised yourself or witnessed someone close to you having success in this physical activity (vicarious experiences)?
   c. Have you received praise or encouragement from those around you and/or had positive thoughts about your ability to compete in this physical activity?
   d. Did you feel prepared, relaxed and positive about performing in this physical activity?
4. Present your primary data in a table.

Evaluate and justify

KEY COGNITION

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

5. From the responses you have collated, draw conclusions about the source of confidence that is most related to higher levels of confidence. Use your primary data as evidence to support your conclusion.

7.6 What are sport psychology techniques?

For optimal performance, athletes require both mental and physical fitness to accompany their skills and strategies. Just like training the body, training the mind is also essential to performance. Coaches and athletes use a range of sport psychology techniques designed to optimise an athlete's mental state and improve physical performance. Although psychological techniques can be highly personalised and range greatly in their implementation, they can be broadly categorised as:

- goal-setting techniques
- mental rehearsal techniques
- positive self-talk techniques
- self-confidence techniques
- pre-performance techniques
- relaxation and energiser techniques
- attention and concentration techniques
- team dynamics and cohesion techniques.

Each of these technique types is explored in more detail throughout this chapter and subsequent chapters of this textbook. However, each technique varies in length and complexity and can be implemented in

ISBN 978-1-009-31125-0 Stewart et al.

isolation or combination depending on the athlete's needs. Additionally, these psychological techniques can be implemented to achieve different outcomes. For example, techniques such as goal-setting and mental rehearsal can have a positive influence over a range of psychological aspects.

In physical training, techniques for correct lifting, running and changing directions are taught. It is just as important that athletes are taught how to effectively use these sport psychology techniques through the process outlined in Figure 7.11.

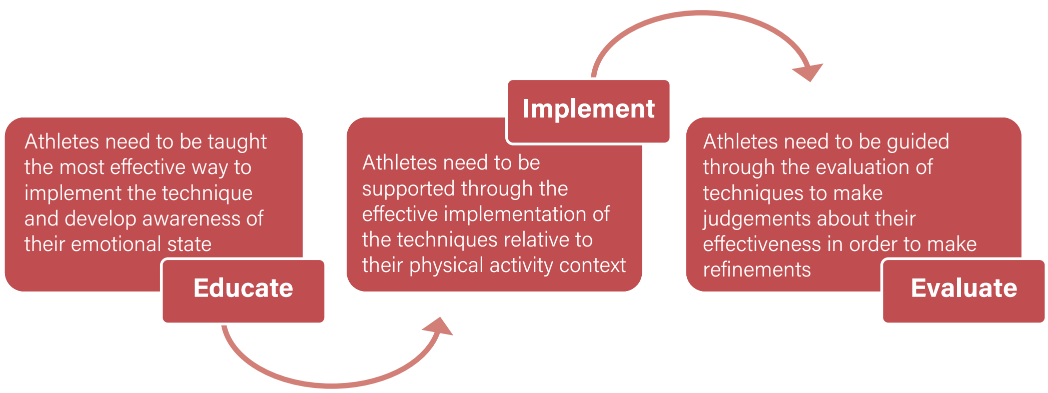


FIGURE 7.11 The process of learning sport psychology techniques

TABLE 7.6 Goal-setting

Goal-setting	
Goal-setting is one of the most fundamental psychological techniques used by many athletes, and has been shown to do the following:	
Increase and maintain motivation	Athletes feel more motivated as goals provide a context and direction for training. Achieving goals also boosts motivation towards new goals.
Increase confidence	Achieving goals boosts self-efficacy and improves self-belief when working towards future goals.
Improve attention and concentration	By focusing on their goals, athletes are less likely to pay attention to distractions.
Regulate arousal	The associated increase in motivation also increases arousal levels, as the athlete wants to meet the challenge set. Additionally, when anxious, refocusing on goals can help to reduce arousal to optimal levels.

TABLE 7.7 Mental rehearsal

Mental rehearsal	
Mental rehearsal has been shown to improve psychological states by doing the following:	
Increasing arousal	Visualising high-energy images of competition can be used as a 'psyche-up' technique and boost levels of preparedness.
Decreasing anxiety	Visualising successful performance increases an athlete's sense of preparedness and provides a sense of comfort that they are up to the task.
Improving concentration	Visualising successful performance prevents the mind from being overloaded with less important stimuli.
Increasing confidence	Visualising successful performance increases the self-belief that the athlete is up to the task at hand.
Increasing motivation	Visualising successful performance increases the intrinsic desire to compete.

ISBN 978-1-009-31125-0 Stewart et al.

7.7 Psychological techniques for motivation and confidence

Goal-setting

Goal-setting is one of the most fundamental psychological techniques used by many athletes.

The process of setting goals helps an athlete to understand their current level of performance and how they want it to improve. The impact of goal-setting on an athlete's psychological state is strongest when they first set the goal and when they are close to achieving it. To maintain positive impacts of goal-setting over a long period, it is recommended that athletes set multiple goals.

Outcome, performance and process goals

There are three main types of goals that athletes can incorporate into their goal-setting system, and each is important in its own way. **Outcome goals** focus only on the end result, such as winning or improving a ranking. These goals are not fully within the athlete's control, as they can be influenced by the performances of other competitors. Although outcome goals provide high levels of motivation in people who are externally driven, an overemphasis on them during competition can create anxiety. For example, an athlete who has an outcome goal of winning a triple jump competition may be so worried about not being in the lead after their first jump that they stop focusing on technique and their performance actually decreases. Outcome goals are typically best set as long-term goals, and athletes should have several performance and process goals that lead to the outcome.

> **outcome goals** goals that focus on a desired outcome, such as winning

Performance goals, on the other hand, are well within the athlete's control as they focus on what they are actually trying to achieve. These goals are typically measurable and involve times, distances, average scores or percentage of successful outcomes. While the long-term goal of a triple jumper may be to win a specific competition, a performance goal through training and in competition might be to increase their personal best by 30 cm, or their hop distance off the board to 3.2 m. These performance goals focus on improvement in their jump distance and are not influenced by the results of other competitors, as an outcome goal is.

> **performance goals** goals related to a measured performance

Finally, **process goals** focus on particular behaviours or procedures that are required to improve performance and are totally controlled by the athlete. These goals are the underpinning building blocks that allow performance and outcome goals to be achieved. For example, in order to perform a personal best jump of 12 m and ultimately win the competition, the triple jumper may set a process goal of maintaining rhythm during the approach or improving landing technique. These process goals are targeted during training and may also provide a source of focus and attentional control during competition.

> **process goals** goals associated with improving essential processes that will lead to performance enhancement

Developing SMARTER goals: how to construct and track goals effectively

The focus identified by any goal is important, as not all goals are effective in developing motivation. Many people spontaneously set goals that have no clear direction, may be beyond their capabilities and have no clear way of identifying when the goal is achieved.

The SMARTER goal-setting principle allows effective goals to be established:

- **S**pecific. Goals that are specific set out exactly what is to be achieved in clear and precise words. Specific goals are much better at enhancing and maintaining motivation.
- **M**easurable. Goals must be measurable to ensure that progress can be monitored and achievement is demonstrated clearly.

ISBN 978-1-009-31125-0 Stewart et al.

- **A**ction-based. Goals must be behaviourally based – that is, they should be observable by another person. This allows the performer and others, like a coach, to monitor the progress of the goal.
- **R**ealistic. Goals must be challenging, yet honestly within the athlete's means, if they are to motivate effectively.
- **T**imed. All goals should provide a deadline by which the goal is to be achieved. Without a target date, motivation will decrease and goals can drag out over time.
- **E**valuate. Once a goal has been set, it is important that progress towards achieving the goal is monitored. Goals that are inappropriate because they are too easy or too difficult can be reassessed. The performer can also be motivated by knowing how close they are to achieving the goal.
- **R**e-establish. Once a goal has been achieved, new goals must be set to maintain motivation and ongoing improvement. Ask the key questions: 'Where am I at now?', 'Where am I going?', 'How am I going to get there?'

Once a goal has been established, it is important to write it down, as this creates ownership of what is to be achieved. Writing down goals also ensures that the specifics cannot be manipulated when the going gets tough. In other words, writing goals down means they won't be changed.

ACTIVE INVESTIGATION 7.1

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: How does the use of goal-setting influence psychological states when performing in a chosen physical activity?

Recognise and explain

1. Collect secondary data by conducting background research into the effects of goal-setting on your chosen physical activity, or its effectiveness for sport in general.
2. Write your hypothesis: 'If I incorporate effective goal-setting techniques, my ____________ levels would ____________ and my performance would improve because ____________.'
3. Reflect on your previous experience in the chosen physical activity and create one performance goal, one process goal and one outcome goal that relate to your performance. For each of these goals, use the following criteria:
   a. specific (What is it?)
   b. measurable (How will you know it has been achieved?)
   c. action-based (What will other people notice when you are achieving?)
   d. realistic (How achievable is it?)
   e. timed.

Demonstrate and apply

4. Over a series of four competitive performances, collate primary data regarding the influence of goal-setting on:
   a. the success of your performance
   b. your level of motivation
   c. your level of confidence
   d. your level of arousal.

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

5. Analyse and interpret the primary data by developing a series of graphs and tables that demonstrate the main findings. Some examples of graphical displays are:
   - column graphs that show results of your psychological state and performance throughout the goal-setting process
   - tables demonstrating percentage changes in psychological ratings and performance
   - X–Y scatter plots showing correlations between changes, psychological ratings and performance for a class or group of students.
6. Critique primary data by supporting or rejecting the identified trends based on valid and reliable research.

Evaluate and justify

7. Evaluate the strengths and weaknesses of your goal-setting approach.
8. In a paragraph, justify three recommendations for maintaining or modifying the elements of your goal-setting strategy for this performance.

KEY MESSAGE

Goal-setting has been shown to assist in optimising levels of motivation, confidence, arousal and concentration.

KEY MESSAGE

Process goals, performance goals and outcome goals are the three main types of goals.

KEY MESSAGE

Writing down goals increases ownership and increases the likelihood of them being achieved.

Mental rehearsal

Mental rehearsal, also known as imagery or **visualisation**, involves creating or recreating successful performances in the mind. It is most effective when the mind simulates all of the senses required to complete the performance successfully. When visualising a performance, the same parts of the brain and nervous system are activated as if physically completing the tasks involved. The vividness (how realistic the imagery is) of this experience and the controllability (the ability to modify unsuccessful performance) are key factors in determining the usefulness of the practice. Mental rehearsal is most successful in sports where the athletes have a high degree of control over their environment, such as swimming, golf, archery and dance. However, it can also be advantageous to athletes playing direct interceptive sports when they are required to execute a specific task (e.g. serve in volleyball or free throw in basketball).

visualisation creating and focusing on a range of positive mental images and experiences

Types of mental rehearsal

Mental rehearsal can be implemented in a variety of ways to improve performance. First, visualisation can focus on the whole performance or specific parts of a performance. For example, a swimmer may visualise their whole performance in order to boost their

ISBN 978-1-009-31125-0 Stewart et al.

confidence and motivation. Alternatively, visualisation could just include completing an effective start if the athlete is specifically looking to improve their concentration and decrease anxiety associated with this aspect of the performance.

> “Imagine entering the pool area. You smell the chlorine. You hear the echoing voices. The coaches and their swimmers are milling around. You take off your shirt and stretch to get ready for the event. You hear the splashing, and the beep of the starter for other races. This is your best race, and you're ready for it. You're as fit as you have ever felt. You hear the starter call the 100 Free. You step up on the blocks. The starter says, 'Take your marks', and you bend into your starting position, waiting for the beep. You launch into a powerful dive, streamlined. Your first powerful kick brings you to the surface, and you begin strong strokes. You see yourself from above. You are powerful and beautiful. Everything is working. With each stroke, you feel stronger and stronger. You approach the first turn. You are focused on nothing but your race. You throw your legs over perfectly, pushing off the wall into a tight, streamlined shape, gliding smoothly. You enter the second half of your race. Your strokes are smooth and powerful. Your breathing is perfect.
>
> You tap into your reserve energy. You are exceeding your own expectations. You surge towards the wall and touch. You pull off your goggles and look up at the scoreboard. You won! And you beat your previous best time. You hear your breath slowing to normal. You become aware of the sights and sounds around you. You are a great swimmer.”
>
> *Editor's note:* This script was written for a 100 m freestyle event, but may be adapted to other events.

Other variations in mental rehearsal revolve around the athlete's perspective. An *internal perspective* is where the visualisation occurs through the eyes of the athlete. This form of visualisation is typically recommended for athletes participating in sports where it is important to identify environmental cues like the flight path of an implement or movement of an opponent. Alternatively, an *external perspective* is where the athlete visualises their performance from someone else's viewpoint or 'watching a movie of themselves'. Visualising performance from an external perspective is most beneficial when competing in aesthetic activities where athletes are judged by others.

Implementing mental rehearsal

The PETTLEP model for imagery created by Holmes and Collins in 2001 assists athletes to develop effective imagery routines to improve their performances. This model has been shown to have assisted a range of athletes, from novices to experts, and children to adults, and is most effective when they are imagining the whole skill or routine rather than just one part.

TABLE 7.8 Components of the PETTLEP model

Component		Recommendations to improve effectiveness of imagery
P	Physical	Athlete should wear the same clothes (or similar), assume correct stance and hold any implements that are used in competition.
E	Environment	Athlete should complete imagery in the same (or similar) environment where competition is held.
T	Task	The imaged task should be identical to the actual performance. As skill level increases, imagery should change to suit this.
T	Timing	Imagery should be completed in real time. If the performance lasts for three minutes, the imagery should replicate this.
L	Learning	Imagery experiences should reflect the stage of learning. As a performer masters a new skill, this should be reflected in their imagery.
E	Emotion	The level or arousal and specific emotions experienced during performance should be replicated throughout the imagery.
P	Perspective	Internal or external perspectives can be used. Usually, internal perspectives are recommended, but in aesthetic performances, external perspectives may be useful.

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 7.12 Visualising successful performance increases self-belief and the intrinsic desire to compete, and improves concentration.

Self-confidence techniques

An athlete's confidence is extremely fickle and can fluctuate based on a range of situations. It is widely acknowledged that thoughts directly influence an athlete's feelings, and ultimately the result of their performance. Expecting to be successful (high confidence) cannot guarantee a successful performance; however, expecting to be unsuccessful (low confidence) may guarantee failure. When preparing for a performance, athletes need to be mindful of negative thoughts, such as the following.

- 'I'm not good enough.'
- 'I'm not ready.'
- 'The opponent is too good.'
- 'I won't be able to finish.'
- 'I might mess up or get hurt.'

Focusing on negative thoughts results in feelings of anxiety, and can lead to increased muscle tension, which can impair the ability to perform. A successful athlete needs to be aware of negative thinking habits and practise controlling their negative thoughts.

Being able to identify thoughts that are negative or unproductive is essential. Thoughts that revolve around self-doubt, self-criticism and hesitation are most detrimental. It is essential that these negative thoughts are recognised as *just thoughts.* Challenging negative thoughts with questions such as 'Is this thinking giving me the best chance to be successful'? allows an athlete to clear the way to use more productive thinking to reflect on their performance.

Positive self-talk

Positive self-talk is a strategy used to readjust negative thought patterns that can affect sporting performance. It has been shown to boost confidence, enhance focus and concentration, and control levels of arousal.

Frequently, positive self-talk is associated with the use of **affirmations**. Affirmations are simply positive statements about you, your abilities or your goals that are true or reasonable enough to be valid in the future. Affirmations can reflect your present or future. For example, a tennis player may use the following affirmations to boost confidence levels.

- 'I was born to play tennis.'
- 'I can cover the court with ease.'
- 'I have a powerful and accurate serve.'
- 'I have sharp and accurate reflexes.'
- 'I have a range of effective shots.'
- 'I am developing into a top-level player.'

positive self-talk making positive comments to oneself, either silently or out loud

affirmation a positive statement about you, your abilities or your goals that is true or reasonable enough to be valid in the future

For most athletes, affirmations need to be complemented by further positive self-talk when reacting to stressful situations during the performance. This takes the form of either *instructional self-talk* or *motivational self-talk*. For example, a tennis player may enter a competition feeling relaxed and confident with their preparation and ready to perform. However, if they lose their first two service games, they may start overthinking why their performance is lower than expected. Negative thoughts, such as 'I'm not good enough for this opponent' or 'My serve is too weak', increase anxiety. In turn, this results in high levels of anxiety and muscular tension, so their technique is less effective and it is harder for them to get back into the set. As the name suggests, instructional self-talk involves replacing negative thoughts with thoughts about specific tasks or cues that will lead to successful performance. This type of positive self-talk is most beneficial when the

ISBN 978-1-009-31125-0 Stewart et al.

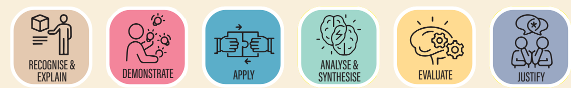
successful performance relies on a degree of precision and coordination. For example, when a tennis player is serving, they may repeat instructional cues such as ‘make high contact’ and ‘follow through straight’.

Alternatively, motivational self-talk involves the use of more general positive mantras and is more beneficial for athletes relying on strength or endurance. If the tennis player previously mentioned was commencing the third and deciding set of their match, they could incorporate mantras such as ‘keep going’, ‘I can do this’ or ‘I know my training will pay off during this set’.

CHECK-IN 7.4

1. Explain the relationship between thoughts, feelings and performance.
2. Make a list of five situations in physical activity that you think negatively about and five situations you think positively about.
3. Select one item from each list in question 2 and explain what incidents may have led you to develop these thought patterns.

ACTIVE INVESTIGATION 7.2



Inquiry question: How does the use of positive self-talk influence confidence and arousal during physical performance?

Recognise and explain

1. Predict the situations that would lead to negative thoughts during your performance.
2. Identify three positive affirmations that are relevant to you and your chosen physical activity.
3. Write your hypothesis: ‘I believe there will be a ____________ correlation between the reduction of negative thoughts and an improvement in my performance because ____________.’

Demonstrate and apply

4. Compete in your chosen physical activity and do the following.
   a. Track the number of negative thoughts you have during a performance. You can do this by keeping count in your head or by placing a number of counters (e.g. paperclips) in your left pocket and moving one to your right pocket every time you have a negative thought about your performance.
   b. List three situation-specific negative thoughts that you experienced the most during your performance.
   c. Evaluate your performance using an appropriate evaluation tool.
5. For three situations in which you experienced negative thoughts, devise a positive self-talk phrase that can redirect your thinking.
6. Participate in another competitive performance, implementing your positive self-talk strategies created in task 5.

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

KEY COGNITION

Implement: put something into effect

7. Re-evaluate your performance and record the number of negative thoughts you had.
8. Analyse the primary data and make links between the use of positive self-talk, negative thought processes and perceived performance.
9. Critique primary data by supporting or rejecting the identified trends based on valid and reliable research.

Evaluate and justify

10. In a paragraph, evaluate the effectiveness of the positive self-talk for reducing your negative thoughts and improving your performance. Justify one recommended change that would improve your positive self-talk process.

KEY MESSAGE

Positive self-talk eliminates negative thought processes that could be detrimental to performance.

KEY MESSAGE

Instructional self-talk uses specific performance cues to focus attention away from negative thoughts.

KEY MESSAGE

Motivational self-talk uses general positive statements and is most beneficial for endurance athletes.

FIGURE 7.13 Cortnee Vine kicks the match-winning penalty in the 2023 FIFA Women's World Cup Quarter Final against France.

ISBN 978-1-009-31125-0 Stewart et al.

Optimistic explanatory styles

A person's explanatory style is how they explain the positive and negative events that occur throughout training and competition. Athletes with an optimistic explanatory style are more confident and regularly outperform those with a pessimistic explanatory style. Be aware of how you explain events.

Explanatory styles are based around the following three dimensions.

- Personalisation – how much control did you have over the event?
- Permanence – how long will this event impact performance?
- Pervasiveness – how much impact will this event have on other aspects of your life?

An athlete with an optimistic explanatory style believes that a positive event will have a long-lasting impact on their performance, that their hard work and determination are directly responsible for the event, and that it will have a positive influence on other areas of their performance and their life.

Australian Cortnee Vine experienced a major positive event by kicking the match-winning penalty in the 2023 FIFA Women's World Cup Quarter Final against France. Using an optimistic explanatory style, she would have believed that her performance was due to all the hard work she had put into training her penalty shots (personalisation). Similarly, she would maintain confidence that she could replicate that performance into the future (permanence) and that this success would carry over into other areas of her game (pervasiveness).

Now imagine the French goalkeeper had stopped that penalty. Cortnee would have been disappointed and the outcome of the match could have been different, but she could still use an optimistic explanatory style to maintain her confidence in her playing ability. The difference is that she would use the optimistic explanatory style in the opposite manner. For example, she would attribute not scoring the goal to the quality of the save rather than a poor kick. Additionally, she would see this as an isolated event and not typical of her penalty shots or influential on other aspects of her performance.

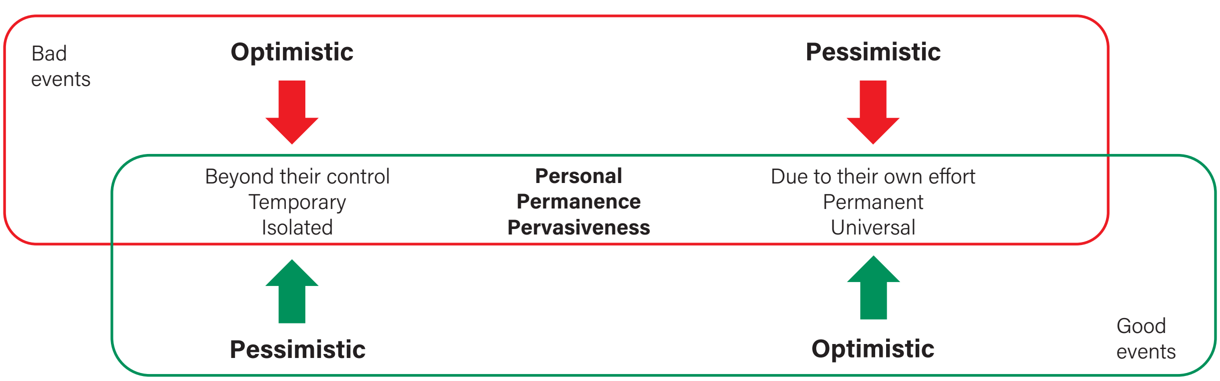


FIGURE 7.14 The use of explanatory styles

KEY MESSAGE

An optimistic explanatory style can be developed by manipulating thoughts about the personal, permanent and pervasive nature of an outcome.

KEY MESSAGE

A confident athlete sees a positive outcome as being due to their own efforts, long-lasting and influential on other areas of performance.

KEY MESSAGE

A confident athlete sees a negative outcome as a result of external sources, only temporary and isolated to one area of performance.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 7.3

RECOGNISE & EXPLAIN DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How does the use of a psychological strategy influence motivation or confidence when performing in a chosen physical activity?

Recognise and explain

1. Gather primary data on factors influencing either your confidence or your motivation in the selected physical activity.
2. Select and gather secondary data on how to effectively implement one psychological technique to improve either your motivation or confidence in the selected physical activity.

Demonstrate and apply

3. Develop a psychological strategy by clearly outlining the purpose and processes involved in implementing your psychological technique in class for your selected physical activity.
4. Over a series of lessons, implement your psychological technique and gather primary data on your performance from each performance and your level of motivation or confidence throughout this time. Make modifications to the implementation of your psychological technique and record the reasons for these changes as the lessons progress.

Analyse and synthesise

KEY COGNITION

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

5. Analyse the data by developing a series of graphs and tables, and draw conclusions from the data.
6. Synthesise the primary data by explaining the relationships between the implementation of the psychological technique, levels of motivation or confidence and the performance demonstrated in the selected physical activity throughout the data-gathering period.

Evaluate and justify

7. Evaluate the effectiveness of the strategy by appraising the outcomes and limitations.
8. In a paragraph, justify recommendations for maintaining and/or modifying the elements of your psychological strategy to optimise your performance.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Sport psychology is the study of how thoughts influence sporting performance.
- The main psychological factors influencing performance are motivation, confidence, arousal, concentration and team dynamics.
- Competence, autonomy and relatedness are all key to developing motivation.
- Motivating factors can be placed on a continuum from intrinsic sources to extrinsic sources.
- Confidence is considered the most influential psychological factor in determining success.
- Best performances occur when confidence is optimal and there is a balance between under-confidence and over-confidence.
- Goal-setting has been shown to assist in optimising levels of motivation, confidence, arousal and concentration.
- The three main types of goals are process goals, performance goals and outcome goals.
- Positive self-talk eliminates negative thought processes that could be detrimental to performance.
- Affirmations are positive statements that are reasonable enough to be true and build confidence.
- Instructional self-talk uses specific performance cues to focus attention away from negative thoughts.
- Motivational self-talk uses general positive statements and is most beneficial for endurance athletes.
- Optimistic explanatory styles allow an athlete to remain confident and can assist in dealing with setbacks.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Sport psychology is:
   A. a strategy to psych out your opponent.
   B. a science that explores the link between thoughts, feelings and physical performance.
   C. a means of predetermining what sports you would be good at.
   D. only relevant to elite athletes.
2. An athlete's motivation is directly related to their experiences of:
   A. competence, relatedness and autonomy.
   B. confidence, readiness and autonomy.
   C. competence, relatedness and anxiety.
   D. competence, relationships and a winning team.
3. Which of the following is not an intrinsically motivating factor?
   A. Learning a new skill
   B. Feeling stimulated
   C. Proving yourself to others
   D. Accomplishing a task
4. Self-efficacy is defined as:
   A. being able to complete a task with minimal wasted energy.
   B. the extent to which an athlete feels prepared for a performance.
   C. how certain the athlete is that they are going to win.
   D. the discrepancy between an athlete's ability and performance.

ISBN 978-1-009-31125-0 Stewart et al.

5. Which of these is not a key source of confidence?
   A. Being told you're doing a great job
   B. Seeing teammates produce a successful performance
   C. The amount of prize money involved
   D. Feeling optimistic about upcoming performances

SHORT-RESPONSE QUESTIONS

1. Explain the difference between optimistic and pessimistic explanatory styles when faced with both positive and negative events.
2. Identify your level of motivation towards succeeding in your current physical activity. Explain the influence of three motivating factors.

EXTENDED-RESPONSE QUESTION

Use primary and secondary data to justify how either motivation or confidence has influenced your ability to perform in your chosen physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 8

Arousal levels, attention and concentration to optimise physical performance

What's ahead?

Chapter 8
Arousal levels, attention and concentration to optimise physical performance

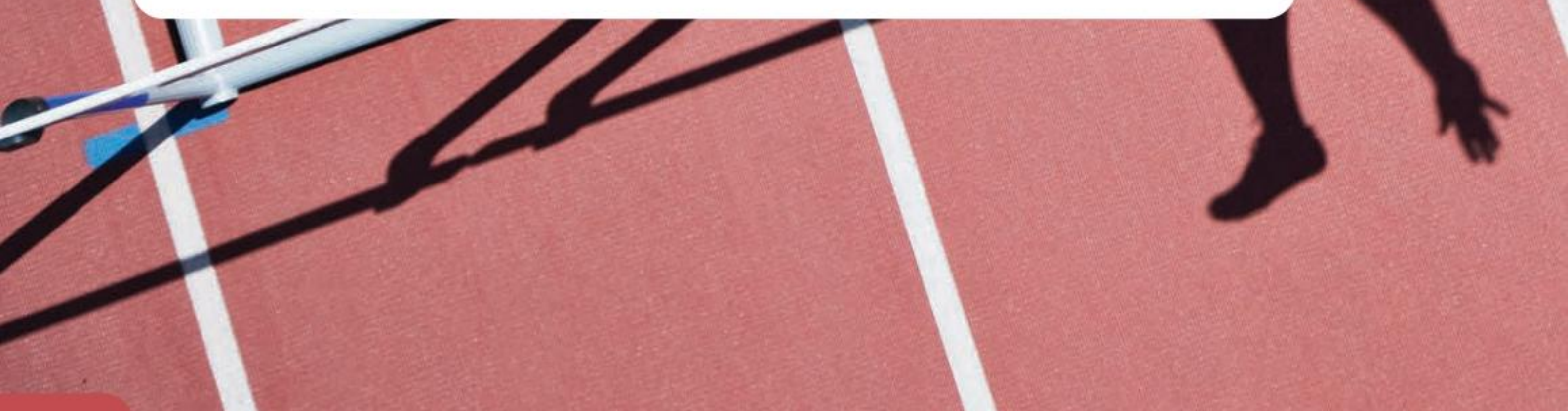
8.1
Arousal

8.2
Attention and concentration

8.3
Psychological techniques to maintain arousal, attention and concentration

Key subject matter

- Recognise and explain that sport psychology aims to optimise performance through the application of psychological knowledge and strategies.
- Recognise and explain the concepts of arousal, attention and concentration.
- Analyse and synthesise primary data and secondary data about the influence of sport psychology concepts and principles on specialised movement sequences and movement strategies.
- Identify and explore the impact of arousal, attention and concentration on personal performance in physical activity.
- Investigate information about psychological techniques that can be used to optimise performance.
- Investigate the use of psychological techniques on personal performance in authentic performance environments.
- Gather primary data about the influence of psychological techniques on personal performance of specialised movement sequences and movement strategies in authentic performance environments.
- Use secondary data to analyse how the sport psychology concepts and principles can influence performance in physical activity.



ISBN 978-1-009-31125-0 Stewart et al.

- Analyse primary data and secondary data to ascertain relationships between the sport psychology and movement strategies, concepts and principles, and personal performance.
- Optimise performance in physical activity by devising personal and team sport psychology strategies that consider the influence of sport psychology concepts and principles, effect of the psychological techniques and factors affecting their implementation.
- Justify the development of sport psychology and movement strategies using evidence from primary data and secondary data.
- Implement the sport psychology strategies and movement strategies to gather primary data about the outcomes and limitations of decisions.
- Reflect on primary data and secondary data to evaluate the effectiveness of sport psychology and movement strategies to achieve a determined outcome.
- Make decisions to maintain or modify the sport psychology strategies and movement strategies.
- Justify maintenance or modification of the sport psychology and movement strategies using evidence from primary data and secondary data.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- How do arousal levels affect physical performance?
- How can performers control arousal level?
- How can level of arousal be measured prior to and during performance?
- Which psychological strategies can be implemented to regulate arousal levels?
- How do attention and concentration affect physical performance?
- How can performers control attention and concentration?
- How can attention and concentration be monitored during performance?
- Which psychological strategies can be implemented to maintain appropriate attention and concentration during performance?

ISBN 978-1-009-31125-0 Stewart et al.

8.1 Arousal

The third psychological factor that can influence an athlete's physical performance is their level of **arousal**. Arousal is defined as a combination of the mind and body's level of activation and preparedness to complete a task. These physiological responses, such as increases in heart rate and respiratory rate, along with psychological responses such as changes in attention levels and focus, will vary depending on the task at hand and motivating factors driving the performance.

> **arousal** a state of physical excitement or attentiveness

Relaxed drowsiness	Wakefulness	Curiosity & attentiveness	Joy	Exhilaration	Anxiety	Panic	Rage
Under-aroused →							Over-aroused

FIGURE 8.1 Arousal continuum

ENGAGE 8.1

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: How do arousal levels influence our physiological and psychological state?

Recognise and explain

1. Think about previous physical activity experiences where you have noticed that your arousal levels have not been ideal. Compile two lists that categorise each of your experiences as feelings of under-arousal or over-arousal.
2. For each of your lists in task 1, describe how your body typically felt, how clearly you could focus and your mood.

Demonstrate and apply

3. Participate in the series of activities below. As you complete each activity, collate primary data on your heart rate, your breathing rate, your level of arousal (use the arousal rating scale in Table 8.1), what you were thinking about and your ability to focus throughout the task.
   a. Find a quiet space to lie down and focus on your breathing.
   b. Listen to calming music.
   c. Listen to upbeat music.
   d. Watch footage of an elite performance in your chosen physical activity.
   e. Stand in front of the class and give a one-minute recount of your most embarrassing sporting moment.
   f. Complete a typical warm-up.

ISBN 978-1-009-31125-0 Stewart et al.

g. Participate in your chosen physical activity.

h. Continually punch a boxing bag or tackle bag for one minute.

Analyse and synthesise

4. Collate primary data by surveying 10 class members. Choose a series of graphical displays that identify trends within and between activities. For example, you could track changes in heart rate for each activity in a bar graph. Or you could determine percentages of people who could or couldn't concentrate during an activity.

Evaluate and justify

KEY COGNITION

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

5. Evaluate the most important physiological and psychological indicators that let you know whether you are over-aroused or under-aroused.

6. In a statement, justify how successful you are at identifying your arousal level before, during and after a performance.

TABLE 8.1 Arousal rating scale

	Level of arousal		Description
Low	0	Relaxed and drowsy	• Your body is in a resting state. • Your mind is not focusing on the performance.
	1	Wakefulness	• You have started to contemplate the performance. • You feel tired and are easily distracted. • Your attention is mostly focused on external performance factors, such as weather, start time and getting equipment organised. • Your body feels calm and relaxed.
	2	Curiosity and attentiveness	• Your heart rate has increased, but you are still relaxed. • You can visualise aspects of your performance. • You are focusing on getting ready to perform.
	3	Joy	• You feel energised and positive. • Your muscles feel warm yet relaxed. • You have clear thoughts of what you need to do to perform successfully. • You can visualise vivid images of a successful performance.
	4	Exhilaration	• You feel ready to produce peak performance. • Your movements are coordinated and fluid. • You have optimal focus and are 'in the zone.' • You have distinct feelings of being successful in your task.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 8.1 *(continued)*

	Level of arousal		Description
	5	Anxiety	• You feel nervous. • Your muscles feel tense. • You can feel a strong pulse in the absence of exercise. • You find it harder to concentrate on the complicated components of the task.
	6	Panic	• You begin to feel jittery and irritable. • You have negative thoughts and are fearful of negative results. • You feel overwhelmed and have lost confidence. • You feel nauseous and have a dry mouth. • You start sweating more.
High	7	Rage	• You feel extremely angry and may resort to violent outbursts (physical or verbal). • You have lost focus on the task. • Your heart is pounding and you breathe faster and move more (in the absence of vigorous exercise).

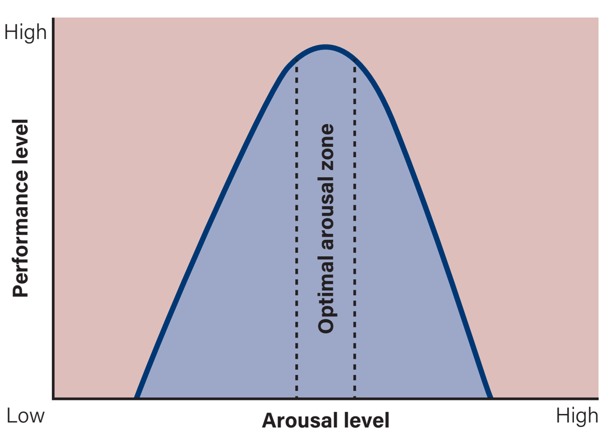


FIGURE 8.2 The inverted-U hypothesis – the optimal arousal zone is centrally located between levels of low arousal and high arousal.

Optimising arousal levels for performance

Levels of arousal fall along a continuum ranging from the low arousal levels experienced when you are just waking to the high arousal levels experienced with a heightened sense of excitement or rage. The inverted-U hypothesis suggests that athletic performance is hindered when arousal levels are either too high or too low for the designated task.

If an athlete is **under-aroused**, their body is less responsive and their ability to concentrate and the attentiveness required to complete the task will be lacking. Being under-aroused can be caused either by feelings of over-confidence, where the athlete expects to win, or by feelings of low confidence, where the athlete believes they have no chance of success. It can also result from a lack of appropriate stimulus in the training or the competition environment. It is hard to 'get excited' when training is repetitive and boring.

Alternatively, if an athlete's arousal levels are above those required to produce peak performance, they are **over-aroused**. This anxiety, panic or rage leads to an increase in muscle tension, resulting in a variation in technique execution, being overly aggressive or feeling nauseous. Mentally, this may lead to poor reading of the game situation and irrational or ineffective decision-making. It may involve overthinking or second-guessing abilities or strategies. Over-arousal is usually caused by pressure placed on an athlete to be able to produce a successful outcome and manifests as anxiety or stress for the performer.

under-aroused when arousal levels are too low for an athlete to produce optimal performance

over-aroused when arousal levels are too high for the athlete to produce optimal performance

ISBN 978-1-009-31125-0 Stewart et al.

Further investigation into the inverted-U hypothesis has developed variations on where optimal performance zones fall based on the level of experience of the athlete and the complexity of the task being performed. The more skill and experience someone has in completing a task, the higher the level of arousal they are able to experience before their performance declines. For example, a less experienced archer may struggle to maintain a high level of performance under the pressure of a competition, whereas an experienced archer can continue to perform at higher levels of pressure. Likewise, the skill level required to complete a task dictates the influence of the arousal levels on performance. A touch football player experiencing high levels of arousal would probably have no trouble executing a simple skill like dumping the ball. However, even though they have mastered it in training, they may find executing a more complex task, like throwing a long cut-out ball accurately, too difficult if their arousal levels are high.

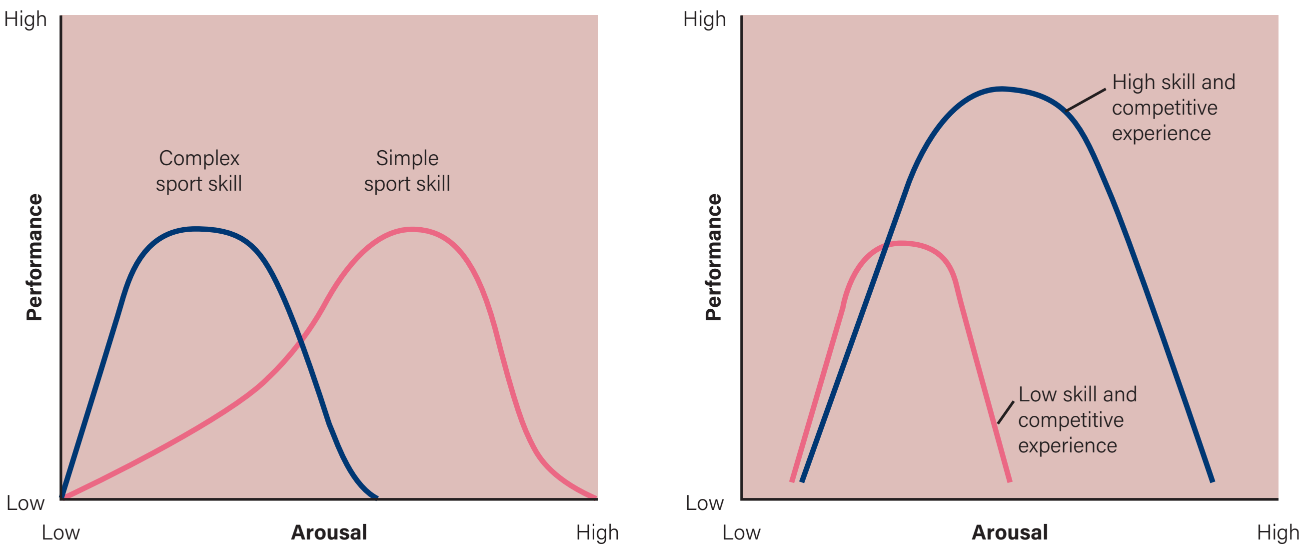


FIGURE 8.3 Varying optimal arousal levels

FIGURE 8.4 British athlete Greg Richards using a technique to reduce arousal

ISBN 978-1-009-31125-0 Stewart et al.

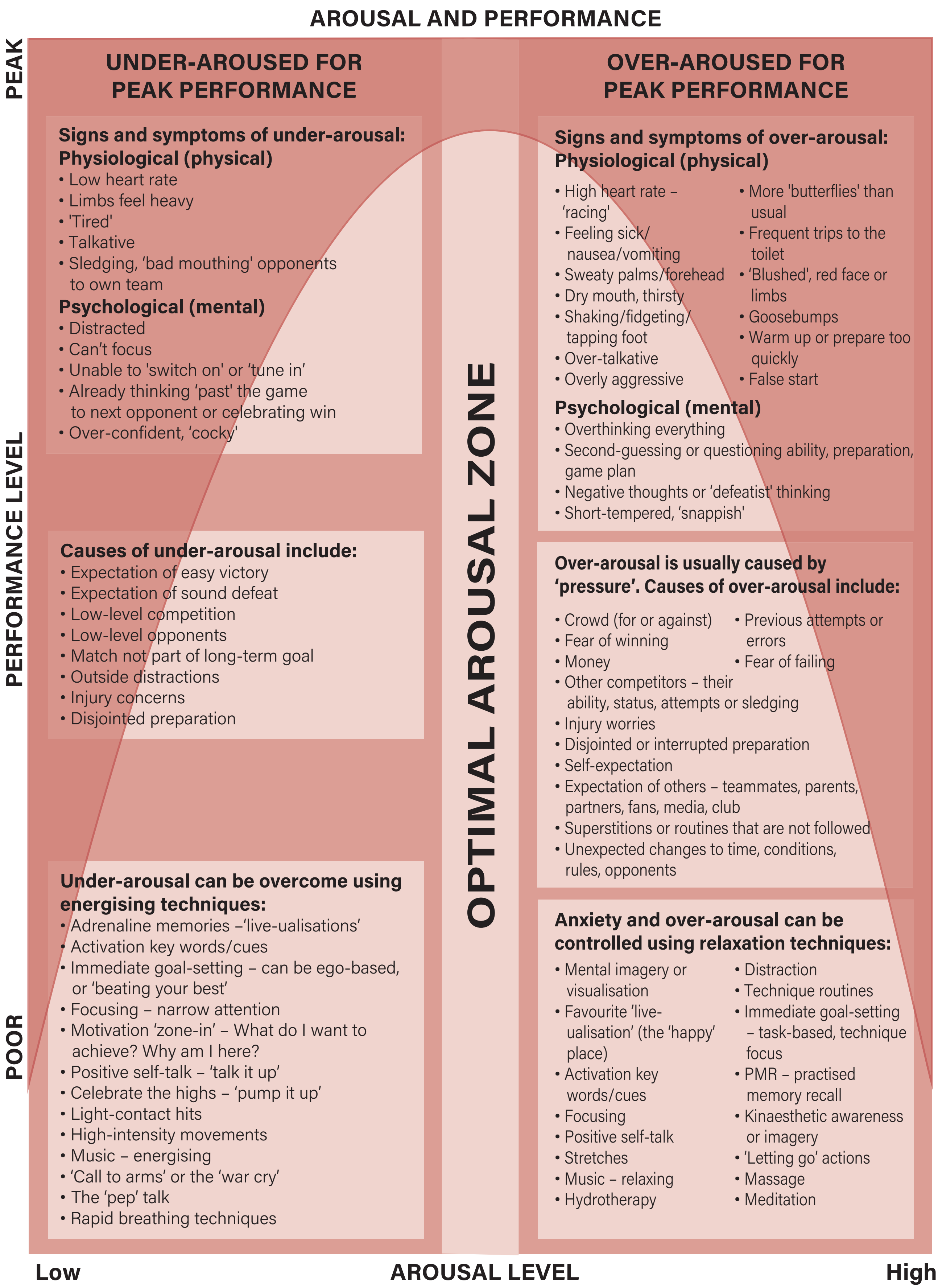


FIGURE 8.5 Signs, symptoms and causes of under-arousal and over-arousal

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 8.2

RECOGNISE & EXPLAIN DEMONSTRATE APPLY EVALUATE JUSTIFY

Inquiry question: What are the causes of suboptimal arousal levels when performing in our current physical activity?

Recognise and explain

1. Consider your experience in executing the required skills for your chosen physical activity. Construct a performance vs. arousal graph predicting the placement of the inverted-U (and optimal arousal zone) for each skill.

Demonstrate and apply

2. Participate in your chosen physical activity and compile a list of situations in which you felt you were either under-aroused or over-aroused and the impact this had on your performance.

Evaluate and justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

3. Justify the three main causes for your arousal levels being too high or too low during this experience.

Anxiety

Anxiety is the negative interpretation of arousal levels experienced by an athlete and is the first indicator that arousal levels are too high. If an athlete feels as if they are not at an ideal level of preparedness for the task, they will begin to develop feelings of discomfort or uneasiness and a decreased level of confidence. **Cognitive anxiety** refers to the thought processes associated with anxiety and includes nervousness, negative thoughts and feelings of apprehension. **Somatic anxiety** involves the physical responses to anxiety, and includes experiencing butterflies, sweating, heavy breathing or an elevated heart rate. An athlete's anxiety is not fixed at a certain level but is ever-changing throughout different stages of a performance. For example, it is normal for a long-jumper to feel an increase in heart rate and 'have butterflies in their stomach' immediately before a competition. If their first attempt is a successful jump, their symptoms of anxiety would reduce. However, if this first attempt was a foul, or believed to be unsuccessful, then increased anxiety could lead to negative thoughts about their ability or apprehension regarding the effort they are prepared to exert.

anxiety an uncomfortable feeling of nervousness or worry about something that is happening or might happen

cognitive anxiety the specific thought processes that occur during anxiety

somatic anxiety the physical symptoms of anxiety

ISBN 978-1-009-31125-0 Stewart et al.

KEY MESSAGE

Optimal levels of arousal for athletes lie between under-arousal and over-arousal.

KEY MESSAGE

Cognitive anxiety and somatic anxiety result from negative responses to over-arousal.

KEY MESSAGE

Optimal levels of arousal can vary, based on ability and complexity of skills.

8.2 Attention and concentration

Attention refers to all the internal and external factors of which an athlete is consciously aware at any one point in time. Internal factors include physiological responses such as fatigue or pain, as well as psychological responses like performance evaluation and feelings of self-efficacy. External factors typically originate from environmental conditions such as wind or the playing surface, or situational conditions such as where the opposition is positioned. Being able to effectively utilise this information is vital to successfully completing a task. Whereas a beginner may be overwhelmed by the multitude of information or miss essential cues, a successful performer can effectively filter all this information and quickly categorise the cues as relevant or irrelevant for their task.

Concentration is the level of attention the athlete is paying to the relevant information needed for successful performance. Moreover, an athlete needs to continually adjust their attention in terms of the direction (internal to external) and range (broad to narrow) of information on which they are focused. Throughout a performance, an athlete's attentional focus can typically be placed within one of the following four categories: broad external, broad internal, narrow internal and narrow external (see Table 8.2).

attention the act or state of applying the mind to something

concentration the ability to think carefully about something you are doing and nothing else

Different physical activities require different levels of concentration in each of the four categories. They will also vary with regard to the speed and frequency required to adjust the focus from one category to another during the performance. These differences are quite clear when comparing athletes in two very different sports, such as archery and netball. An archer does not need to pay much attention to many external cues, as they perform in a predictable environment. Instead, they place more emphasis on and take a lot more time to identify and categorise the relevant internal cues for each shot. They place a higher focus and more of their attention on analysing the consistency of their technique and preparing for any required adjustments. Alternatively, a netballer focuses a lot of their attention on a range of external cues, such as the position and movements of the other players on the court. Due to the fast-paced nature of the game, they also have limited time to analyse and prepare for each skill. Furthermore, they have to narrow their attention more quickly to concentrate on the ball when catching and passing before again broadening their attention to decide on their next movement.

Errors in performance typically are associated with lapses of concentration. The focus of the athlete's attention is not on the most important information required for that stage of performance. Concentration can be affected by both internal distractions (e.g. negative thoughts, fear of failure) and external distractions (e.g. crowd noise, score). Errors in performance can also be attributed to having an attentional focus that is too broad or too narrow. If focus is too narrow, key environmental cues may be missed. If focus is too broad, it would be difficult to efficiently filter the relevant and irrelevant information required for success.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 8.2 Categories of attentional focus

<table>
<tr><th></th><th>External</th><th>Internal</th></tr>
<tr><td>Broad</td><td>Assessing the scene

Shifts focus to general external cues in attempt to identify the most relevant information for their performance. This might include:
wind speed/direction
nature of playing surface
sounds of play
position, actions and sounds of other performers
score
surrounding noise (crowd, music).</td><td>Analysing the options

Shifts focus to reviewing general internal cues to decide on the best course of action for their performance. This might include thoughts and feelings about:
previous success
previous failures
what is most likely to succeed
how much risk is acceptable
level of fatigue
personal feelings.</td></tr>
<tr><td>Narrow</td><td>Acting

Shifts focus to specific external cues in order to successfully execute the performance. Focus on specific external cues such as:
tracking objects or targets
tracking player positions.</td><td>Preparing to perform

Shifts focus to the specific internal cues that will ready them for the performance. This could include psychological and physiological cues to ensure that the body is ready to perform the skill (e.g. using a pre-performance routine).</td></tr>
</table>

TABLE 8.3 Errors in concentration and performance

<table>
<tr><th>Skill</th><th>Required concentration</th><th>Possible errors in concentration</th><th>Errors in physical performance</th></tr>
<tr><td rowspan="2">Catching a netball</td><td rowspan="2">Narrow external focus – tracking the trajectory of the ball into the hands</td><td>Broad external focus – looking at the positions of other players on the court</td><td rowspan="2">
Mistiming the catch</td></tr>
<tr><td>Broad internal focus – over-thinking the next play (e.g. where to pass, where to run, the score, recent errors)</td></tr>
</table>

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 8.1

1. For the following physical activities, classify one situation that requires a broad focus and one that requires a narrow focus:
   - cricket
   - lawn bowls
   - badminton
   - touch football
   - netball
   - sports aerobics
   - high jump
   - 200 m butterfly swimming race.
2. Using a pie chart, display the predicted percentage of time that you would need to maintain a broad focus vs. a narrow focus for each of the activities in question 1.
3. Make and justify two statements regarding correlations between type of physical activity (team/individual, performance/invasion) and the attentional requirements.
4. Organise all the attentional requirements for your current physical activity into the four categories of attentional focus (broad external, broad internal, narrow internal, narrow external).
5. Select three errors that are common in your physical activity and identify how lapses in concentration contributed to these errors (refer to Table 8.3).

TABLE 8.4 Attention and concentration rating scale

	Level of concentration		Description
Low	0	Totally distracted	• Your attention is not on the performance or situation at hand. • Irrelevant or external cues that do not dictate performance are the primary focus of attention.
	1	Distracted and inattentive	• You have broad attentional focus, with many irrelevant or external cues integrated with those relevant cues from the performance environment. • Your decision-making is slow or ineffective as it is being influenced by irrelevant elements or issues from the environment, or by other issues not associated with the performance.
	2	Attentive	• You have broad attentional focus that is about the task at hand. • You have minimal distractors in your thinking, which occasionally influence decisions and performance.
	3	Attentive and focused	• You have broad attentional focus that is on relevant external or internal cues from the performance environment. • Concentration is generally about overall performance or outcomes.
	4	Zoned-in	• You have a more narrowed attentional focus that is on specific relevant external or internal cues that will influence your course of action and therefore the performance outcome. • Concentration is on what is to be done now based on the situation and available thinking–acting time.
High	5	Totally focused	• You have a narrow attentional focus that is on the correct cues influencing your course of action for the situation. • Concentration is fully on the internal processes of reading cues, deciding on actions and performing a suitable response. • There are no distractors influencing your actions.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 8.3

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: What distractions impact our concentration and ability to perform with accuracy?

Recognise and explain

1. Select a skill within your current physical activity and design a task that requires accuracy (e.g. shoot a free throw, pass a ball through a hoop).
2. Explain which category of attentional focus is the most important for this task.

Demonstrate and apply

3. Perform a control experiment by executing the skill 10 times with no distractions (note your score).
4. Repeat this experiment by adding one of these distractions at a time.
   a. Loud music in the background
   b. A classmate trying to distract you by jumping around near the target (if safe to do so)
   c. A classmate trying to distract you by using negative, but not hurtful, comments (such as 'You're going to miss')
   d. Incorporating a punishment for inaccurate performance (e.g. 10 push-ups for every miss).

Analyse and synthesise

5. Calculate average scores for the control and the different distracting scenarios.
6. Identify any patterns within your results for each scenario. For example, were the 10 attempts consistent? Did your performance improve or get worse during the 10 attempts?

Evaluate and justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

7. Draw a conclusion from your data that indicates which distraction had the most influence on your performance.
8. Justify this conclusion with secondary research data that supports your results. For example, your research question may involve comparing how distracting loud music is to personal comments.

KEY MESSAGE

The focus of an athlete's attention will fall into one of four categories.

KEY MESSAGE

Attention is continually shifting from one category to another.

KEY MESSAGE

Misdirected attention is linked directly to errors in physical performance.

ISBN 978-1-009-31125-0 Stewart et al.

8.3 Psychological techniques to maintain arousal, attention and concentration

Pre-performance routines

Pre-performance routines assist athletes to focus on specific performance cues instead of potentially damaging thought processes such as missing a shot, losing a game or negative evaluations of their competency and self-efficacy. Pre-performance routines traditionally have been associated with closed skills, in which an athlete has a high degree of control over the environment. Examples of closed skills associated with pre-performance routines are a golf swing or putt, a free throw in basketball, and a serve in tennis, table tennis or badminton. All these skills can be practised over and over without relying on teammates or opposition. The importance of pre-performance routines in sports was highlighted by National Basketball Association star Russell Westbrook. He was voted the 2016–17 NBA Most Valuable Player and had a career free throw shooting percentage of 82.2 per cent. He had to modify his pre-performance routine before taking his second free throw to accommodate a new rule enforced by the NBA that banned walking beyond the three-point line between free throws. This resulted in his success rate at the free throw line plummeting to 55.6 per cent at the beginning of the 2017–18 season.

FIGURE 8.6 Russell Westbrook shooting a free throw

> 'I used to shoot and walk back behind the 3, and I'm not allowed to do that because of this new rule. I've been doing that since high school. Just gotta figure it out, figure out a different routine where I can take some time, take a deep breath, and figure it out. But I'll be alright.'
>
> – Russell Westbrook

When creating successful pre-performance routines, it is recommended to include both positive self-talk and a consistent set of actions that can easily be repeated before attempting the skill.

An example of a pre-performance routine for volleyball could include the following:

Preparation phase:

- Stand 1 m behind the service line.
- Take two deep breaths.
- Think 'My overhead serve is my strength'.

Focusing phase:

- Select service target.
- Bounce the ball twice with both hands.
- Focus on the target.
- Think 'swing fast, hit flat'.

Execution phase:

- Take two deep breaths.
- Throw the ball up with your left hand.
- Step forward and hit with your right hand.

FIGURE 8.7 Australian beach volleyball player Nicole Laird preparing to serve

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 8.1

RECOGNISE & EXPLAIN DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How will the use of a pre-performance routine influence confidence and arousal during physical performance?

Recognise and explain

1. Identify a list of common errors or areas of inconsistency that occur when performing your chosen physical activity.
2. Examine the causes of these errors. Consider factors such as technique, psychological state, concentration and fatigue.
3. Identify three key factors that you need to develop to improve your performance.

Demonstrate and apply

4. Participate in a competitive performance and evaluate your psychological state (confidence and arousal) and your level of performance.
5. Construct a pre-performance routine that incorporates a consistent set of actions and positive self-talk. Specifically, try to target the factors identified above that are affecting your performance. Make sure you clearly develop a preparation phase, focusing phase and execution phase.
6. Over a series of lessons, practise implementing your routine in a series of environmental conditions (high pressure, loud noise, different competitors).
7. Participate in another competitive performance and re-evaluate your psychological state and your level of performance.

Analyse and synthesise

8. Analyse the primary data and make links between the use of pre-performance routine, your psychological state and your performance.
9. Critique primary data by supporting or rejecting the identified trends based on valid and reliable research.

Evaluate and justify

KEY COGNITION

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

10. In a paragraph, evaluate the effectiveness of your pre-performance routine on reducing your errors and improving your performance. Justify one recommended change that would improve your positive pre-performance routine.

ISBN 978-1-009-31125-0 Stewart et al.

KEY MESSAGE

Pre-performance routines help athletes to mentally and physically prepare for performance.

KEY MESSAGE

Pre-performance routines typically are associated with closed skills.

KEY MESSAGE

A good pre-performance routine involves positive self-talk and a consistent set of actions.

Arousal-regulation techniques

Achieving optimal levels of arousal for performance can be achieved through the use of various relaxation and energising techniques. Elite athletes looking for a psychological edge are likely to engage in one or more of these approaches to regulate their level of arousal. As with any essential skill, these techniques require specific training to master them.

Progressive muscle relaxation

Progressive muscle relaxation (PMR) is one common method of reducing arousal levels and associated somatic anxiety. It is also believed that cognitive anxiety is reduced as a result of decreased muscle tension. PMR involves progressively tensing then completely relaxing each muscle group. The purpose of this technique is to teach the athlete how to identify tension in the body and then to be able to release it when needed. Ideally, after practising this technique, competitive athletes are able to identify tension in specific muscle groups and are able to relax them as they are competing.

Progressive muscle relaxation

- Find a quiet space to either sit or lie down quietly where you will not be distracted.
- Start by focusing on your breathing. Take about 10 deep controlled breaths; each breath should fill the abdomen and slowly be released.
- Contract each muscle group for five seconds before relaxing. As you relax each muscle group, focus on releasing the tension from the area of the body. Contractions can be completed either unilaterally (one side at a time) or bilaterally (both sides at the same time).

Progressive muscle relaxation order:

Legs and lower body

- Contract the muscles of your feet at the toes by bending the toes down and curling the arches of the feet. *Hold for five seconds and release.*
- Tense the muscles of your lower legs by flexing the ankles and pointing the toes back towards you. *Hold for five seconds and release.*
- Tense the muscles of your upper leg by squeezing the thigh muscles. *Hold for five seconds and release.*
- Contract the muscles of your buttocks by squeezing them together. *Hold for five seconds and release.*
- Contract your abdominal muscles by sucking your stomach in towards your spine. *Hold for five seconds and release.*

Arms

- Contract the muscles of your hand by making a fist and flexing the wrist. *Hold for five seconds and release.*
- Tense your forearm muscles by tensing the biceps and triceps. *Hold for five seconds and release.*

ISBN 978-1-009-31125-0 Stewart et al.

Upper body

- Contract your chest muscles by taking a deep breath and drawing your shoulders back. *Hold for five seconds and release.*
- Tense the muscles in your neck and shoulders by shrugging your shoulders up and tilting your head back. *Hold for five seconds and release.*
- Contract the muscles of your jaw by opening your mouth as wide as possible. *Hold for five seconds and release.*
- Contract the muscles of your eyes by tightly shutting your eyes. *Hold for five seconds and release.*
- Contract the muscles of your forehead by raising your eyebrows as high as possible. *Hold for five seconds and release.*

ENGAGE 8.4

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | EVALUATE | JUSTIFY

Inquiry question: How effective is progressive muscle relaxation for reducing arousal?

Demonstrate and apply

1. Have each individual class member evaluate their level of arousal.
2. Each person finds a place to sit back or lie down.

KEY COGNITION

Apply: use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation

3. Read through the progressive muscle relaxation script on pages 166–7. Remember that this exercise is most effective if each individual muscle is tensed. Do not tense muscles to the point of strain, and refrain from tensing injured areas of the body.
4. Re-evaluate arousal levels.
5. Participate in five minutes of vigorous physical activity.
6. Re-evaluate arousal levels and analyse changes before and during activity. This could include looking at class averages, and identifying who had the largest decrease in arousal and whose level of arousal did not change.

Evaluate and justify

7. Use a series of statements to evaluate how effective this progressive muscle-relaxation exercise was in optimising arousal levels during rest and following vigorous physical activity.

Breathing techniques

People experiencing acute anxiety or panic are told to take a deep breath. Therefore, teaching the skill of deep breathing can also help reduce an athlete's arousal levels. Somatic anxiety levels lead to feelings of tension and short, shallow breathing. Alternatively, deep, calm breathing is a sign that an athlete is relaxed and in control of a situation. By training their breathing, athletes will also be able to control their levels of tension and adjust their arousal to optimal

ISBN 978-1-009-31125-0 Stewart et al.

levels. Controlled breathing is best used during breaks in performance, like a time-out or change of ends. To reduce arousal levels, extending the exhalation phase is required and a 1:2 ratio of inhalation to exhalation should be used. To increase arousal levels, the inverse is true. An elongated inhalation implementing a 2:1 ratio will increase tension and energise the athlete.

Music

Music is another tool that can be used to help an athlete dissociate from distractions and regulate their levels of arousal. Listening to their favourite music will improve the athlete's mood. Many athletes incorporate music into their pre-competition routine. Calming, slow music has been shown to calm an athlete's nerves and reduce levels of arousal. This is most useful in sports that require higher levels of precision, like archery or golf. Alternatively, fast, stimulating music increases arousal and overall levels of motivation to perform. Athletes participating in sports likes athletic jumps and throws that require short, powerful movements would most benefit from faster music.

ENGAGE 8.5

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE

Inquiry question: Does listening to music during a warm-up influence arousal regulation?

Evaluate

1. Each class member evaluates their level of arousal before a game.

Demonstrate and apply

2. Conduct a class warm-up and evaluate levels of arousal.
3. Engage in competition and record when each class member believes they have reached their optimal arousal level.

KEY COGNITION

Apply: use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation

4. Create individual 10-minute playlists to listen to during warm-up, which help regulate arousal (towards optimal levels).
5. Engage in another competition and again record when each class member believes they have reached their optimal arousal level.

Analyse and synthesise

6. Analyse the data and make comparisons between initial arousal levels and the time taken to achieve optimal arousal with and without music.

Evaluate

7. Use a series of statements to evaluate how effective listening to music was in optimising arousal levels during rest and following vigorous physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

Visualisation

Visualisation can also be used to manipulate arousal levels. If successful performance is clearly visualised, the athlete's motivation increases. The extent of this increase depends on the ability to clearly visualise success and associated feelings of joy and excitement. Subsequently, the greater motivation to compete results in an increased level of arousal. Visualising success can also help relax an athlete, as they feel more competent to complete the task successfully. This reduces the anxiety related to failure and limits internal distractions.

visualisation creating and focusing on a range of positive mental images and experiences

FIGURE 8.8 Some athletes use music to dissociate from distractions.

CHECK-IN 8.2

1. Have your teacher talk you through a simple scenario from the physical activity that is your current focus – for example, serving for the match in tennis, volleyball, badminton or table tennis; teeing off on the first hole or putting for the match on the 18th hole; running through a rucking pattern to work out of your half in a touch football match; using a centre pass move in netball; or competing in any athletic or swimming events. The scenario should be quite specific and your teacher should outline the venue, time of day, weather conditions, score and any other features that might help imagine the performance. While your teacher sets the scenario, close your eyes and imagine you are performing in the scenario.
2. Copy the table below and then evaluate the effectiveness of your visualisation by placing a tick in the appropriate numbered box along the continuum for each imagery element.

	1	2	3	4	5	
Distractible						Total concentration
Fuzzy						Sharp
Black and white						Colour
No feeling						Felt every move
No sound						Sound
Confused						Knew my job
Scared						Confronted situation
Unsuccessful performance						Perfect performance
No emotion						Emotional
Distorted time (fast/slow)						Real time
Self only one involved						Saw faces of opposition

ISBN 978-1-009-31125-0 Stewart et al.

KEY MESSAGE

Optimal arousal levels can be achieved by incorporating one or more relaxation or hype-up strategies.

KEY MESSAGE

Relaxation strategies reduce anxiety and include listening to music, progressive muscle relaxation and breathing.

KEY MESSAGE

Hype-up strategies increase readiness to perform and can be achieved through visualisation, listening to fast-tempo music and breathing.

Optimising attention and concentration

'Choking' is a common term used when athletes drastically underperform during high-pressure situations. It is believed that lapses in concentration are caused by increases in anxiety and muscle tension. This might occur during important periods in a season, like finals games, or important periods of an isolated performance. For example, batters in cricket place extra emphasis on scoring centuries, so their anxiety increases during the 'nervous nineties', where they are close to this milestone. This anxiety could inhibit their decision-making and their ability to play high-percentage shots.

Home ground advantage is often referred to in relation to athletes or teams. Most sporting teams naturally have a superior record when competing at their home ground. One reason for this is that they have become efficient at filtering information and accustomed to potential distractions in their environment. Competing in 'away' fixtures or competitions requires adjustments to effectively filter environmental cues and block out distractions. Naturally, opposition crowds and announcers are quite happy to provide visiting athletes with as many distractions as they can to support their own team.

Strategies that athletes use to control attention and improve concentration include:

- training selective attention
- using trigger words
- performance segmenting
- pre-performance routines
- within-competition routines.

Training selective attention

Selective attention refers to the ability to efficiently filter relevant and irrelevant information to complete a task. This can be achieved by learning to block the internal and external distractions that occur during a performance. When training to improve selective attention, athletes familiarise themselves with the playing conditions faced during competition. A player or team may prepare for a competition with loud music or simulated crowd noise playing in the background. This helps them to block out this irrelevant external information and maintain concentration on important performance cues. Similarly, they may practise executing their plays immediately following periods of intense physical activity in order to practise ignoring irrelevant internal cues associated with fatigue.

Trigger words

Trigger words are simple words, sayings or acronyms that an athlete can utilise to refocus their concentration back to the relevant performance cues. When focusing on the cues associated with trigger words, athletes are automatically blocking out distractions that could hinder their performance. When developing trigger words, it is essential that an athlete uses a phrase that is short, personal and positive. Furthermore, the phrase should relate directly to the performance and/or the potential distractions the athlete is likely to experience. In general, trigger words refocus attention to tactical, emotional and/or psychological cues. Trigger words are extremely important during a performance to re-establish focus after an error, as they help the athlete not to dwell on their mistake.

ISBN 978-1-009-31125-0 Stewart et al.

Segmenting performance

Segmenting performance is a strategy by which athletes plan ahead to complete smaller tasks within their performance and narrow their concentration accordingly. For example, a 400 m runner may break their race into two segments. They focus the first part of their race on internally pacing themselves and ensuring that they are using an efficient technique and not burning too much energy. However, during the second segment of the race, they adjust their concentration externally to be able to focus on their position and the strategy of their opponents. Segmenting performance is also beneficial for quickly adjusting focus during a performance and isolating errors. A volleyball player, for example, would separate their attention from serving to playing on the court. When serving, they have a narrow focus, but when playing on the court they have to broaden their focus and start playing defence. By segmenting the different performance tasks, an error on serve is less likely to influence their concentration during court play.

Pre-performance routines

The use of pre-performance routines is commonplace where the environment is stable. These include actions or sayings that help an athlete to narrow their attention to the task at hand and limit the distractions from external sources. Similar to using trigger words, if the focus of attention is on completing a familiar routine, there will be less focus on irrelevant distractions.
A 100 m sprinter would incorporate a pre-performance routine to block out irrelevant internal and external distractions to prepare for their race.

FIGURE 8.9 Runners may break their race into two segments – one to pace themselves, and the other to focus on their position.

Within-competition routines

During competition, routines are used to refocus attention and typically are used when the parameters of the performance change. For example, a goal shooter in netball needs to have a broad attentional focus to get away from the defender and into space. However, they need to quickly change their focus after receiving a pass in the goal circle. A simple performance routine, such as taking a deep breath and focusing on the back of the hoop, helps block out the actions of the defender and narrow their focus in preparation for shooting.

FIGURE 8.10 Michelle Jenneke dancing as part of her pre-performance routine

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 8.2

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: How does the incorporation of attention and concentration training impact performance in a physical activity?

Recognise and explain

1. Examine the key causes of distractions for you in your chosen physical activity. Think specifically about distractions that draw your concentration away from the essential cues of your tasks or skills.
2. Collect secondary data by conducting background research into common attention and concentration techniques used by athletes in your chosen physical activity.
3. Select an attention and concentration strategy to incorporate into your training and performance.

Demonstrate and apply

4. Participate in a competitive performance and evaluate your psychological state (motivation, confidence and arousal) and your level of performance.
5. Design and implement a series of practice lessons in which you can incorporate your attention and concentration strategy.
6. Participate in another competitive performance and re-evaluate your psychological state and level of performance.

Analyse and synthesise

7. Analyse and interpret the primary data by developing a series of graphs and tables that demonstrate the main findings. Some examples of graphical displays could include:
    a. column graphs that show results of your psychological states before and after implementing your strategy
    b. tables comparing percentage changes in psychological ratings of pre- and post-performance based on preparation.

Evaluate and justify

KEY COGNITION

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

8. In a paragraph, evaluate the effectiveness of attention and concentration technique on reducing distractions and improving your psychological state and performance. Use both primary and secondary data to justify your evaluation.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 8.3

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: How will the use of a psychological strategy influence arousal, or attention and concentration, when performing in a chosen physical activity?

Recognise and explain

1. Gather primary data on factors influencing either your arousal or attention and concentration in the selected physical activity.
2. Identify the signs of optimal arousal or attention and concentration for you in your current physical activity of study.
3. Select and gather secondary data on how to effectively implement one psychological technique to improve either your arousal or attention and concentration in the selected physical activity.

Demonstrate and apply

4. Develop a psychological strategy by clearly outlining purpose and processes involved in implementing your psychological technique in class for your selected physical activity.
5. Over a series of lessons, implement your psychological technique and gather primary data from each session on your performance and your level of arousal or attention and concentration throughout this time. Make modifications to the implementation of your psychological technique and record the reasons for these changes as the lessons progress.

Analyse and synthesise

KEY COGNITION

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

6. Analyse the data by developing a series of graphs and tables and draw conclusions from the data.
7. Synthesise the primary data by explaining the relationships between the implementation of the psychological technique, levels of motivation or confidence and the performance demonstrated in the selected physical activity throughout the data-gathering period.

Evaluate and justify

8. Evaluate the effectiveness of the strategy by appraising the outcomes and limitations.
9. In a paragraph, justify recommendations for maintaining and/or modifying the elements of your psychological strategy to optimise your performance.

KEY MESSAGE

Training to control attention and concentration will reduce the likelihood of 'choking' under pressure.

KEY MESSAGE

Training in environments that simulate performance will help an athlete to focus their attention more effectively.

KEY MESSAGE

Using words and actions before and during a performance assists to refocus attention on relevant stimuli.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Optimal levels of arousal for athletes lie between under-arousal and over-arousal.
- The optimal levels of arousal can vary based on ability and complexity of skills.
- Cognitive anxiety and somatic anxiety result from negative responses to over-arousal.
- The focus of an athlete's attention fall into one of four categories.
- Attention is continually shifting from one category to another.
- Misdirected attention is directly linked to errors in physical performance.
- Mental rehearsal of all or part of the performance assists in optimising levels of motivation, confidence, arousal and concentration.
- Internal perspectives are recommended for athletes who are required to track objects or opponents.
- External perspectives are recommended for athletes being judged on aesthetic performance.
- Pre-performance routines help athletes to mentally and physically prepare for performance.
- A good pre-performance routine involves positive self-talk and a consistent set of actions.
- Optimal arousal levels can be achieved by incorporating one or more relaxation or hype-up strategies.
- Relaxation strategies reduce anxiety; they include listening to music, progressive muscle relaxation and breathing.
- Hype-up strategies increase readiness to perform; they include visualisation, listening to fast-tempo music and breathing.
- Training to control attention and concentration reduces the likelihood of 'choking' under pressure.
- Training in environments that simulate performance helps an athlete to more effectively focus their attention.
- Using words and actions before and during a performance helps to refocus attention on relevant stimuli.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Which of the following statements is true about anxiety?

A. Anxiety assists successful performance in some sports.

B. Anxiety falls within the optimal arousal zone.

C. Anxiety is the negative psychological and physiological response to decreased arousal.

D. Anxiety is the negative psychological and physiological response to increased arousal.

2. A broad external attentional focus is best described as being able to:

A. look at multiple players at once.

B. identify a range of relevant environmental cues at one time.

C. concentrate on a defender for a long period of time.

D. quickly filter relevant information from irrelevant information.

ISBN 978-1-009-31125-0 Stewart et al.

3. Which of the following lapses in concentration describe a touch football player missing a catch because they were looking for gaps in the defensive line?
   A. Narrow internal instead of narrow external
   B. Broad internal instead of narrow external
   C. Broad external instead of narrow external
   D. Broad external instead of narrow internal
4. A narrow external attentional focus is most important to an athlete in which part of a performance?
   A. Assessing the scene
   B. Analysing options
   C. Preparing to perform
   D. Acting
5. What psychological technique develops the ability of an athlete to efficiently filter relevant and irrelevant information?
   A. Within-competition routine
   B. Training selective attention
   C. Performance segmentation
   D. Rezoning

SHORT-RESPONSE QUESTIONS

1. Explain how having a misdirected attentional focus could lead to errors in your chosen physical activity.
2. Explain how optimal arousal levels can vary based on the complexity of skills and the competition experience of the performer.

EXTENDED-RESPONSE QUESTION

In a 250-word response, evaluate the effectiveness of one arousal-regulating technique in improving your performance in your chosen physical activity. Justify your evaluation by identifying at least three aspects about the technique that regulates (or fails to regulate) your arousal level effectively.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 9

Team dynamics and cohesion to optimise group performance

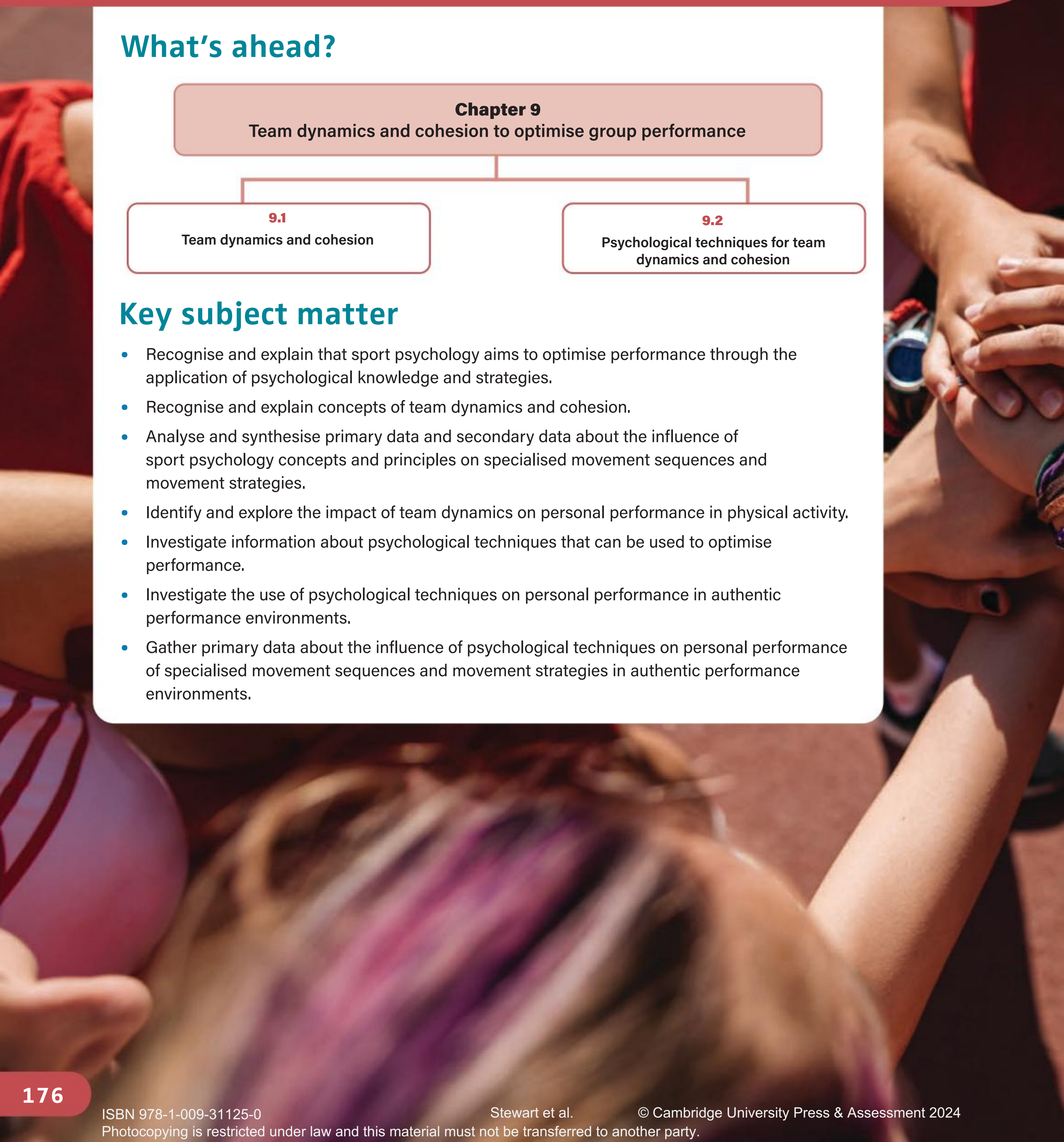
What's ahead?

Chapter 9
Team dynamics and cohesion to optimise group performance

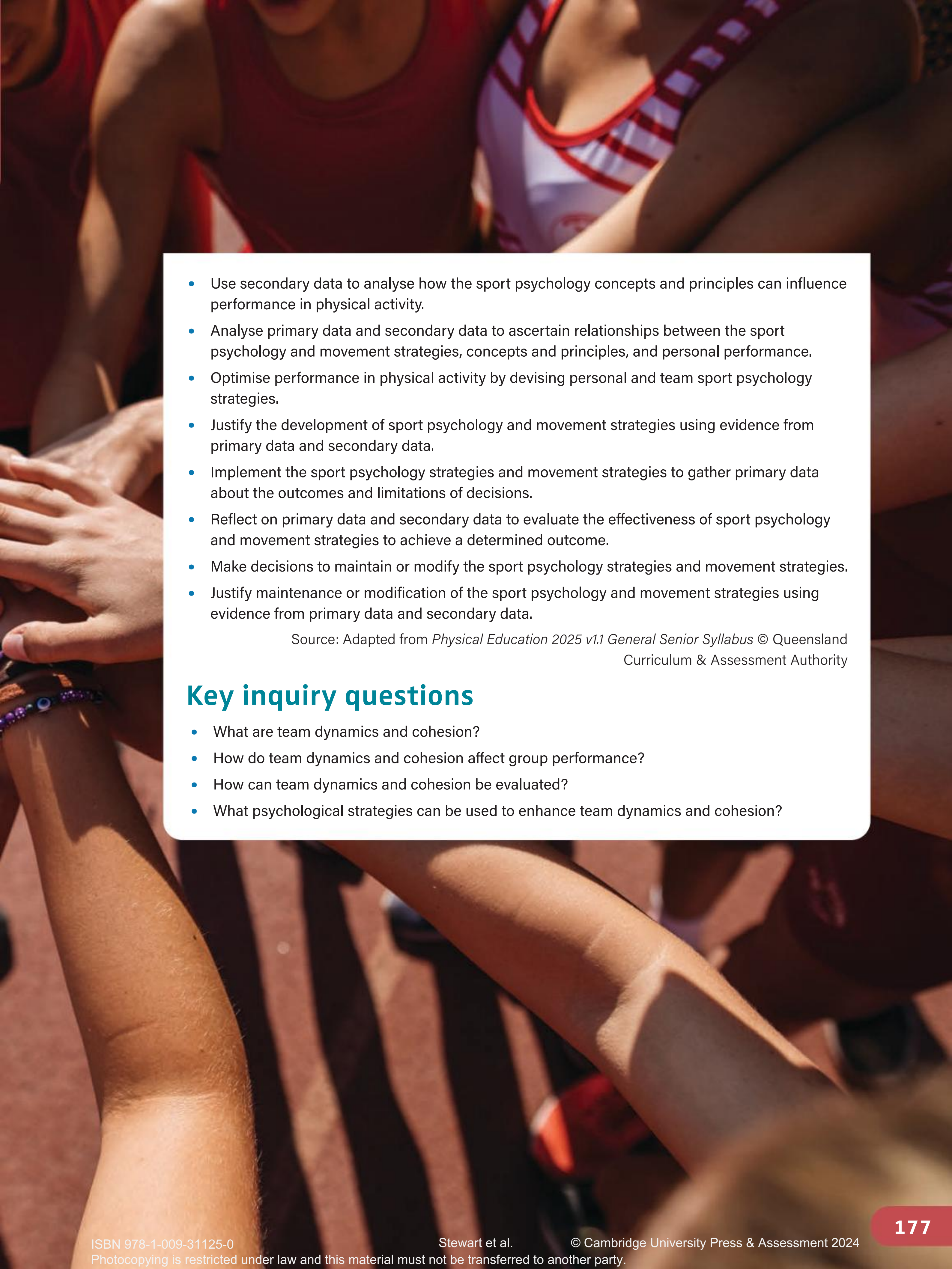
- **9.1** Team dynamics and cohesion
- **9.2** Psychological techniques for team dynamics and cohesion

Key subject matter

- Recognise and explain that sport psychology aims to optimise performance through the application of psychological knowledge and strategies.
- Recognise and explain concepts of team dynamics and cohesion.
- Analyse and synthesise primary data and secondary data about the influence of sport psychology concepts and principles on specialised movement sequences and movement strategies.
- Identify and explore the impact of team dynamics on personal performance in physical activity.
- Investigate information about psychological techniques that can be used to optimise performance.
- Investigate the use of psychological techniques on personal performance in authentic performance environments.
- Gather primary data about the influence of psychological techniques on personal performance of specialised movement sequences and movement strategies in authentic performance environments.



ISBN 978-1-009-31125-0 Stewart et al.



- Use secondary data to analyse how the sport psychology concepts and principles can influence performance in physical activity.
- Analyse primary data and secondary data to ascertain relationships between the sport psychology and movement strategies, concepts and principles, and personal performance.
- Optimise performance in physical activity by devising personal and team sport psychology strategies.
- Justify the development of sport psychology and movement strategies using evidence from primary data and secondary data.
- Implement the sport psychology strategies and movement strategies to gather primary data about the outcomes and limitations of decisions.
- Reflect on primary data and secondary data to evaluate the effectiveness of sport psychology and movement strategies to achieve a determined outcome.
- Make decisions to maintain or modify the sport psychology strategies and movement strategies.
- Justify maintenance or modification of the sport psychology and movement strategies using evidence from primary data and secondary data.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What are team dynamics and cohesion?
- How do team dynamics and cohesion affect group performance?
- How can team dynamics and cohesion be evaluated?
- What psychological strategies can be used to enhance team dynamics and cohesion?

ISBN 978-1-009-31125-0 Stewart et al.

9.1 Team dynamics and cohesion

Coaches will often state that 'a champion team will beat a team of champions'. Psychologist Dr William Schutz (1925–2002) undertook extensive research in the area of **team dynamics**. His theories assist in understanding interpersonal relationships by exploring the underlying motivation for an individual's actions. They suggest that there are three drivers that motivate group relationships: the need for inclusion, the need for control and the need for affection. For each of the drivers, there is an ideal level that allows effective interactions to occur with other members of the group. When a group member displays an excess or shortage of these drivers, then group dynamics may suffer.

Teams that work effectively together or demonstrate strong cohesion are far more likely to achieve common goals when competing, and to play together as a team for longer. Obviously, in striving for a common goal, individual athletes may be required to sacrifice their own ambitions in order to put the needs of the team first. If an individual's need for control is balanced by their need for affection and inclusion, they will be more willing to put in the extra effort to help the team reach its goal. The aspects of group roles, group norms and **social support** are also inherent in the concept of team dynamics and cohesion.

The benefits of improving dynamics and building cohesion include:

- acceptance of roles and responsibility by team members

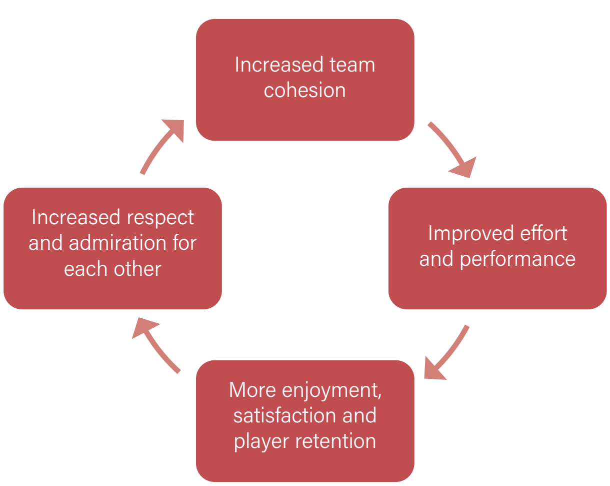


FIGURE 9.1 Increased team cohesion cycle

team dynamics the unconscious, psychological forces that influence the direction of a team's behaviour and performance

social support the assistance provided by others to an individual; in team dynamics, it is the support provided by a team and its members to individuals within the group

team cohesion how well a group can work together and remain united in pursuit of its goals and objectives

- dedication of members' efforts towards collective achievement
- development of a positive and energetic environment
- increased effectiveness of group meetings and practices
- reduction or elimination of negative team influences
- increased general player well-being through increased social support and group inclusion.

Team cohesion and improved team performance are generally considered reciprocal in team sports – that is, improvements in performance also lead to an increased enjoyment and satisfaction. Furthermore, the respect and admiration that the players have for each other grow, further improving the cohesiveness of the team.

Optimising team dynamics and cohesion

Positive team dynamics rely on players developing a shared understanding of acceptable or **normalised** behaviours that will help the team to progress towards its goals. These **normalised behaviours** are also referred to as norms, and are essential to team cohesion. They provide shared understandings of how the team members interact with each other, and the level of commitment and effort expected by the playing group. Team cohesion can suffer if players are not complying with the team norms. If some team members are consistently late to training or are not providing the required social support to their teammates, resentment and anxiety levels will increase and the productivity of the team will decrease.

ISBN 978-1-009-31125-0 Stewart et al.

normalised to cause something to be accepted as normal or expected

normalised behaviour a social process through which actions come to be seen as 'normal,' typical or expected in relation to everyday life or specific contexts, such as the behaviours expected by a specific family, school or team

CHECK-IN 9.1

1. As a class, brainstorm the characteristics of the teammates you have found to be the most annoying or most destructive with regard to their team dynamics.
2. Categorise these factors in terms of how they are not meeting the characteristics of a good team member (e.g. not reliable).

FIGURE 9.2 A cricket team celebrating their good performance and, as a result, improving team cohesion

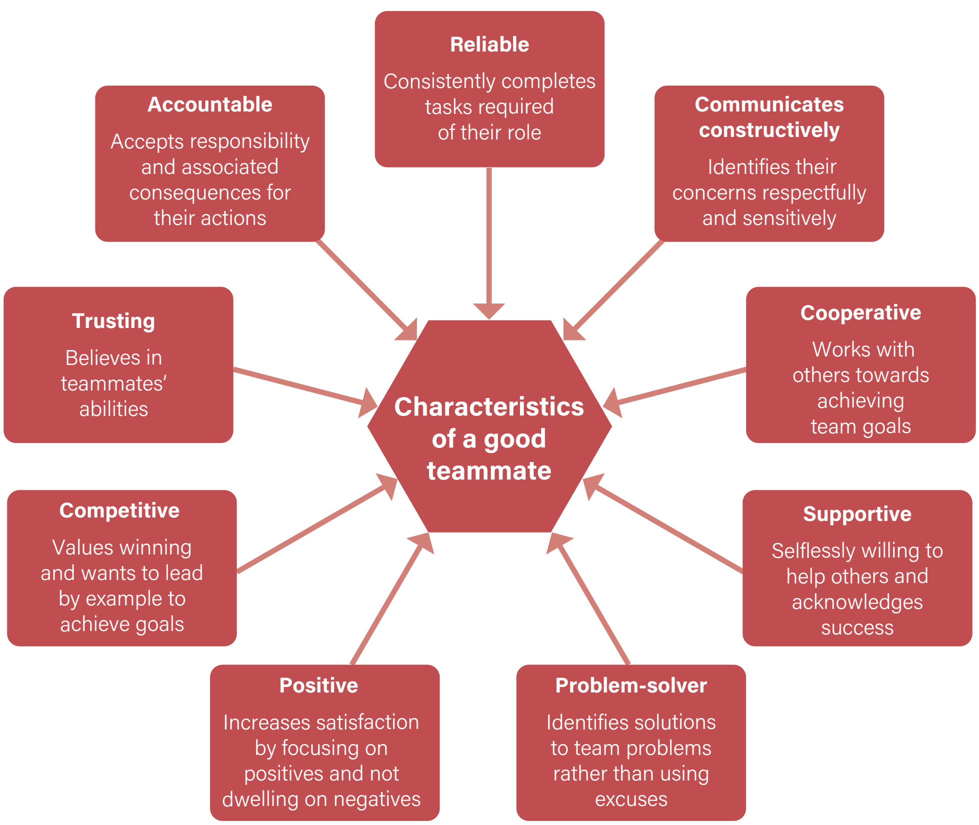


FIGURE 9.3 Characteristics of a good teammate

ISBN 978-1-009-31125-0 Stewart et al.

Factors affecting team dynamics

Carron's conceptual model of team cohesion stipulates that cohesion is dynamic between and within team environments. The multitude of factors that can influence team cohesion are categorised as:

- environmental factors
- individual factors
- leadership factors
- team factors.

Adjusting team norms and the level of social support to account for the specific requirements of the team will result in greater cohesion. Overall, team cohesion consists of **social cohesion** and **task cohesion**.

For young athletes, the social cohesion of the team, or how much they like each other's personal characteristics, is paramount to their enjoyment, success and retention. However, for more competitive or elite athletes, the team's task coherence, or the extent to which they are working together to perform a task or reach a goal, is prioritised. If players are not adhering to the team norms, it is likely to be detrimental to the overall cohesiveness of the team and result in poor performance.

social cohesion how much individual team members like each other and enjoy each other's company

task cohesion the team's ability to work towards a specific goal

ENGAGE 9.1

RECOGNISE & EXPLAIN | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: How do successful teams develop positive team dynamics and strong team cohesion?

Between 2006 and 2017, the Queensland Rugby League team dominated New South Wales in the annual State of Origin competition. This dominance resulted in 11 series wins in 12 years and included an unprecedented streak of eight straight series wins. Much of the analysis of this dominance has related to the culture and cohesion of the Queensland team.

Recognise and explain

1. Investigate news articles from 2006 to 2017 referring to factors that influence either state's team dynamics and cohesion. Specifically, identify:
   - environmental factors (player familiarity, club cultures/success)
   - personal factors (on- and off-field behaviours, adherence to norms, individual differences)
   - leadership factors (leadership behaviour, style of leadership)
   - team factors (group behaviour, desire to win, work ethic, team ability, player retention).

KEY COGNITION

Investigate: carry out an examination or formal inquiry in order to establish or obtain facts and reach new conclusions; search, inquire into, interpret and draw conclusions about data and information

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

2. Represent your research using a Venn diagram comparing the two states' teams.

Evaluate and justify

3. Write a conclusion about whether, and if so how, team performance has been influenced by team dynamics and cohesion. Use specific news articles to support your conclusion.

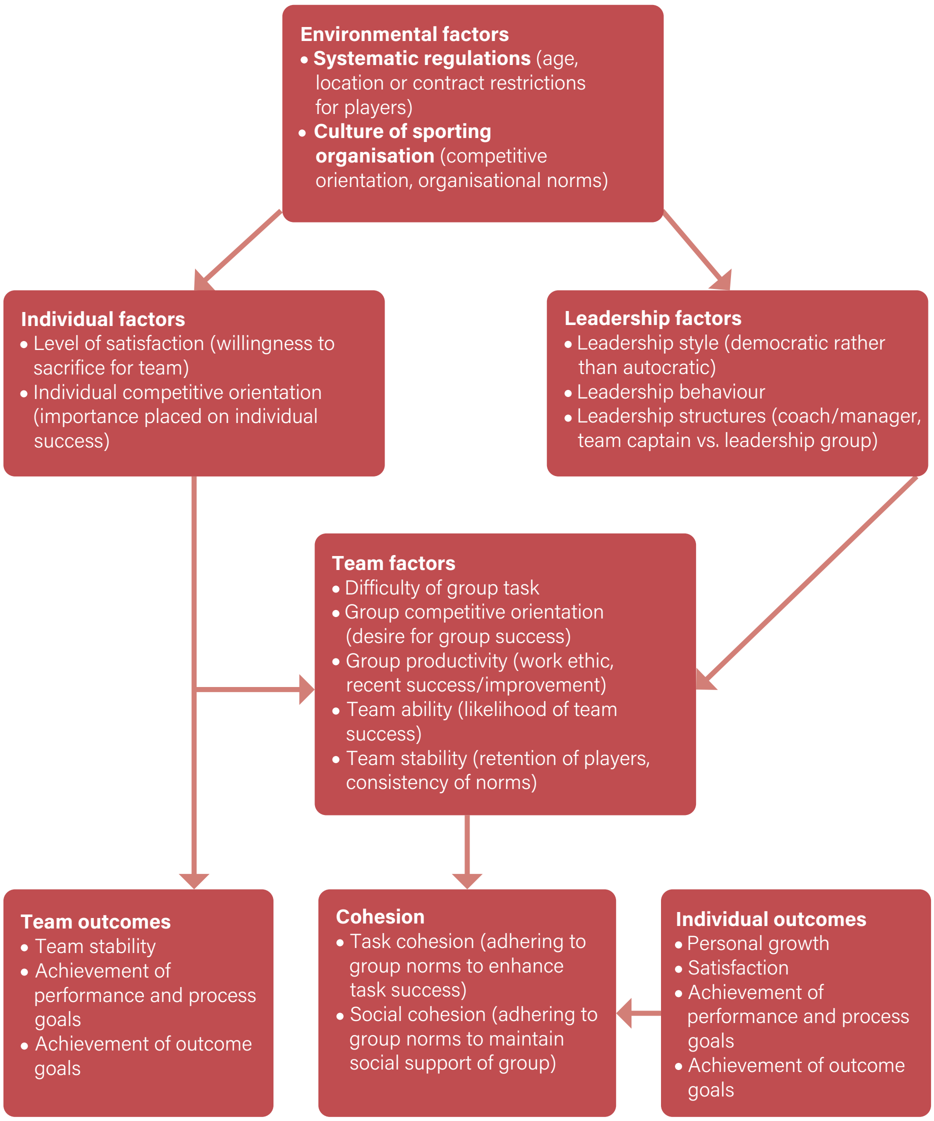


FIGURE 9.4 Factors influencing team dynamics

CHECK-IN 9.2

1. Make a list of 10 behaviours that could be displayed by teams to demonstrate they are putting in the required effort during games and competition.
2. Develop a flow chart of suitable consequences that could be implemented if team members did not adhere to these norms.

ISBN 978-1-009-31125-0 Stewart et al.

KEY MESSAGE

Schutz believes group cohesion is driven by the need for inclusion, the need for control and the need for affection.

KEY MESSAGE

There is a reciprocal relationship between team cohesion and team performance.

KEY MESSAGE

Team dynamics are influenced by environmental, individual, leadership and team factors.

9.2 Psychological techniques for team dynamics and cohesion

Optimising team dynamics and cohesion

In line with the development of physical and strategic skills, a successful team also needs to work on team cohesion and improve team dynamics. People in leadership groups are responsible for developing and maintaining the required norms and social support for the team. Team leadership traditionally has been the responsibility of the captain or coach. However, many professional sports have started to utilise leadership groups instead. This approach involves more of the senior players demonstrating the team norms and also increases the amount of social support provided by the leaders. Democratic leadership, where players feel comfortable to have their say and offer constructive criticism, is needed to build positive team dynamics. Essential processes required to build team cohesion include:

- negotiating and clearly defining the roles of the individuals
- providing leadership for the team
- negotiating specific and realistic common goals for the team
- creating a specific team identity.

Negotiate and clearly define the roles of the individuals

Providing players with the opportunity to consider their best role as a team member can be beneficial for reducing an athlete's anxiety. Having ownership of, and acknowledging, the role they will play as a team member will allow them to share the responsibility for the performance and be less anxious about failure. Being given a specific team role also increases motivation and willingness to make sacrifices for the team. Additionally, being entrusted with an important team role increases self-efficacy and boosts confidence.

CHECK-IN 9.3

1. Split the class into four groups. Each group explores one of the following topics:
   a. negotiating and defining roles
   b. providing leadership
   c. negotiating goals
   d. creating identity.
2. Each group is required to analyse the influence of its topic on the class dynamics. (For example, does the class have a unique identity?)
3. Report back to the class with at least one recommendation that could improve the dynamics and cohesion of the group.

Provide leadership for the team

Leaders play an important role in promoting and regulating team cohesion. A democratic leadership approach involves open lines of communication where players feel free to provide constructive criticism regarding team processes and personal satisfaction. This approach emphasises feelings of inclusion for players and increases confidence and motivation. Dealing with concerns about player mood and satisfaction reduces resentment and improves player

ISBN 978-1-009-31125-0 Stewart et al.

resilience, as well as the team's ability to overcome setbacks. Good leadership reinforces the importance of individual roles in the team's success and provides support and affection where required.

Negotiate specific and realistic goals for the team

Goal-setting will provide motivation for the team's efforts. The negotiation process allows players to develop feelings of control over their goals, which will increase their desire to meet team norms and make individual sacrifices. Furthermore, teams that successfully reach their goals – especially early in their development – will be more cohesive and continue the cycle by improving their performance.

Create a specific team identity

Building a team identity is arguably the most important means of developing social cohesion. A distinct team identity encourages unity within the team, strengthens social bonds and enhances feelings of inclusion. Players will put in more effort if they feel a strong affection towards their group. Team rituals, sayings, chants and warm-up practices are all means of building team identity and enhancing affection among teammates.

Devising psychological strategies to improve team dynamics and cohesion

A psychological strategy is a plan of action devised to bring about a determined outcome, in this case to enhance group performance through improving team dynamics and cohesion.

As previously outlined in this chapter, there are many factors affecting team dynamics and cohesion, and each of these aspects must be considered when a psychological strategy is being developed in the area. Unlike personal strategies that are relevant to the individual performer, these strategies must cater for the needs of all people within the group. This can be a complex challenge, as the requirements of different players, their goals and personalities can frequently be opposing or competing. However, to improve team dynamics and cohesion, psychological strategies should aim to improve:

- leadership
- communication and/or
- team **norms**, **rules** and **discipline**.

norms (team) the expected standard of behaviours for members of the team when acting as the team

rules (team) the explicit regulations to follow, as established by the team or leaders within the group

discipline (team) the expected level of self-control, commitment and effort that a team member should contribute to the group

ACTIVE INVESTIGATION 9.1

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What is the influence of team cohesion on the psychological state of individuals?

Demonstrate and apply

1. Divide the class into two even teams using an arbitrary selection process such as the suburb in which they live, where they were born or whether they have been overseas.
2. The two teams compete in a competition. Upon completion, each team should collect primary data, with each team member evaluating their psychological state (level of motivation, confidence, arousal) and their perceived level of task cohesion and social cohesion within their team. Use a five-point scale to evaluate each of the five areas, and collate the scores from each player.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

KEY COGNITION

Identify: distinguish; locate, recognise and name; establish or indicate what something is

3. Each team should identify:
   a. team roles, including leadership
   b. team goals (process, performance and outcome goals)
   c. essential team rules, norms, and expected discipline levels required to achieve goals
   d. their own team identity (team name, motto, chant or even mascots).
4. Each team should implement a series of training sessions in preparation for a culminating competition against their opponents, where their newly established team expectations can be implemented.
5. Before and after the final competition, re-evaluate your psychological state and your perception of team cohesion, using the same system from step 2 above.

Analyse and synthesise

6. Analyse and interpret the primary data collected from your team regarding changes in psychological state and levels of team cohesion (this can be done anonymously). Identify specific correlations within the data (e.g. as social cohesion increased, so did motivation).
7. Critique primary data by supporting or rejecting the identified trends based on valid and reliable research.

Evaluate and justify

8. Use a series of statements to evaluate the effectiveness of the process of developing your team's cohesion, and participating in training sessions and the competitive performance. Justify the three most significant experiences that influenced team dynamics, cohesion and overall psychological state.

KEY MESSAGE

Team leaders are responsible for fostering group norms and applying consequences for undesirable behaviours.

KEY MESSAGE

Athletes will be more compliant with norms if team roles and goals are negotiated with them.

KEY MESSAGE

Developing a unique team identity influences social cohesion and fulfils the need for inclusion.

FIGURE 9.5 No matter your physical activity or level, success is a great builder of team cohesion.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- There is a reciprocal relationship between team cohesion and team performance.
- Team dynamics and cohesion include the development of group roles, group norms and social support.
- Team dynamics are influenced by environmental, individual, leadership and team factors.
- Team leaders are responsible for fostering group norms and applying consequences for undesirable behaviours.
- Athletes will be more compliant with norms if team roles and goals are negotiated with them.
- Developing a unique team identity influences social cohesion and fulfils the need for inclusion.
- Team dynamics and cohesion techniques work to develop the aspects of leadership and communication, as well as team norms, rules and discipline.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. According to Schutz, which of the following is not one of the three key drivers that motivate team cohesion?
   A. The need for affection
   B. The need for success
   C. The need for control
   D. The need for inclusion
2. Improving team dynamics can influence performance by:
   A. improving skills.
   B. improving the effectiveness of practice.
   C. improving club reputation.
   D. eliminating weaker players.
3. Normalised behaviours or 'norms' can best be described as:
   A. a list of behaviours that the captain decides is the best for the team.
   B. shared understandings of how team members interact and the level of commitment expected.
   C. a list of key plays for everyone to memorise.
   D. a coach's understanding of what another team does to win.
4. Which of the following is considered an individual factor that affects team dynamics?
   A. Level of sacrifice
   B. Leadership behaviour
   C. Team ability
   D. Task difficulty
5. Which of the following is not a way to optimise team dynamics and cohesion?
   A. Provide leadership for the team
   B. Negotiate clearly defined roles for the individuals
   C. Create a specific team identity
   D. Dictate specific goals for the team to adhere to

SHORT-RESPONSE QUESTIONS

1. Explain how the importance of team cohesion and task cohesion changes as young athletes develop into more experienced athletes.
2. Using an example for a positive team experience and a negative team experience, explain the most valuable characteristics of a teammate.

EXTENDED-RESPONSE QUESTION

Use primary and secondary data to justify the selection of any three psychological factors that have influenced your team's ability to work together to perform to their highest potential.

ISBN 978-1-009-31125-0 Stewart et al.

UNIT 2

TOPIC 2

Equity – barriers and enablers

Topic 2:
Equity – barriers and enablers

- **Chapter 10** Equity, access and engagement in physical activity
- **Chapter 11** Personal factors that act as barriers and enablers for self and others in physical activity
- **Chapter 12** Social factors that act as barriers and enablers for self and others in physical activity
- **Chapter 13** Cultural factors that act as barriers and enablers for self and others in physical activity
- **Chapter 14** Environmental factors that act as barriers and enablers for self and others in physical activity

Introduction

Being physically educated is concerned with developing knowledge in the biophysical, sociocultural and psychological domains that underpin physical activity and utilising this knowledge to maximise enjoyment, engagement and physical performance for yourself and others. The physically educated become advocates for both the social and physical importance of being physically active.

This topic explores human social behaviour, how humans think and act as social creatures and the impact this has on social structures and culture in relation to physical activity. As a key element within the sociocultural sub-discipline of physical activity, equity is the primary focus. An understanding of equity assists the physically educated in overcoming barriers restricting access to physical activity as well as maximising opportunities to participate – for themselves and for others.

Students will become aware of actions that are inclusive and will embrace diversity as a means to enhance physical activity and the associated experiences for those who participate. They will understand that by maximising access, opportunities and enjoyment, their physical performance can also reach its maximum potential.

UNIT 2 TOPIC 2
Overview

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 10

Equity, access and engagement in physical activity

What's ahead?

Chapter 10
Equity, access and engagement in physical activity

- **10.1** Equity, access and engagement
- **10.2** Access to physical activity
- **10.3** Engagement

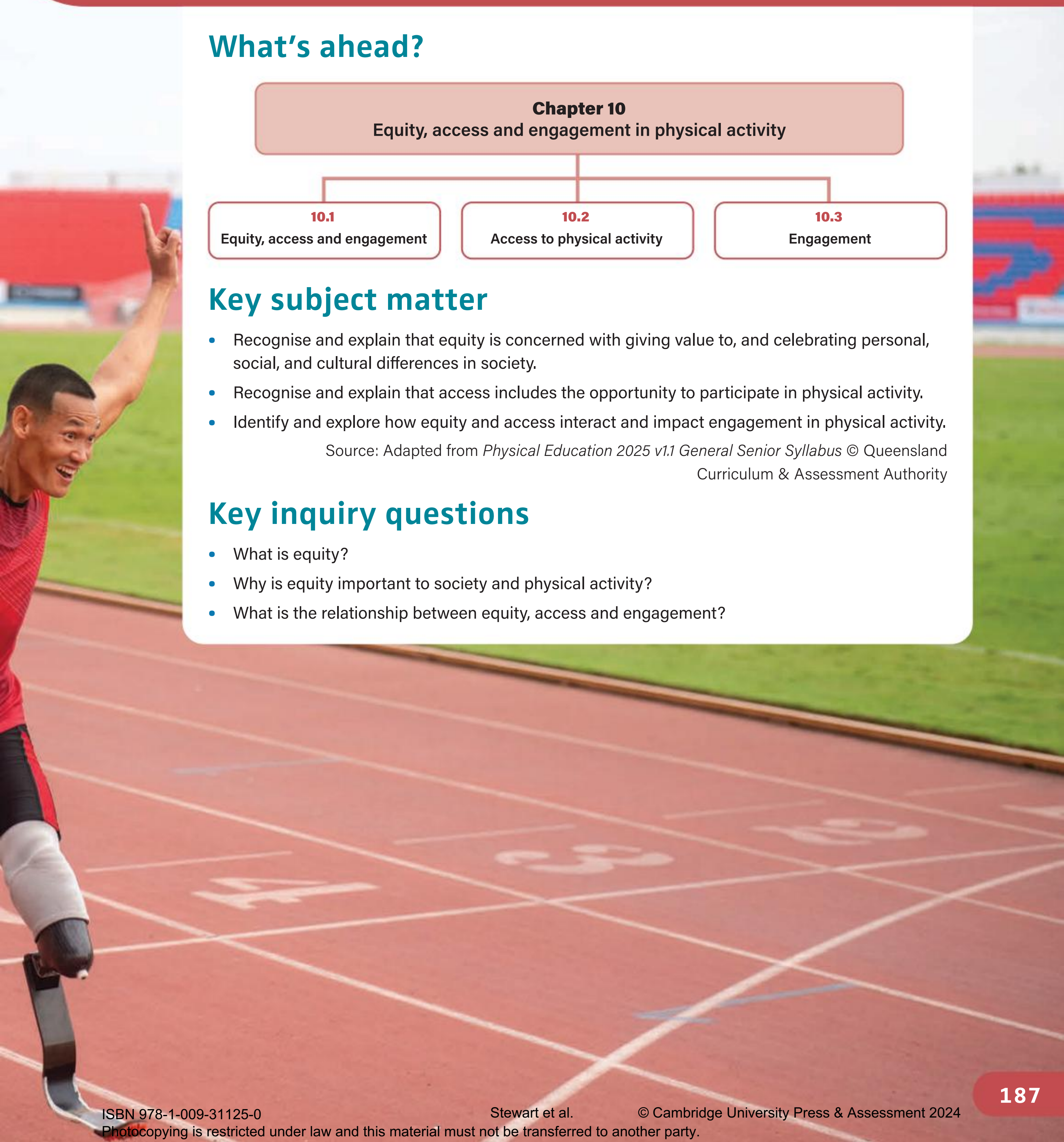
Key subject matter

- Recognise and explain that equity is concerned with giving value to, and celebrating personal, social, and cultural differences in society.
- Recognise and explain that access includes the opportunity to participate in physical activity.
- Identify and explore how equity and access interact and impact engagement in physical activity.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What is equity?
- Why is equity important to society and physical activity?
- What is the relationship between equity, access and engagement?



ISBN 978-1-009-31125-0

10.1 Equity, access and engagement

What is equity?

Human rights are at the heart of modern society and the global community. Human rights are entitlements that are inherent to all human beings, regardless of race, gender, nationality, ethnicity, language, religion or any other status that could be attributed to an individual. Human rights include basic liberties such as the right to life, and freedom from slavery, torture or unjust persecution. These rights are fundamental, and must be upheld globally without discrimination.

Aside from human rights, each society also has civil rights, sometimes referred to as civil liberties or civil freedoms. These are entitlements that are recognised by the society as fundamental to the fair and equal treatment of its people. For example, civil rights in Australia include freedom of expression, freedom of religion, freedom of speech, the right to security or privacy, and the right to fair treatment under the law.

Equity is a concept embedded in social justice and is both a human and civil right. As such, it is reflected in Australian law, government policies and the cultural values of our nation. Equity is concerned with giving value to and celebrating personal, social and cultural differences in society. Equity deals specifically with the dignity, privilege and power to which every individual is entitled. It is a term closely related to equality, equal opportunity, **inclusion** and diversity.

As a **microcosm of society**, sport reflects the values and behaviours of the broader Australian society. As an **institution** of Australian society, sport is also bound by laws, government policies and the expectations of all Australians. Therefore, sporting institutes, governing bodies and affiliated people all have an obligation to embrace equity and behave in ways that will enhance equity for all.

In a sporting context, equity is concerned with **access**, inclusiveness and the provision of opportunities to all members of society. The United Nations Educational, Scientific and Cultural Organization (UNESCO) states:

> ‘Sports equity’ is about fairness in sport, equality of access, recognising inequalities and taking steps to address them. It is about changing the structure of sport to ensure that it becomes equally accessible to all members of society, whatever their age, gender, race, ethnicity, sexuality, or socio-economic status.

It is through the exploration of concepts such as access, inclusiveness and opportunities that equity can be enhanced, and through targeted interventions that sporting groups and individuals can overcome society’s constructs that diminish equity.

equity concerned with giving value to and celebrating personal, social and cultural differences in society

inclusion the practice or policy of providing equal access to opportunities and resources for people who might otherwise be excluded or marginalised

microcosm of society a subsection of society (such as sport, education or politics) that reflects the values, beliefs and behavioural norms of the broader society

institution a body or group that establishes rules and procedures for how the group should behave or operate, and actively promotes these regulations

access (to physical activity) the opportunity to participate or to be involved

FIGURE 10.1 Equity has been at the centre of many human and civil rights actions, particularly when practices and policies are discriminatory.

ISBN 978-1-009-31125-0 Stewart et al.

KEY MESSAGE

Equity is concerned with giving value to and celebrating differences, ensuring individuals have dignity, privilege and power.

KEY MESSAGE

As a human right, equity is the responsibility of all Australians and is embedded in our laws, policies and behaviours.

KEY MESSAGE

Sporting bodies have an obligation to uphold and enhance equity for all Australians through its physical activity practices.

10.2 Access to physical activity

Access to physical activity is closely linked to equity in modern society. Access in this sense refers to the opportunity to participate. Historically, age, **gender**, race, ethnicity, sexuality or socio-economic status have all been factors that prevented members of society from engaging in physical activity or a specific sport. Consider what opportunities and barriers existed in particular sports throughout Australia's history for these demographic groups. How many examples can you think of?

As society's expectations around equity have grown, so too have our expectations around embracing diversity and inclusion. Sport in general, sporting bodies and sportspeople can no longer ignore or accept that people lack the opportunity to participate. All sporting **stakeholders** must now work towards embracing equity – finding ways within sport to value, include and celebrate the diversity in our society. When physical activity groups increase equity, access to that activity increases for members of society and participation levels increase. In contemporary Australia, physical activity works to increase equity and improve access for all members of society for the betterment of sport and the broader community.

gender the male or female sex, when considered with reference to social and cultural differences rather than biological ones; or one of a range of other identities that do not correspond to established ideas of male and female

stakeholder any person or group affected by the way something is organised or managed

FIGURE 10.2 The Brisbane Lions celebrating their win in the 2023 AFLW Grand Final

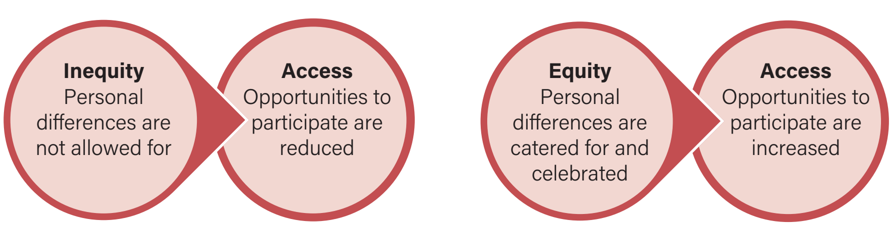


FIGURE 10.3 The equity–access link

ISBN 978-1-009-31125-0

FIGURE 10.4 Physical activity opportunities that are influenced by issues of access and equity

ENGAGE 10.1

Inquiry question: How do resources increase access to physical activity?

Recognise and explain

1. Look in your Physical Education storeroom to identify equipment that is seldom used, or gear for an activity in which you do not regularly engage.

Demonstrate and apply

2. From the equipment discovered, participate in a lesson for an activity that you do not normally do as part of your Physical Education subject.

Analyse and synthesise

3. At the completion of the lesson, discuss:
   a. why you do not normally get to undertake this activity
   b. what factors influence your access to these resources
   c. how these resources could be made more accessible to you, your class and all students.

ISBN 978-1-009-31125-0 Stewart et al.

Evaluate and justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

4. Reflect on your class discussion and write a brief recommendation that outlines how these resources could be made more available to students. Justify the purpose for doing so.

TABLE 10.1 Access to the resources required for physical activity will affect the ability of individuals to engage.

Personal resources	Social resources	Community resources
The resources required by the individual that allow participation	The resources provided by others that support participation	The resources supplied by government, sporting authorities, clubs and schools required for participation
For example: • available disposable income • personal equipment • uniforms • transport • time • child care	For example: • other participants • supportive family network • supportive friendship group • a competition to compete in • quality coaches and administrators • the number and quality of support staff to run a viable competition (e.g. volunteers, referees, canteen workers)	For example: • facilities within the area • facilities of appropriate standard • facilities that are financially accessible • funding support • a well-organised institute to oversee participation • an institute that promotes inclusive practices • appropriate media coverage

ENGAGE 10.2

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How does a lack of resources affect access to physical activity?

Demonstrate and apply

1. Organise a class excursion to a venue to undertake a physical activity that you cannot do at school. Venues to consider could include a tenpin bowling centre, indoor rock-climbing venue, lawn bowls club, squash, tennis or indoor cricket centre, trampoline centre, canoeing, kayak or paddleboard areas, or a pool for water polo. While undertaking the activity, consider the resources described in Table 10.1 and undertake a full audit of what resources are required to engage in this activity.

Analyse and synthesise

2. Under the headings of 'Personal resources', 'Social resources' and 'Community resources', list the barriers that are currently affecting your access to this activity.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Evaluate and justify

KEY COGNITION

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

3. From your analysis, construct a PMI table identifying factors that affect your access to the physical activity undertaken.
4. Write a 200-word response that evaluates the importance of access to resources in determining the physical activities that are undertaken by an individual.

CHECK-IN 10.1

1. Select two physical activities – one in which you engage regularly and one in which you have not participated before.
2. Using Table 10.1 as stimulus, create a Venn diagram to compare and contrast the access to resources you have experienced for each activity.
3. For the activity in which you engage regularly, identify the three resources that have most significantly enabled your participation.
4. Provide an example for each resource category in addition to those in Table 10.1.

engagement (in physical activity) an individual or group taking up the opportunity to participate in or be involved with physical activity

10.3 Engagement

It is important to remember that **engagement** in physical activity is a personal choice for each individual. The right to personal choice is considered a civil right and a freedom that we enjoy in Australia. No matter what opportunities to access physical activity are afforded to individuals, there are some who will not take up these opportunities due to a broad range of personal factors, and who enact the personal choice to have limited participation in physical activity.

However, in general it is true that reducing the factors causing inequity leads to increased access to, as well as more opportunities for, physical activity. With increased opportunities to participate in physical activity, more people will take up those opportunities and as a result engagement in physical activity will increase. Alternatively, by enhancing those factors that positively influence equity, opportunities and access also increase and lead to increased engagement.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 10.3

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What personal factors prevent engagement?

Demonstrate and apply

1. As a class, engage in 10 minutes of aerobics, dance or another similar activity using the instructional video provided by your teacher. Follow the moves together with your class to the best of your ability and ensure that you are up and moving for 10 minutes.

Analyse and synthesise

2. As a class, discuss the following.
   a. What were people's initial response when told what they were doing? Who was keen to participate? Who was not?
   b. To what level did people participate? Who worked for the full 10 minutes? Who gave it a go, then sat down? Who reluctantly tried? Who refused and sat out?
   c. What was the level of enjoyment? Who loved it? Who hated it?

Evaluate and justify

3. With a partner in a one-minute 'chat change', share the reasons behind your level of engagement.

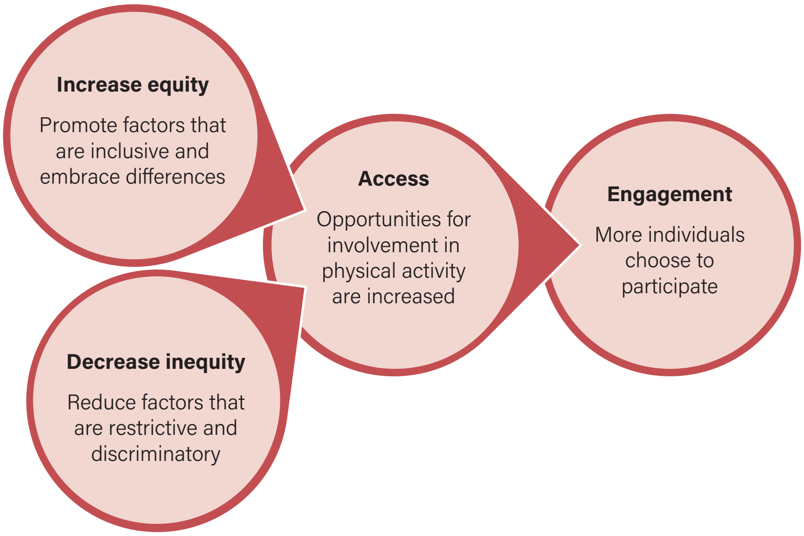


FIGURE 10.5 The equity–access–engagement link

ISBN 978-1-009-31125-0 Stewart et al.

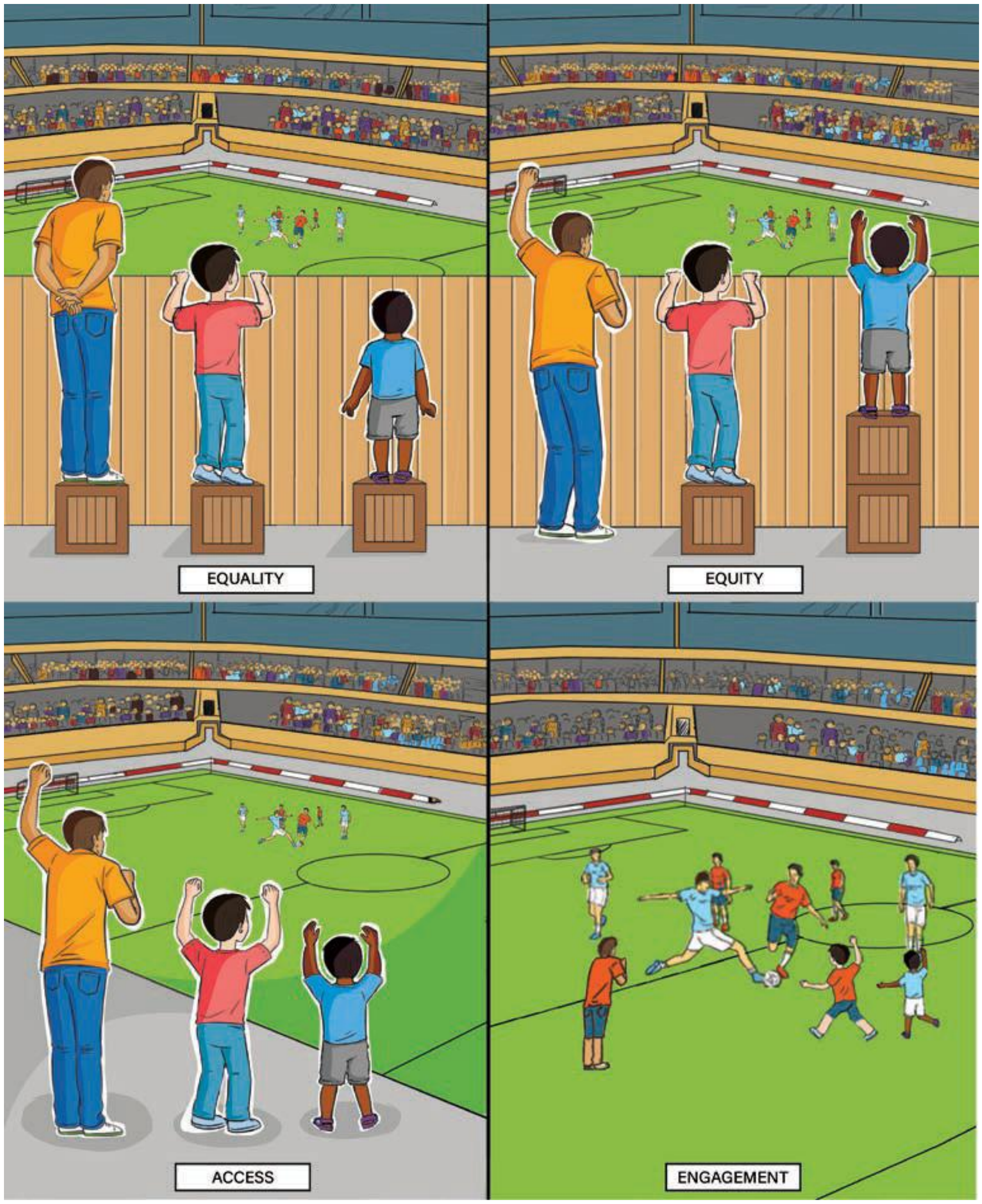


FIGURE 10.6 Many visual representations are used to demonstrate the links that surround equity, access and engagement.

CHECK-IN 10.2

1. As a class, review the picture in Figure 10.6 and discuss the meaning in the image. Consider the meaning of the boxes and the fence; what is the image trying to convey?
2. In your own words, explain why equity is an important issue in physical activity.
3. Think of two sports that you believe experience low engagement for a specific age, gender, ethnicity, ability or socio-economic status. Justify your selection by outlining any inequity that may be present.
4. Identify two physical activities in which you would not engage, even if given the opportunity, and explain what is preventing your engagement. Consider personal preference, confidence, fear of failure or injury, or any other reason.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Equity is a concept embedded in social justice, and is concerned with giving value and celebrating personal, social and cultural differences.
- Sports equity is about fairness in sport, equality of access, recognising inequalities and taking steps to address them; it is about changing the structure of sport to ensure that it becomes equally accessible to all members of society.
- Increased equity in physical activity provides greater access for individuals, providing more opportunities to engage at all levels.
- Many personal factors influence engagement with physical activity and the level to which an individual participates.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Sports equity is about:

A. fairness in sport, equality of access and taking steps to address inequalities.

B. increasing policies and procedures for individuals to adhere to.

C. reducing access to individuals who show unacceptable behaviours and attitudes.

D. reducing diversity and restricting multiculturalism.

2. A microcosm of society is:

A. an organisation specifically designed to oversee the implementation of equitable practices.

B. a collective group of individuals with a diverse range of values and beliefs.

C. a subsection of society that reflects the values, beliefs and behavioural norms of the broader society.

D. the section of society that holds beliefs, values and behavioural norms that differ from the mainstream culture of the population.

3. Increasing equity in sport will increase physical activity access through enhancing opportunities. Which of the following is not an opportunity that is related to equity and access?

A. The opportunity to develop skills and improve

B. The opportunity to put personal success above the engagement of others

C. The opportunity to participate

D. The opportunity to be successful through earnings or prestige

4. What type of resources does an individual require in order to maximise access to physical activity?

A. Personal, relational and community resources

B. Individual, relational and cultural resources

C. Personal, interpersonal and cultural resources

D. Personal, social and community resources

5. Engagement in physical activity is more likely if:

A. personal opportunities to participate are maximised.

B. equity is increased by promoting factors that are inclusive and embrace differences.

C. inequity is decreased by reducing factors that are restrictive and discriminatory.

D. all of the above.

SHORT-RESPONSE QUESTIONS

1. Explain why equity is an important consideration in contemporary Australian physical activity.

2. Using a specific physical activity, explain how your engagement has been limited through a lack of access. Refer to different opportunities that you have had access to for the selected activity, and how this may reflect issues of equity you have experienced.

EXTENDED-RESPONSE QUESTION

In a 200–300-word response, justify the physical activity that you have the greatest engagement in so far in your life. Use aspects of equity, access and engagement in your justification to explain why you have had enhanced opportunities in your selected physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 11

Personal factors that act as barriers and enablers for self and others in physical activity

What's ahead?

Chapter 11
Personal factors that act as barriers and enablers for self and others in physical activity

- **11.1** Factors that affect equity and access
- **11.2** Personal factors that act as barriers and enablers for self and others in physical activity
- **11.3** Strategies to enhance personal factors for increased physical activity engagement

Key subject matter

- Recognise and explain that barriers are personal, social, cultural and environmental factors that limit access to personal, social and community resources.
- Recognise and explain that enablers are personal, social, cultural and environmental factors that increase access to personal, social and community resources.
- Analyse and synthesise primary data and secondary data about access, equity and engagement in physical activity contexts.
- Identify relationships between personal, social, cultural and environmental factors.
- Identify and explore information about personal factors acting as barriers and enablers for self or others to influence equity and access, including motivation, confidence, personality traits, personal ability, genetic disposition, gender and previous experiences of physical activity.
- Gather primary data about the influence of equity and access concepts and principles, including personal, social, cultural and environmental factors acting as barriers and enablers, on engagement in physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

- Use secondary data to analyse how equity and access concepts and principles influence engagement in physical activity.
- Analyse primary data and secondary data to identify relationships between the equity strategies and engagement in physical activity contexts.
- Devise equity strategies to influence personal, social, cultural and environmental factors in a physical activity context, e.g. event or tournament, come-and-try session or group participation activity.
- Justify the development of the equity strategies using evidence from primary data and secondary data.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- Which personal, social, cultural and environmental barriers are reducing access to physical activity for others and myself?
- What personal, social, cultural and environmental factors are increasing equity and enabling access to physical activity for others and myself?
- How are personal, social and cultural factors that affect access to physical activity related?
- How do personal factors act as barriers and enablers to physical activity access?
- What strategies can be used to overcome personal factors that affect access to physical activity?

ISBN 978-1-009-31125-0 Stewart et al.

11.1 Factors that affect equity and access

Equity and access are complex issues in modern society. By its very definition, equity is concerned with giving value to and celebrating personal, social and cultural differences. At times, equity is difficult to achieve, as each individual has unique circumstances in these three areas of difference. It is difficult to establish behaviours and policies that include all three areas when individuals display such diversity. However, while the factors that may influence equity are significantly different for each individual, they can be categorised as personal, social, cultural and environmental, so that their impact can be evaluated and strategies to enhance equity and access can be devised.

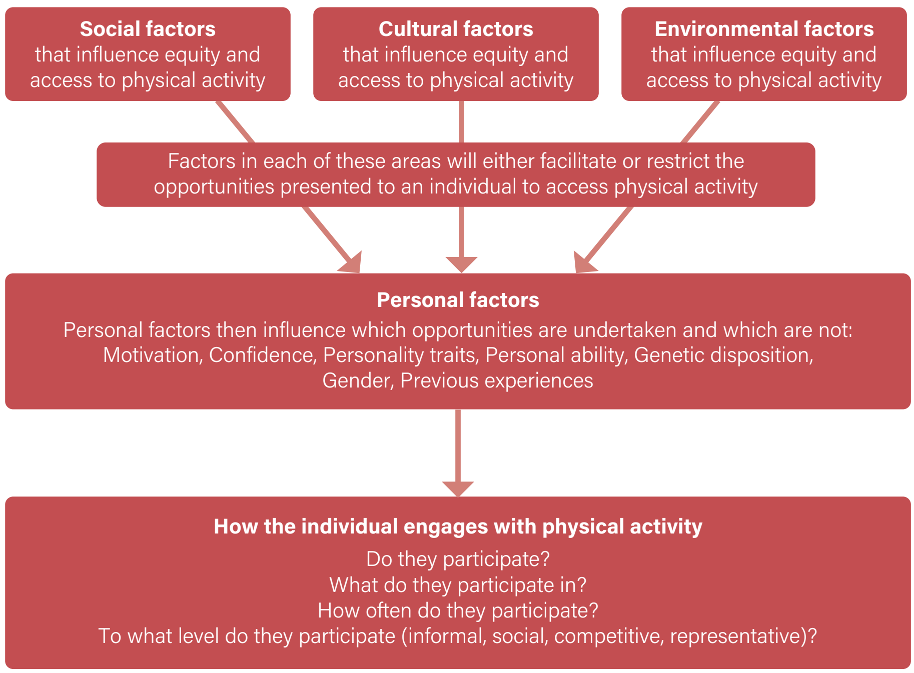


FIGURE 11.1 The many factors that affect equity can be grouped together, making the impact they have on access and engagement easier to investigate.

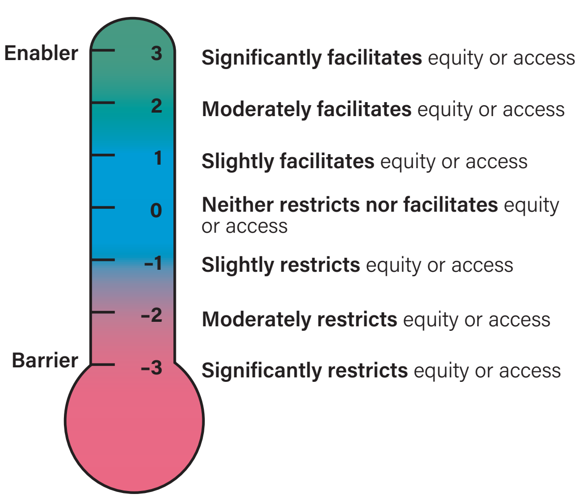


FIGURE 11.2 An equity and access enabler barometer. By applying some simple criteria to any factor, it is possible to identify areas that require attention if action to increase equity is to be considered.

When investigating equity and access to physical activity, it is important not only to identify the factors, but also to evaluate the degree of influence for each contributing factor. Some factors play only a minor role in the equity and access experienced by an individual, while other factors impact significantly. **Barriers** are factors that restrict or prevent access to physical activity. They diminish equity and reduce the chances of engagement. **Enablers** are factors that facilitate access and equity in physical activity. Enablers increase the chance of engagement. When exploring the degree to which individual factors influence access for an individual or group, it can be helpful to think of these as two ends of a continuum.

barrier a factor that restricts or prevents access to physical activity

enabler a factor that facilitates access and equity in physical activity

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 11.1

1. Create a list of five physical activities in which you have participated in the last year.
2. Consider the activities on your list and identify five enablers to your access – that is, things in your life that helped you to participate.
3. Create a list of five physical activities in which you have not participated in the past year.
4. Consider the activities on your list in question 3 and identify 10 barriers to your access – that is, things in your life that prevented you from participating.

ENGAGE 11.1

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What barriers to physical activity participation are there?

Demonstrate and apply

1. Over the next two weeks, you (and everyone in your class) must participate in eight 20-minute high-intensity interval training (HIIT) sessions or something similar. Three of these sessions will be done in Physical Education lessons; however, the remaining five must be done during your own time. Consider using suitable instructional clips on the internet to guide your sessions.
2. Before you begin, identify any barriers that might prevent you from completing the required sessions and, where possible, put measures in place to reduce these barriers.
3. Complete the eight sessions within the fortnight period.

Analyse and synthesise

4. Reflect on the success of completing this task. Were all sessions completed? Were they a full 20 minutes' duration? Were they completed at appropriate intensity for the duration? Where you predicted a barrier, did it arise? Where you had a plan to limit barriers, did it work? Did other barriers present themselves?

> KEY COGNITION
> **Analyse**: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

5. Using the reflection in task 4, analyse the cause(s) of any factors that you identified as barriers to participating in these physical activity sessions.
6. Undertake research to find the common reasons people give for not participating in physical activity in Australia. Identify the barriers people commonly give and how these relate to any barriers you identified to your own participation in the HIIT sessions.

Evaluate and justify

7. In a short statement, justify three main factors in your life that act as barriers to physical activity participation in general, and, if possible, use secondary data to support your justification.

ISBN 978-1-009-31125-0 Stewart et al.

Interconnected factors that affect equity and access

As previously stated, and shown in Figure 11.1, factors that affect equity and access to physical activity can be broadly categorised as personal, social, cultural and environmental. However, in reality there is generally an interconnected complexity surrounding these factors for any individual and the resulting equity and access experienced. Typically, there is not just one factor that may be acting as a barrier or enabler, but relationships between many factors. For example, influencing an individual's choice of activities (personal factor), may be the number of friends playing (social factor), which might be prompted by the local community's enthusiasm and promotion for the specific activity (cultural factor), which may be a result of the ample playing fields and resources available (environmental factors). Understanding the relationships between these factors can help to overcome barriers and enhance enablers when looking to devise strategies to increase equity and access to physical activity.

CHECK-IN 11.2

1. Select the physical activity that you have participated in the most over the past five years, and list all the major enablers (factors) that have contributed to this access.
2. Construct a paragraph that justifies why you have had access to the physical activity in the question 1. Ensure that your response identifies factors from different categories (personal, social, cultural and environmental), and explains the relationships between these factors.
3. Select a physical activity that is available to you in your local community but which you have not participated in, and list all the major barriers (factors) that have contributed to this lack of access.
4. Construct a paragraph that justifies why you have experienced a lack of access to the physical activity in question 3. Ensure that your response identifies factors from different categories (personal, social, cultural and environmental) and explains the relationships between these factors.
5. Compare and contrast the factors affecting equity and access for both these physical activities.

ENGAGE 11.2

Inquiry question: What factors influencing equity and access are most significant for school populations?

Recognise and explain

1. In the first part of this chapter, key personal, social, cultural and environmental factors that affect equity and access were presented. List the headings and key factors identified for each of these categories.
2. As a class, create four groups and allocate a category to each group. Construct a survey to gather primary data on how each area is affecting equity and access. Each group must contribute 10 questions about its area to the survey. The goal of the survey is to identify common barriers to access and engagement.
3. Collate the questions and publish them on a digital platform in order to survey as many respondents as possible. Remember to add key questions to highlight various demographics – for example, age, sex, current level of participation.

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

4. Have students (and the broader community if possible) complete the survey.
5. Export the data gathered from the digital platform and have each group review the data for its area to identify patterns and trends with regard to barriers and enablers.

Evaluate and justify

KEY COGNITION

Make decisions: select from available options; weigh up the positives and negatives of each option and consider all the alternatives to arrive at a position

6. From the data gained, decide on five factors that tend to create barriers to access for local individuals or groups. Retain this data for use in the Active Investigation activities later in the chapter, to assist in justifying any engagement strategies you develop.

11.2 Personal factors that act as barriers and enablers for self and others in physical activity

Throughout life, every person is faced with choices on a daily basis, and the selections made reflect their beliefs and values and are demonstrated by their actions and behaviours. This is also true for physical activity. Each day, individuals make a choice to participate or not participate in physical activity; to engage at high levels or be a low-level participant; to engage in training for improvement or try out for representative teams; or to reject these opportunities. While social, cultural and environmental factors may provide a wide variety of opportunities to access physical activity, the individual chooses how those opportunities are utilised. There are many interconnected personal factors that influence the choices made about access to physical activity.

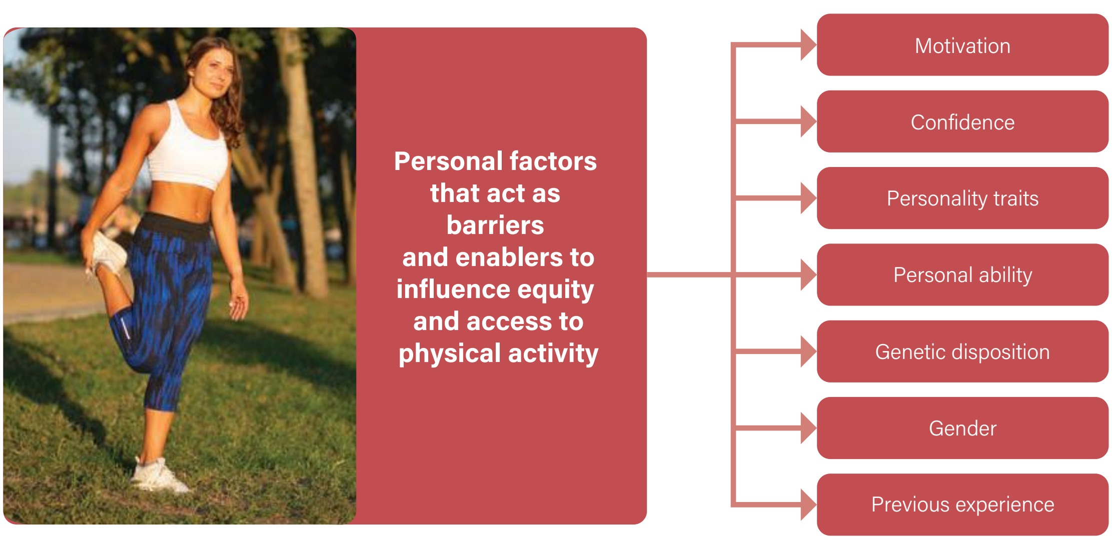


FIGURE 11.3 Many personal factors influence the choices made to access physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 11.3

RECOGNISE & EXPLAIN ANALYSE & SYNTHESISE JUSTIFY

Inquiry question: To what extent do personal attitudes and values about physical activities affect engagement?

Recognise and explain

1. Access the current version of the senior Physical Education syllabus and identify the physical activities that are outlined as possible study options.
2. Develop a five-point scale to rate how much you 'like' each activity listed and rate them using the scale – for example, 1 = dislike, 5 = extremely enjoyable.
3. Develop a five-point scale to rate how often you engage in each activity listed and rate them using the scale – for example, 1 = never engage, 5 = regularly engage.

Analyse and synthesise

4. Examine your 'like' and 'engage' rating for each physical activity and identify any generalisations that can be made from this primary data.
5. Acknowledge any anomalies – for example, 'I find Australian Rules football enjoyable, but I rarely engage.'

Justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

6. In a short statement, summarise the findings for this activity and justify any anomalies – for example, 'Why do I not engage with Australian Rules football even if I find it enjoyable?

ENGAGE 11.4

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: To what extent do personal attitudes and values about Physical Education affect engagement?

Demonstrate and apply

1. Engage in a variety of physical activities across a two- or three-lesson period. Approximately five different activities would be ideal.
2. Following each activity, consider how you would currently rate your overall level of:
   a. effort in physical activity lessons – how hard you try
   b. engagement with improving physical skill – how much attention you pay to getting better.
3. Rate each of these factors on a 10-point scale.

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

4. As a class, collate this primary data in an appropriate format – for example, a table or a graph.
5. Discuss the data and any trends that emerge or inferences that can be made. For example, is there a link between effort, engagement and results? What might cause this?

Evaluate and justify

6. Consider the primary data you have identified for yourself. From the different factors that influence personal access to physical activity listed in Figure 11.3, identify two that you believe significantly contributed to the rating you made, and justify their selection.

Motivation

In Chapter 7, the psychological effect of *motivation* on performance levels for an athlete was explored. However, motivation also has a significant influence on a person's access to and engagement in physical activity. When motivation levels are elevated, a person is more likely to undertake opportunities to participate and engage in that specific activity. They are more likely to seek opportunities to improve their performance and persist with participation, even through periods of poor performance. Highly motivated people are also more likely to engage in opportunities that may bring about higher levels of competition – for example, trialling for representative teams. Conversely, lower levels of motivation mean that it is far more likely that an individual will engage with lower effort levels. This results in performances that are below the person's potential, and they may see very little improvement or success when involved. Athletes with lower motivation are less likely to stay engaged in the physical activity and may actively avoid involvement, even if the opportunity to engage is presented. Essentially, low motivation acts as a barrier for access to and engagement in physical activity, while high motivation is an enabler.

FIGURE 11.4 Motivation and confidence are inherently linked to opportunities and access for individuals in physical activity.

CHECK-IN 11.3

1. Select a physical activity in which you have not yet had the opportunity to participate, but that you would be very motivated to try. Note why you are motivated to try this activity and what 'life factors' have prevented you from engaging in it so far. Be prepared to verbalise your response in a 30-second summary to a partner, a group or the class.
2. List physical activities towards which you are motivated.
3. From the activities identified, can you identify similar characteristics that show up as trends or preferences – for example, team sports, contact sports, non-competitive, social activities, fewer rules, self-directed, tactical, highly technical?
4. Explain the underlying causes of any preferences identified – for example, 'I am motivated towards team sports as I enjoy playing with friends.'

ISBN 978-1-009-31125-0 Stewart et al.

Confidence

Confidence is the level of belief an individual has that a task will be completed successfully or produce a favourable outcome. Confidence is a reflection of the trust an athlete places in their abilities, capacities or judgements that they must draw on to be successful. When presented with a task, such as engaging in a new physical activity, their confidence will dictate whether they expect to be successful, both with initial attempts and in the long term. In this way, the level of confidence experienced will act as an enabler or barrier to physical activity participation. If their confidence is low, the individual may be hesitant and not fully engage or give up early on. If their confidence is high, the expectation of being successful can motivate performance and act as an enabler to enhance engagement.

While undertaking specific physical activities, confidence can affect a competitor's opportunities. For example, low confidence will be a barrier when it causes a player to pass a basketball rather than shoot, even though they have an open shot at the basket. High levels of confidence act as an enabler within physical activity as players eagerly undertake opportunities where they believe a favourable outcome will result from their actions. Consider a player who volunteers to go full forward during an Australian Rules football match when the designated player is injured. Confidence is also an important enabler for athletes seeking access to higher levels of competition. Generally, players will only trial for representative duties if they have some confidence that they may make the squad.

ENGAGE 11.5

DEMONSTRATE APPLY ANALYSE & SYNTHESISE JUSTIFY

Inquiry question: To what extent do successful previous experiences impact confidence levels?

Demonstrate and apply

1. Engage in a physical activity for 30 minutes. At this point, your teacher will stop the activity and set the scenario of a high-stress situation where a key action must be performed – for example:
   - a specific movement sequence in sport aerobics that requires strength
   - a set shot for a goal in Australian Rules football from 35 m out on a slight angle
   - a free throw to win a basketball or netball match
   - a 2 vs. 1 situation to score in a touch football match
   - a set point serve in a volleyball match
   - a 1 m putt in golf
   - a last bowl to draw shot in a lawn bowls match.

   Everyone in the class will get one attempt at the selected scenario; however, prior to the attempt, make a quick mental check of your confidence level and what is influencing it.
2. Make your attempt.

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

3. After the attempt, note your thoughts and the success of the attempt. Add to your notes whether your confidence levels have gone up or down for the next time you find yourself in a similar scenario, and state whether this experience has been an enabler or barrier to future participation in the activity.

Justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

4. Referencing this activity in your response, justify how confidence can be either a barrier or an enabler to physical activity.

CHECK-IN 11.4

1. Listed in the table below are the physical activities from the current version of the senior Physical Education syllabus. For each activity, give yourself a confidence rating. Then assess how likely you would be to participate in the activity if you were given the opportunity to engage in a free 10-week program at school taken by expert coaches.

Activity	Confidence rating (how successfully you believe you would perform)				Participation level (the level at which you would undertake the free 10-week program)			
	Very unsuccessful	Unsuccessful	Somewhat successful	Very successful	Would not participate	Would try, but stop if not performing well	Would participate for 10 weeks	Would participate enthusiastically
Aerobic gymnastics (sport aerobics)								
Australian Rules football								
Basketball								
Futsal								
Netball								
Soccer								
Touch football								
Duathlon, aquathlon, triathlon								
Swimming								
Track and field – jump								
Track and field – throws								

(continued)

ISBN 978-1-009-31125-0 Stewart et al.

Track and field – track								
Badminton								
Tennis								
Volleyball								
Cricket								
Softball								
Archery								
Golf								
Lawn bowls								

2. There may be many reasons why you choose not to engage in a free physical activity program, and these may have nothing to do with confidence. However, from the list above, select one activity where there is a clear link between your low level of confidence and your reluctance to engage with the 10-week program. In approximately 50 words, describe how you have developed low confidence towards this activity. What factors have led you to believe you would not be successful?

Personality traits

Personality traits encompass a number of distinct, yet closely interconnected, personal factors that influence the equity experienced by individuals and their access to physical activity available. While each factor may contribute in different ways and to varying degrees, holistically these aspects tend to work together as enablers or barriers to influence the opportunities people have.

Enjoyment

From a sociological perspective, enjoyment can be considered the level of pleasure that is taken from engaging in or succeeding at physical activity. The level of enjoyment a person experiences from physical activity is generally influenced by:

- **personal temperament** – does the nature of the activity itself suit what the person likes to do?
- **personal ability** – does a level of mastery bring about satisfaction when performing?
- **previous experiences** – have similar experiences been positive or negative?
- **confidence** – does the knowledge that the performer can be successful provide a feeling of joy?

When high levels of enjoyment are gained from participation in a physical activity, they act as an enabler, with opportunities eagerly being undertaken to access the activity. However, when a physical activity does not provide enjoyment for the participant, this acts as a barrier, with the likelihood of ongoing participation low. When opportunities to access an activity, to develop skills or to advance to higher levels are presented to a person experiencing low enjoyment, they may be declined.

CHECK-IN 11.5

Source the physical activities identified in the current version of the senior Physical Education syllabus and place each along the enjoyment continuum below, based on how engagement currently makes you feel.

Distressed → Depressed → Displeased → Bored → Satisfied → Pleased → Happy → Delighted → Fantastic

FIGURE 11.5 The enjoyment continuum

ISBN 978-1-009-31125-0 Stewart et al.

Temperament or preference

Many psychologists have researched how people develop their personality and the influence personality has on values, beliefs and behaviours. The work of experts such as Carl Jung and Isabel Briggs Myers (who with her mother Katharine Briggs developed the Myers–Briggs Type Indicator questionnaire) has developed knowledge about people's temperaments. Individual **temperament** determines the way an individual sees the world, approaches tasks and makes decisions. People with dissimilar psychological preferences have varying interests and views, behave differently and are motivated by different things. Put simply, people prefer certain physical activities over others, as the nature of the activity seems to suit what they like. For example, more outgoing athletes might like the team atmosphere of touch football or netball, while more introverted people may appreciate the solitude of archery.

Where there is alignment between the characteristics of an activity and the temperament of the athlete, temperament works as an enabler to engagement. However, barriers form when personal **preference** and the characteristics of the activity do not match. As a result, a person may disassociate from the physical activity.

Self-concept and self-esteem

Self-concept is the mental self-image a person has of themselves; it includes physical attributes and abilities, as well as personality and intellectual ability. Two factors relating to self-concept dictate whether this aspect is a barrier or enabler to equity and access:

- **Sporting self-concept.** This is the general image the person holds of their ability as an athlete. Do they see themselves as 'sporty', 'athletic', 'coordinated' or 'competitive'? If a person has a sporting self-concept, and views themselves as a 'sportsperson', they will be far more likely to engage in opportunities to participate in activities when they are presented. Those who view themselves as 'not sporty' will find this a barrier to participation.
- **Sport-specific self-concept.** This self-concept is linked to a specific activity. For example, does the person view themselves as a 'volleyballer'? If so, they are more likely to engage in volleyball opportunities; however, those who view themselves as poor volleyball players will find this a barrier to volleyball access.

CHECK-IN 11.6

1. Select a physical activity from those listed in the current version of the senior Physical Education syllabus that you believe your personality does not suit.
2. In 100 words, justify your selection. In your justification, provide clear evidence that links the disjoint between your personality and the characteristics of the activity. For example, *'I am not suited to archery as it requires a calm and relaxed approach to be successful, as well as the ability to carefully analyse each shot in order to make improvements for the next. I find it difficult to remain focused and concentrate, particularly when outdoors enjoying sport. I prefer more movement from an activity. I would struggle to control my body for long periods of time in order to demonstrate the consistency required from a good archery technique and be successful.'*
3. Conduct some research into personality types and the work of Carl Jung and Isabel Briggs Myers. If possible, locate a simple temperament test to undertake online. From the results of your test, are you able to make links between the outcome of the test and the type of activities you enjoy?

temperament a person's nature, their natural propensity and innate behavioural and personality traits; temperament is shown in how people behave or react to others or situations

preference (for physical activity) a strong like for, or a predisposition in favour of, a physical activity or activity type

self-concept the mental self-image a person has; it includes physical attributes and abilities as well as personality and intellectual ability

Our self-concept develops in response to the cultural and personal stereotypes we hold about sport, physical activity and its participants, as well as in relation to our own abilities, preferences and body type.

ISBN 978-1-009-31125-0 Stewart et al.

Self-esteem is the way an individual feels about their own abilities. While self-concept may mean an athlete perceives they are a good runner but a poor swimmer, self-esteem will demonstrate how they feel about that view. Self-esteem is a complex issue but can be viewed simply as a continuum from low to high. A person with high self-esteem views most aspects in their life positively. Whether they are a good runner or a poor swimmer, they engage in opportunities to learn and continue to persist through poor performance and negative outcomes. This makes high self-esteem an enabler to physical activity. A person with lower self-esteem may approach physical activity with negative thoughts and the expectation of failure (low confidence). This acts as a barrier to participation.

self-esteem the way an individual feels about their own abilities, as demonstrated through their self-worth and self-respect

CHECK-IN 11.7

1. Based on your knowledge of different physical activities, your own ability, skills, talents and body composition, select a physical activity to which you believe you would be most suited. This activity does not need to be one in which you have participated before. Justify your selection by outlining how your self-concept for this activity aligns with the 'stereotypical ideal player.'
2. Consider a physical activity you have studied. Do you believe your sport-specific self-concept for this activity is a barrier or an enabler to your participation, improvement and success? Justify your response.

FIGURE 11.6 The belief in your ability acts as an enabler to future access and opportunities.

Personal ability

Personal ability refers to the capacity an athlete has to produce successful performances of a selected physical activity. Where an athlete has engaged in a physical activity, they can make a judgement about personal ability level based on the success achieved in actual performances in training or games. Where a performer has no, or very little, actual experience of undertaking a physical activity, a judgement about personal ability may revert to experiences in other similar activities. This may reflect 'potential' ability rather than 'actual' ability. In either case, there is an inseparable link between personal ability (how well they perform) and self-concept (how they view themselves in relation to that activity). For example, a person with a high-level skill in badminton (ability) may view themselves as a good badminton player (self-concept). This acts as an enabler to access and opportunities for this performer. On the other hand, a player with low soccer ability may view themselves as a poor player, and this becomes a barrier to future participation in the game.

An athlete's ability is governed by:

- their natural body structure and the level to which it has been trained to meet the movement demands of a specific activity
- the techniques and tactics learned, the level to which they have been refined and the expertise of the performer to adapt them to different physical scenarios

CHECK-IN 11.8

1. In which physical activity do you have the greatest personal ability? Justify your selection by providing an example of each characteristic discussed so far in section 11.2.
2. Identify a physical activity for which you possess low personal ability. Compare your level of engagement undertaken in this activity with the one selected in question 1.

ISBN 978-1-009-31125-0 Stewart et al.

- their capability to analyse sporting situations and react with appropriate movements at appropriate times
- the aptitude to make effective decisions about how to move to bring about successful outcomes, without being distracted by unnecessary information from the performance environment.

Genetic predisposition

Another individual factor that influences equity and access to physical activity is **genetic predisposition**. Genetic make-up determines a person's body type, muscle type and bulk, as well as their height and limb length. These body features can be beneficial for specific physical activities when they facilitate the movements required by the activity. For example, taller athletes have a natural advantage in activities like basketball, volleyball and high jump, while more muscular performers with a lower centre of mass suit wrestling, and leaner athletes with the right muscle fibre type naturally do well in long-distance running.

Where there is a strong association between a person's body features and the physical attributes conducive to success for a physical activity, genetic predisposition will act as an enabler. However, if a person believes they are not physically suited to an activity, genetic predisposition may act as a barrier, with the individual less likely to take up opportunities to participate in the activity.

genetic predisposition the concept that a person's body type and systems, as a result of their genetic make-up, may provide natural benefits for success in specific physical activities

Gender

Despite many changes in society and within sport, gender continues to be a factor that influences equity and access in many areas. Gender is a social construction by which characteristics, roles and behavioural norms are considered to be masculine, feminine or another identity. Many of these attributes are based on cultural stereotypes founded in historical contexts. While some of these attributes may be outdated, they still exist in modern Australian society as they are embedded in our cultural upbringing. They extend to all aspects of society, including sport.

From a personal perspective, gender issues can be explored as a part of self-concept and its relationship with personal beliefs and stereotypes about being male, female or another identity. For example, males who view themselves as being conventionally masculine may find this a barrier to accessing a non-contact or gentle type of activity associated with femininity. Conversely, females who view themselves as feminine may choose not to engage in traditionally masculine activities that are rough or aggressive. Essentially, individuals are more likely to participate in physical activities that are culturally associated with their gender and reflect the behavioural expectations of those around them. This concept will be explored in more detail later in the chapter.

CHECK-IN 11.9

Genetic predisposition can be more beneficial to some physical activities. Consider the body features below and list three physical activities for each where that physical feature may provide a natural advantage.

- Short
- Tall and lean
- Tall and muscular
- Broad shoulders
- Large arm span
- More explosive muscle fibres
- More endurance muscle fibres

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 11.7 Self-concept limits opportunities for an individual when there is a mismatch between how they want to be seen and their stereotypes about gender and physical activities.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 11.6

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: To what extent does gender affect physical activity engagement?

Recognise and explain

1. Brainstorm a list of physical activities that stereotypically fit under the headings 'Male', 'Female' and '**Gender-neutral**'.

> **gender-neutral (physical activities)** refers to activities that display characteristics, roles and behavioural norms that either equally share traditional male and female characteristics, or display characteristics of neither

2. Decide on one physical activity from each category to engage in over the next three Physical Education lessons and discuss as a class how best to divide into teams so as to accommodate diverse gender identities.

Demonstrate and apply

3. Engage in three different physical activities over the next three lessons, each time playing half the time in games based on sex (i.e. an all-boys game, and an all-girls game), before playing in a mixed game. Select a range of physical activity types for this activity, considering those that have stereotypically been considered male, female and gender-neutral.

Analyse and synthesise

4. Reflect on the experiences of the previous lessons. Consider the:
   a. level of enjoyment and engagement in each activity in relation to your own gender beliefs and the gender stereotype of the activity
   b. construction of the team make-up and games – did you engage in and enjoy mixed situations or games specific to your gender? Did this change for different activities?

Evaluate and justify

> KEY COGNITION
> **Evaluate**: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

5. From the experiences in this activity, evaluate and justify whether your personal gender beliefs act as a barrier or an enabler to physical activities that are stereotypically associated with a different gender.

Previous experience in the physical activity

As mentioned earlier in the chapter, previous experience plays a significant role in developing enjoyment levels, sporting self-concept and an understanding of personal ability. Where previous experiences have been successful, positive and enjoyable, they will act as enablers to access and engagement. A player will seek out future opportunities to participate, enhance performance and reach their potential where possible. Barriers form for athletes as they accumulate negative previous experiences. This may see them engage less, quit the activity or refuse to take the opportunity to participate should it be presented to them.

ISBN 978-1-009-31125-0 Stewart et al.

KEY MESSAGE

Many external factors influence an individual, but the final decision to engage in physical activity is a personal choice.

KEY MESSAGE

The personal choice to access and engage in physical activity involves the complex interaction of many unique aspects for the individual.

KEY MESSAGE

In varying degrees, motivation, confidence, personality traits, ability, genetic disposition, gender and previous experience all influence decisions regarding physical activity engagement.

CHECK-IN 11.10

Reproduce the table below. In the barrier and enabler columns, insert a personal example for a specific physical activity.

Personality traits

Factor		A personal example of how this factor was a barrier	A personal example of how this factor was an enabler
Motivation	Intensity and direction of effort		
Confidence	Belief in a successful or favourable outcome		
Personality traits: Enjoyment	Level of pleasure from participation		
Personality traits: Temperament or preference	The activities to which your personality is suited		
Personality traits: Self-esteem and self-concept	The type of athlete you see yourself as, and how you feel about it		
Personal ability	The level of performance an athlete can produce		
Genetic disposition	The link between body composition and movements required		
Gender	The impact of personal views on femininity or masculinity		
Previous experiences of physical activity	The impact of historical performances in the same or similar activities		

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 11.11

1. Describe a previous experience in a physical activity that acted as a barrier to future participation.
2. Explain how this experience made you feel. Did you quit, want to quit or put in less effort following the experience, or was your confidence shaken? Or did you have a different reaction?

ENGAGE 11.7

RECOGNISE & EXPLAIN | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: To what extent do personal factors affect access to and engagement in a specific physical activity?

Recognise and explain

1. Reflect on the seven factors that have been identified as affecting personal access to and engagement in physical activity (see Figure 11.3).
2. Select any one of the physical activities in the current version of the senior Physical Education syllabus for the focused analysis to follow.

Analyse and synthesise

3. Analyse each personal factor by using the barrier–enabler barometer in Figure 11.2. This will give you a 'score' between −3 and +3 for each factor. In making your judgement, consider:
   a. the knowledge accumulated through the other activities in this chapter
   b. your knowledge about your own values, beliefs and performances in the selected activity.
4. From this, identify the number one personal barrier and the number one enabler for the selected physical activity.
5. Add together the seven individual scores to get an overall result. Is the result a positive or negative number?

Evaluate and justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

6. In a 300-word statement, justify whether personal factors have had an overall positive or negative influence on your access to the selected physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

11.3 Strategies to enhance personal factors for increased physical activity engagement

An individual's ability to exercise personal choice will affect engagement in physical activity. In many ways, individuals may restrict their own access to physical activity when they choose not to participate, despite having ample access to do so. Subsequent chapters will explore how issues of equity and access concerning social, community and environmental factors can be overcome, but at the individual level personal preference can mean some people simply choose to limit their engagement in physical activity, or not participate at all. Despite this, the health benefits of physical activity are undeniable, and a lack of motivation to participate can be overcome, as can many of the personal factors that limit engagement.

An **equity strategy** is a plan of action devised to enhance equity, access and/or engagement to physical activity. To devise an effective equity strategy to mitigate personal factors affecting equity and access requires the individual to develop self-awareness of interests and evaluate the personal barriers and enablers influencing engagement.

When developing equity strategies for personal factors, a significant area to consider is motivation. Motivation has been comprehensively explored earlier in this chapter and in Chapter 7. Equity strategies should aim to enhance the three underlying areas of motivation – autonomy, competence and relatedness. By finding activities that provide autonomy, competence and relatedness, individuals are far more likely to engage in, and sustain, their participation in their selected activity. The activity itself may need to change its structure, organisation or rules to provide enhancements in these areas and therefore become more appealing to individuals.

To further increase motivation and enjoyment for physical activity when devising equity strategies, the elements of positive psychology may be considered. One field in this area is the notion of PERMA, which is based on work by Professor Martin Seligman.

equity strategy a plan of action devised to enhance equity, access and/or engagement

FIGURE 11.8 A successful equity strategy is unique to each individual.

PERMA is designed to enhance overall well-being, enjoyment and resilience through developing skills in the following areas:

- **P**ositive emotion – finding things that provide amusement, hope, interest, joy, love, compassion, gratitude and pride
- **E**ngagement – finding things that you love doing, where you lose track of time; this is referred to as 'flow'
- **R**elationships – finding things where you feel loved, supported and valued by others
- **M**eaning – finding things that involve being part of something greater than ourselves, where your contribution is valued and worthwhile
- **A**ccomplishment – finding things that provide the intrinsic motivation to complete, that are achievable and provide a sense of achievement and satisfaction.

When physical activities can provide the elements of PERMA and enhance motivation, engagement increases. If equity strategies can adjust the physical activity so that it better supplies the elements of PERMA, this becomes an enabler for the individual and enhances equity, access and engagement.

Equity strategies designed to increase physical activity engagement through targeting the personal factors that affect equity, access and engagement should therefore consider the PERMA elements to create an activity:

ISBN 978-1-009-31125-0 Stewart et al.

- of interest – one that has personal meaning or meaning can be developed from the activity
- that provides personal enjoyment – one that provides flow for participants
- that is challenging, but provides a frequent sense of accomplishment
- that builds relationships through a sense of belonging and commitment to others.

CHECK-IN 11.12

1. Conduct some secondary research into PERMA and the work of Professor Martin Seligman, by finding further information on each of the PERMA areas.
2. Select two physical activities and compare what each provides you in terms of PERMA. For each PERMA area, provide a specific example to demonstrate how the activity contributes to that area. For example, *'daily jogging provides me with a sense of achievement as I see myself getting fitter and running further or faster. I track this on my smart watch and can see my weekly goals being accomplished.'*

ACTIVE INVESTIGATION 11.1

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: How realistic is personal preference as a strategy for enabling physical activity?

Recognise and explain

1. Select any three physical activities that you would undertake in your next Physical Education lesson if you could wave a magic wand and do them.
2. Now select three activities in which you will engage over the next two Physical Education lessons. Consider constraints such as facilities, equipment and teacher monitoring. Your activities must be approved by your teacher. You can choose individual activities or combine in small groups to play games. You can play competitive matches or participate informally with modified rules and spaces.

Demonstrate and apply

3. Undertake the three activities you have identified over the next two lessons. You can allocate equal time to all of them or do some more than others, but this is your chance to do the activities you want, to the level you wish.

Analyse and synthesise

KEY COGNITION

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

4. After the lessons, reflect on the level of enjoyment and engagement by rating each activity and noting the factors that influenced these. For example, 'Heightened enjoyment as I could stop and start as I pleased.' Link the factors noted from the class to the factors that affect equity and access.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

5. Identify barriers that prevented higher level of participation during the lessons or that shaped the decisions about the activities you would do. For example, 'I wanted to do Australian Rules football but I did not have enough other players and the teacher was not qualified to oversee the game.'

Evaluate and justify

6. Personal preference is an enabler to physical activity engagement when individuals feel they have a choice about what activity they engage in and how they engage in it. In a 200-word response, and referencing the primary data collected during this activity, explain the barriers faced when providing personal preference as a strategy to increase access.
7. Present two recommendations that may help to limit any of the barriers identified in schools.

ACTIVE INVESTIGATION 11.2

Inquiry question: Does acknowledging differences in personal attitudes and values enhance engagement in physical activity?

Recognise and explain

1. Engage in a physical activity for a lesson, then as a class, collect data from each individual on the following using a simple 1–5 scale:
   a. enjoyment of activity
   b. level of engagement and effort
   c. value or worth they hold for the activity.
2. Collect primary class data on the most important aspect of engaging in physical activity – meaning what class members value most from their physical activity engagement. This might be:
   a. high-level competition
   b. rewards
   c. fun
   d. acknowledgement
   e. inclusiveness.

Demonstrate and apply

3. In the following lesson, use the data gathered previously to change the playing environment of your physical activity. Consider:
   a. high-level competition (class rankings, competitiveness – knock-out competition)
   b. rewards (competition with a prize, consider an 'A' and 'B' grade competition, random draws for prizes)
   c. fun (change the rules, time, scoring system)

ISBN 978-1-009-31125-0 Stewart et al.

d. acknowledgement (everybody who reaches a certain level gets something – perhaps a prize, achievement certificate or recognition – or goes on parade)
e. inclusiveness (vary the organisation of rules, team structure or scoring so that everybody gets involved – for example, allocate a different scoring system so lower-ability students are worth more points if they score).

This could be done once for a single aspect above or done five times, each time using a different strategy and then reflecting.

Analyse and synthesise

4. After engaging in each modified game, gather further primary data on the same three areas identified in task 1.
5. Analyse the data, looking for trends, specifically between the modified activity undertaken and students who identified this as an important feature for engagement in task 2.

Evaluate

KEY COGNITION

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

6. In a 150-word statement, evaluate the effectiveness of catering for individual attitude in enhancing engagement in physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- There are relationships between personal, social, cultural and environmental factors that determine the opportunities individuals experience to engage in physical activity.
- The factors that influence engagement in physical activity can be classified as either enablers or barriers.
- Social, cultural and environmental factors influence the opportunities that individuals experience to engage in physical activity, but the decision to engage remains an individual choice, based on personal factors.
- Many personal factors influence engagement with physical activity and the level to which an individual participates; these can be generally organised into motivation, confidence, personality traits, personal ability, genetic disposition, gender and previous experience.
- Motivation, confidence, personal ability and previous experience are closely linked personal factors, where positive qualities may become enablers to physical activity engagement and negative qualities may become barriers.
- Personality traits incorporate a range of aspects that revolve around factors affecting individual preference and enjoyment gained from different activities, or physical activity in general; these aspects include enjoyment, temperament or preference, self-concept and self-esteem.
- Genetic predisposition is the notion that a body's natural make-up may suit the physical requirements of a physical activity, and therefore could act as a barrier or enabler depending on an individual's body composition and the activity's physical movement requirements.
- At an individual level, personal beliefs about gender, and how this relates to self and to specific physical activities, may act as a barrier or enabler for physical activity engagement.
- Strategies to enhance personal factors for increased physical activity engagement must be based on increasing personal motivation by increasing positive emotion, engagement with physical activity, the relationships gained through physical activity, the meaning gained from participation in physical activity, and the sense of accomplishment gained through physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Factors that affect equity and access to physical activity can be broadly classified as:
   - A. personal, social, diverse and accessible.
   - B. personal, social, cultural and environmental.
   - C. individual, social, cultural and equitable.
   - D. personal, social-cultural and environmental.
2. An enabler for physical activity will:
   - A. increase access and engagement.
   - B. always diminish any inequity experienced.
   - C. decrease access and engagement.
   - D. ensure that an individual engages in physical activity.
3. Which of the following is not a personal factor that influences physical activity engagement?
   - A. Your personal ability
   - B. Your confidence
   - C. Your coach
   - D. Your beliefs about gender
4. A personal factor that influences physical activity engagement is:
   - A. personality traits.
   - B. friends.
   - C. individual access to coaches.
   - D. an individual's family.
5. A strategy to enhance personal access to and engagement in physical activity will:
   - A. aim to increase motivation towards physical activity and the meaning and accomplishment gained by the individual.
   - B. eliminate all barriers to participation, allowing the individual to engage.
   - C. provide enablers such as local facilities and grants to clubs, allowing easier access for individuals.
   - D. take away barriers and add more enablers to promote access and engagement for the individual.

SHORT-RESPONSE QUESTIONS

1. Select one personal factor that has significantly negatively affected your engagement in a specific physical activity and provide examples to demonstrate how this factor has acted as a barrier for you.
2. Select a significant personal factor that acts as an enabler for you to engage in physical activity (in general or for a specific activity). Identify the enabler, why it is a personal factor and what makes the factor significant for you.

EXTENDED-RESPONSE QUESTION

Justify the selection of the three most significant personal barriers that are currently affecting your access to and engagement in a specific physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 12

Social factors that act as barriers and enablers for self and others in physical activity

What's ahead?

Chapter 12
Social factors that act as barriers and enablers for self and others in physical activity

- **12.1** The socialisation process
- **12.2** Social factors that act as barriers and enablers for self and others in physical activity
- **12.3** Strategies to enhance social factors for increased physical activity engagement

Key subject matter

- Identify and explore information about social factors acting as barriers and enablers for self or others to influence equity and access.
- Gather primary data about the influence of equity and access concepts and principles, including personal, social, cultural and environmental factors acting as barriers and enablers, on engagement in physical activity.
- Use secondary data to analyse how equity and access concepts and principles influence engagement in physical activity.
- Analyse primary data and secondary data to identify relationships between the equity strategies and engagement in physical activity contexts.
- Devise equity strategies to influence personal, social, cultural and environmental factors in a physical activity context, e.g. event or tournament, come-and-try session or group participation activity.
- Justify the development of the equity strategies using evidence from primary data and secondary data.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What is socialisation?
- How does socialisation impact on physical activity equity, access and engagement?
- What social factors act as barriers and enablers to physical activity equity and access?
- What equity strategies can reduce the impact of barriers to enhance equity, access or opportunities within physical activity?

ISBN 978-1-009-31125-0 Stewart et al.

12.1 The socialisation process

Every human develops as an individual in response to the social, cultural and environmental context in which they are placed. As social participants, people learn about all aspects of life as they develop from infant to child to adult, including their values, attitudes and behaviours towards physical activity. The process by which an individual acquires these aspects from their surroundings is called **socialisation**. Socialisation allows an individual to conform to the behavioural norms and roles required for integration into a group or community. Humans must gain acceptance into a social group at a very basic level for survival: to gain the food, shelter and support required for ongoing existence. At a psychological level, humans also require group acceptance to feel loved and valued and to obtain a sense of worth. Therefore, it is essential to acquire the necessary social skills and beliefs to 'fit in'.

FIGURE 12.1 Behaviours such as showing concern for an injured player are learned through the process of socialisation.

socialisation the process by which an individual acquires knowledge, language, social skills and values from their surroundings

agent of socialisation an element or a section of a society through which learning occurs as part of the socialisation process

Agents of socialisation

As an individual grows, they encounter many elements within society that shape their values, beliefs, attitudes and behaviours. Each of these elements affect the individual in different ways to varying degrees, and teach divergent life lessons. Any element within a society through which learning occurs as part of the socialisation process is referred to as a socialising agent, or **agent of socialisation**. An agent of socialisation may be an individual, a group or an organisation.

Due to the unique circumstances and experiences that shape each life, every individual has a specific set of socialising agents. Some of these agents will have had a significant and profound influence on an individual's socialisation process, while others may have only a slight influence on the values, beliefs, attitudes and behaviours developed. Agents with which there is a strong relationship play a significant role in learning. For example, a parent or sibling will make a significant contribution to the socialisation process. However, so too can a local football club with which an individual has developed a strong allegiance. Agents with which there is frequent contact will also be significant in shaping the individual. Consider the impact a teacher has on a student's socialisation when they see them every school day for a year. The school itself, with its rules, policies and curriculum, is also an agent of socialisation. As agents of socialisation establish personal beliefs, values and attitudes towards physical activity, they work as enablers or barriers to physical activity.

FIGURE 12.2 Life experiences provide many agents of socialisation for individuals. Each agent contributes to the values, beliefs, attitudes and behaviours developed by individuals in unique ways.

ISBN 978-1-009-31125-0 Stewart et al.

KEY MESSAGE

Socialisation is the process through which we learn the appropriate values, attitudes and behaviours to fit in.

KEY MESSAGE

Individuals, groups and organisations from which we learn social norms are called agents of socialisation.

KEY MESSAGE

Values, attitudes and behaviours concerning physical activity are acquired from the agents of socialisation in our lives.

CHECK-IN 12.1

1. Consider the values, attitudes and behaviours you have developed towards physical activity as a result of your life experiences to date.
2. Copy the table below as a template. Under the headings, list all the agents of socialisation that have contributed to your socialisation process regarding physical activity. As you construct your list, use larger writing to denote those that have had a more significant influence, and smaller writing for those that have played a minor role.

Individuals	Groups	Organisations

3. List five common behaviours concerning sportsmanship expected on a sporting field that you have learned through the socialisation process.

Social factors that influence equity and access to physical activity

- Parents and siblings
- Friends and peers
- Teachers and coaches
- The social construction of gender
- Diversity
- Physical activity preferences

FIGURE 12.3 Social factors that can influence equity and access to physical activity

ISBN 978-1-009-31125-0 Stewart et al.

12.2 Social factors that act as barriers and enablers for self and others in physical activity

As displayed in Figure 12.3, there are many social factors that act as barriers and enablers to influence equity within, and access to, physical activity. These social factors include parents and siblings, friends and peers, and teachers and coaches. The social construct of gender also plays an important and contested role, as do diversity and physical activity preferences.

Parents and siblings

Parents exercise the most important influence on their child's equity, access and ability to engage in physical activities. For a young child, the family is responsible for making decisions about the type and scope of the child's activities. Parents organise opportunities for very young children to participate in formal and informal physical activities, and provide financial and emotional support to encourage their involvement. This could be as simple as an organised play date or as extensive as involving them in organised sport and providing the equipment and emotional support necessary for their involvement. The child also learns about sport participation through observation, imitation and modelling of parental involvement.

By having one or both parents providing sporting opportunities, support and encouragement, and role modelling physical activity, children are more likely to participate.

While it may not be true in all cases, in general the values, attitudes and behaviours demonstrated towards physical activity by parents will be the largest factor in establishing positive sporting behaviours for the rest of a child's life. The access and opportunities that parents present are a key barrier or enabler to physical activity engagement.

The socialisation process towards physical activity and the opportunity to engage in physical activity seem to be much stronger when children have siblings. This is due to the opportunities provided by having someone to play with. Having at least one other person with whom to actively play ensures that from a young age basic movement skills are being developed. As chasing, climbing, dodging and wrestling skills are developed, this may see young people acquire a more positive attitude towards their own physical abilities. These interactions also create pleasant experiences and a strong sense of enjoyment from physical activity, as a key enabler to physical activity access for an individual.

FIGURE 12.4 Individuals, groups and organisations are all agents of socialisation that can influence teens.

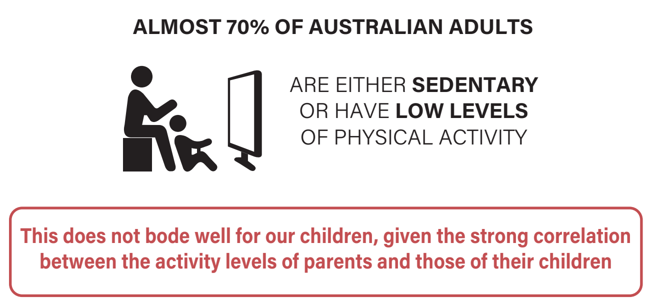


FIGURE 12.6 Australian children benefit from active, sporty parents.

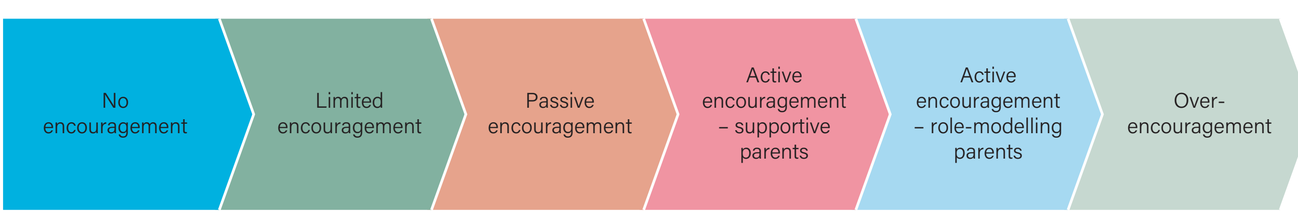


FIGURE 12.5 The values, attitudes and behaviours demonstrated towards physical activity by parents will generally be the most significant factor in establishing positive sporting behaviours for the rest of a child's life. Parents encourage sporting engagement in a wide variety of ways.

ISBN 978-1-009-31125-0 Stewart et al.

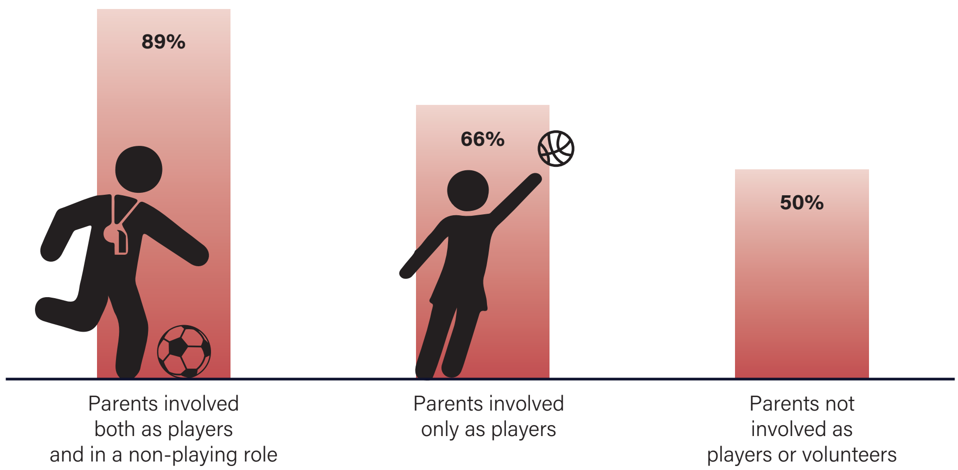


FIGURE 12.7 Child participation based on parent involvement

Source: https://www.clearinghouseforsport.gov.au/participation-in-sport

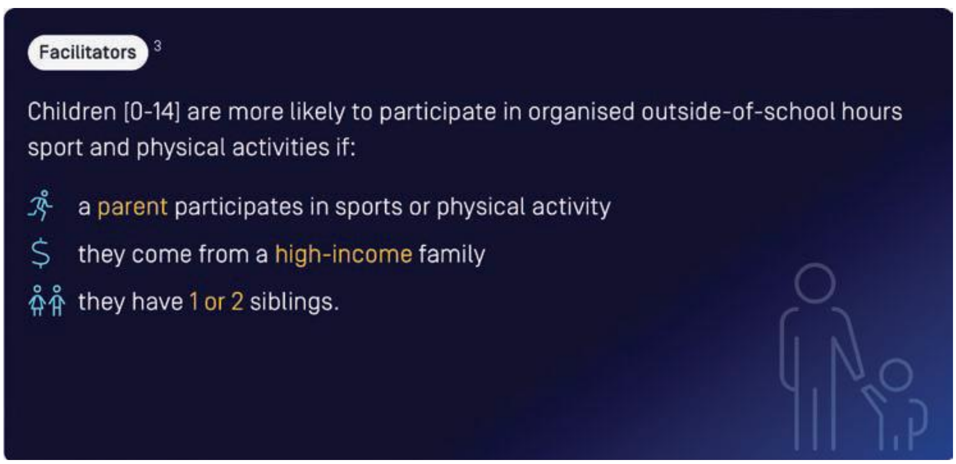


FIGURE 12.8 Key factors from parents and siblings that enable child participation

Source: Australian Sports Commission (2023)

Parents and siblings act as enablers to physical activity by providing resources, creating opportunities for engagement and instilling positive sporting values and behaviours. Barriers are created by parents and siblings when they display negative attitudes and behaviours towards physical activity or the importance of being active, or are discouraging about participation in specific activities.

It should also be noted that family groups that value and participate in specific sports tend to enable access to just one or two activities, thus creating barriers to others. For example, parents who value and have been involved in tennis and football may choose to involve their children in tennis during the summer months and football during the winter season. While this decision enables access to these activities, it creates barriers for their children's access to other physical activities.

CHECK-IN 12.2

1. Interview your parents to identify the physical activities in which they engaged when they were younger, the level to which they participated and the overall value they place on involvement in physical activity. State any correlations between these areas and your own responses to these questions.
2. Conduct secondary research into the link between parent play and child play. Ensure that your research is from a valid source and save the data for future use in class discussions and assessment tasks (be sure to record your source using an appropriate method of referencing).

ISBN 978-1-009-31125-0 Stewart et al.

Friends and peers

As children get older, friends and peer groups begin to have a greater influence over the development of attitudes and behaviour through the socialisation process. Between the ages of 10 and 14, the child shifts predominantly to interactions with their peers for information and feedback regarding social norms. This transition is a significant step to adulthood, as a child begins to develop their own identity and social groups away from the family. As an individual moves away from the family to establish their own social group, they try to establish values, attitudes and behaviours that demonstrate conformity to the expectations of their peer group, thereby allowing them to gain peer acceptance.

With regard to physical activity, this may see individuals experience greater opportunities to access activities that are accepted and being undertaken by those within their peer group. For example, in Victoria a large percentage of 12-year-old boys participate in Australian Rules football; as a result, a 12-year-old boy may experience more opportunities to participate in Australian Rules football than an activity such as archery. The same 12-year-old boy in Queensland, however, may experience more opportunities to participate in Rugby League or soccer, as these are the more dominant activities undertaken by his peers. Physical activities with larger participation rates among peers are therefore enablers for increased access, as participation in these traditional and stereotypical activities is one way to conform to the expectations of the peer group. The reverse can see peers create barriers when it comes to equity and access to physical activity. Imagine the captain of a Rugby Union team telling his peers that he will be quitting next season in order to pursue a spot on the synchronised swimming team. In this case, the player may fail to make this transition due to exclusion from his peer group, because he is not displaying the group's expectations for an adolescent male.

FIGURE 12.9 Swimming is one of the most popular physical activities in Australia for any age group.

ENGAGE 12.1

RECOGNISE & EXPLAIN | ANALYSE & SYNTHESISE | JUSTIFY

Inquiry question: What activities do our peers engage in?

Recognise and explain

1. Conduct some secondary research into the physical activities most commonly being undertaken by adolescents in Australia. Try accessing the AusPlay data portal on the internet; it contains information concerning many factors of participation and sporting trends across all activities for Australians.
2. Note three different sources of the secondary research found and collate the evidence discovered.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

3. Conduct primary data-gathering for peers in your local area on the activities in which they engage by using the following table to tally responses. Gather data about the physical activities in the current version of the senior Physical Education syllabus, as well as four other activities that were identified in your secondary research.

4. In order to assist in finding trends, use three different versions of this table and survey: for your class, your friends and your peers. As a class, discuss the number of respondents required to ensure the validity of your data. You might also use different-coloured pens to tally male and female responses.

Physical activity	Outside school				At school		
	Has never participated	Rarely participates	Occasionally participates	Frequently participates	Never	Once or twice	Regularly
Aerobic gymnastics							
Archery							
Australian Rules football							
Badminton							
Basketball							
Cricket							
Triathlon							
Futsal							
Golf							
Lawn bowls							
Netball							
Softball							
Soccer							
Swimming							
Tennis							
Touch football							
Track and field							
Volleyball							
+ 1 from research							
+ 1 from research							
+ 1 from research							
+ 1 from research							

ISBN 978-1-009-31125-0 Stewart et al.

5. Present the data collected in an appropriate format to assist with analysis – for example, an appropriate graph type. Remember that you should have three tally tables to work from: data sets for class, friends and peers.

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

6. Analyse the primary data collected by doing the following.
   - Identify the top two activities being undertaken by each group, both at school and away from school.
   - Note any trends or inferences from the data. For example, are those activities that are most typically engaged in at school the same as those engaged in outside school – why or why not?
   - Identify any factors that may be affecting the validity of data. For example, your location or availability of resources may naturally exclude some activities.

Justify

7. In a short response, based on primary and secondary data, justify whether the physical activities in which you engage reflect those most commonly engaged in by your peers.

Teachers and coaches

Aside from family members, studies have reported that teachers and coaches play an influential role in generating interest in sport and physical activities. Teachers and coaches constitute important social agents in the lives of young people. As such, the attitudes and behaviours they display are pivotal to shaping the values, attitudes and self-concept of young players.

CHECK-IN 12.3

1. Recall the best Physical Education teacher or coach you have had. In a short summary, outline the characteristics this person had as a teacher or coach that made them so effective.
2. Explain the positive influence this had on your engagement in physical activity and your own self-concept as an athlete. Ensure that you identify at least one specific example of a situation where they did or said something positive.

Not only do they model behaviours, but their interactions will also guide the self-concept of the individuals within their teams and classrooms. Positive interactions with a teacher or coach are enablers to ongoing engagement and positive sporting attitudes, while negative experiences can create barriers to future involvement that may be very hard to overcome.

The social construction of gender

The role played by gender as a personal factor influencing equity in and access to physical activity has already been highlighted. However, personal beliefs and behaviours regarding gender and physical activity are heavily influenced by external factors, as gender is a social construct. While sex refers to the biological differences between males and females, gender refers to how society views characteristics, roles and behaviours as being either masculine or feminine. Gender is a sociological phenomenon that individuals learn through the socialisation process from their society and the people within it.

ISBN 978-1-009-31125-0 Stewart et al.

From an early age, individuals receive messages from society that display social norms and expectations for the accepted **dominant versions of gender**. For instance, a newborn may receive cards that depict gender-stereotyped roles, such as a boy fishing or a girl playing with a doll. Colours are also used to construct gender, with little boys in blue and girls in pink. While many parents now actively work to reduce these stereotypes, often they are reinforced on a much more subtle level, making them difficult to avoid. Research shows that baby girls are often showered with comments like 'Aren't you a pretty little thing?', whereas baby boys receive comments like 'Aren't you a big, strong boy?' So from birth, society is already imposing its interpretation of gender upon its members.

Due to an increased focus on diversity in recent decades, gender stereotypes are increasingly being challenged. Alternative interpretations of gender have led to variations of how the terms 'femininity' and 'masculinity' are used. More recently, there has been an acknowledgement that many cultural attributes are gender-neutral – that is, many characteristics, roles and behavioural norms either share characteristics of being both male and female or display characteristics of neither. In reality, the vast majority of people are not totally masculine or totally feminine, but instead display social characteristics of both. They may fall somewhere along a continuum from feminine to masculine, with gender-neutral attributes in the middle. Many individuals now choose to reject traditional socially constructed notions of gender for personally ascribed gender labels, or reject the notion of gender altogether.

dominant versions of gender the most common and socially accepted ideas associated with being either male or female

While equity is about valuing differences, and sporting policies must not discriminate, the more recent changes to our understanding of gender do pose complex issues for sport participation. While many sporting events and divisions are based on sex (biologically men or women), how does this meet the needs of those who align themselves with the opposite gender or those that have had gender reassignment surgery? Sporting organisations at all levels are struggling to ensure that their policies and procedures are inclusive to all members of society in this area.

TABLE 12.1 Gender attributes and how they appear in sport

Culturally feminine attributes	Culturally masculine attributes
Delicate Fragile Helpful Caring, compassionate and empathetic Emotional Cooperative Weak Clean and tidy Pretty Reactionary Less skilled	Physical Aggressive Isolated and non-emotional Competitive Strong Dynamic Sweaty and dirty Rough Proactive Skilled
Sport characteristics	**Sport characteristics**
Non-contact Distance maintained between participants Limited running space Set positional areas No running with the ball Strict dress requirement	Speed Strength Endurance Agility Physical contact, tackling and violence Risk-taking Open field

ISBN 978-1-009-31125-0 Stewart et al.

Despite this increased awareness of gender diversity, it is still true that due to the pressure to conform and the satisfaction gained from being accepted, people tend to favour behaving in ways that meet the expected social gender stereotypes. As a result, males – particularly those who display masculine qualities – experience greater access and opportunities to activities that are considered masculine by society. Conversely, females experience the same in relation to feminine activities. Where there is alignment between a person's gender and the social expectations for the physical activities in which they engage, the social construction of gender acts as an enabler. When those around the individual see a mismatch between their gender and the activity they wish to undertake, the social construction of gender acts as a barrier.

Gender-neutral physical activities are those that, through their movements and rules of play, contain characteristics that may be both masculine and feminine, or characteristics of neither. These activities are typically enjoyed by both sexes. Consider swimming, volleyball, badminton, tennis, golf, and track and field. All these activities appear to be gender-neutral in Australian society, so gender is not typically a barrier to access.

It is also apparent that in recent times the success of competitions such as the National Rugby League Women's Premiership and Australian Football League Women's, as well as the Australian Matildas in the 2023 Federation Internationale de Football Association Women's World Cup, is continuing to change the perspective of female sport. The popularity and increased emphasis on these sports is helping to eliminate barriers for female athletes. However, males in netball or gymnastics have not experienced the same degree of change in regard to gender stereotyping.

FIGURE 12.10 The success of the Australian Matildas on home soil in the 2023 FIFA Women's World Cup is continuing to change the perspective of female sport.

ENGAGE 12.2

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | JUSTIFY

Inquiry question: Do we preference activities that display gender-stereotyped characteristics?

Recognise and explain

1. Identify the physical activities from the current version of the senior Physical Education syllabus and individually place them on a continuum from feminine to masculine, with neutral in the middle. Use Table 12.1 to guide your placements.
2. Once completed, share ideas as a class and, where needed, seek clarification.
3. Select 10 more physical activities not in the syllabus and conduct some primary research into the gender stereotypes relating to these activities that exist in your class. This can be done by a simple data collection method. Consider writing the activities on a large sheet of paper and using different coloured sticky dots (e.g. red = feminine; blue = masculine; green = gender-neutral). Students place the appropriate coloured dot next to the physical activity based on how they perceive that activity.
4. As a class, select one activity from the list that is considered gender-neutral. You will engage in this activity for task 5.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Demonstrate and apply

5. In the performance environment, engage in the activity selected in task 4 for part of a lesson, then stop and break into the gender groups with which you identify most closely. Using the sport characteristics in Table 12.1, each gender group must change the rules or playing conditions so the activity more closely reflects the characteristics of their gender. Spend some time developing the activity – it might look quite different from the original activity.

6. In the following lesson, each gender group should engage in the activity they designed in task 5 and collect data on enjoyment and engagement using a simple scale. Then engage in the activity designed by the opposite gender group and again collect data on enjoyment and engagement.

Analyse and synthesise

7. Analyse your own personal data, looking at preferences between the activities you engaged in for tasks 5 and 6. As a class, collate data and identify any trends or anomalies.

Justify

KEY COGNITION

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole in order to create new understanding

8. In a short response, synthesise the data collected in the activity to answer the inquiry question at the top of this activity. In doing so, identify any physical activities where this might act as a barrier to engagement.

Diversity

Diversity encompasses the visible and invisible differences that exist between people, while equity is concerned with giving value to and celebrating those differences. It is widely acknowledged that diversity provides a society with many cultural, social and economic benefits. It has been a long-held view in Australia that diversity through multiculturalism is a significant factor in the development of our nation, and that it plays a significant role in all areas of our society.

diversity the visible and invisible differences that exist between people, such as gender, culture, race, ethnic origin, physical and mental ability, sexual orientation, age, economic class, language, religion, nationality, education and family/marital status

FIGURE 12.11 A wide variety of biological and social factors make humans different from one another.

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 12.4

1. Select five factors from Figure 12.11 that make people different. For each, provide an example of a physical activity or sport that demonstrates inclusive practices – for example, wheelchair basketball or competitions with varying ability level grading.
2. Select three factors from Figure 12.11. For each, explain how this can be a barrier for a specific sport. For example, when English is a second language, it may be difficult for some individuals to be included in team sports at large clubs, like netball.
3. It is widely accepted that inclusion of diversity will enhance physical activity. Use an example to explain why this is true.

FIGURE 12.12 Inclusion and inclusive practices form the link between the diversity of individuals and increasing the equity they experience.

The link between equity and diversity is inclusion. Social inclusion is concerned with how a society embraces individuals or groups of people, despite the factors that make them different. Social inclusion works to remove the barriers that exclude and the discriminatory aspects that discourage involvement in society. It must be noted that social inclusion is not integration or assimilation, where individuals might be expected to adapt in order to conform to established social beliefs and behaviours; rather, social inclusion is concerned with how society itself must change in order to cater for the differences of the individuals within it.

Diversity can act as an enabler to equity and access when social inclusion supports the participation of society's members. This is particularly true when the contribution of the individual or group would assist in the development of the activity or society in general. For example, it is now common for Australians to value the contribution female players make to Australian Rules football. This was evident with the first season of the AFLW (Australian Football League for female players) in 2017, and the rapid expansion of clubs in the NRLW in 2023. The public support and media exposure for these competitions was seen by many as a celebration of female athleticism and skill. However, diversity still works as a barrier when the differences of individuals cannot be accounted for, or members of society are reluctant to accept those differences. For example, strictly practising Mormons would not be able to participate in activities on a Sunday. How would club members react if it were suggested that Sunday matches were no longer being held to support the beliefs of the Mormon faith?

Group physical activity preferences

Earlier in this chapter, the influence that peers have on equity and access for an individual was discussed. Essentially, as a social influence, the values and attitudes peers have about physical activity, along with what they do, influence the individual. To explore this social factor further, it is relevant to investigate the preferences of the social group or peers of an individual. It stands to reason that where a higher percentage of peers prefer to participate in physical activity generally, or a specific physical activity, this will act as an enabler for a person within that peer group.

ISBN 978-1-009-31125-0 Stewart et al.

If many teenagers are playing touch football, it is much more likely that a specific teenager will conform to the dominant social ideal for the peer group and also take up the sport. On the other hand, where the preferences of a social group do not support participation in physical activity or a specific activity, barriers are formed for an individual. This can be very evident for children and adolescents during the school years, where friendship groups may prefer to sit during lunch rather than play on the oval. This makes it difficult for a person within the group to be active.

TABLE 12.2 Top 20 sports by participation rates for 15–24-year-olds

Sport	Age group (years)					
	15–17		18–24		Total	
	Estimate	Participation rate (%)	Estimate	Participation rate (%)	Estimate	Participation rate (%)
Fitness/gym	239 478	27.6	1 070 228	44.8	**1 309 706**	**40.2**
Running/athletics	213 119	24.5	558 739	23.4	**771 858**	**23.7**
Walking (recreational)	112 261	12.9	531 441	22.3	**643 702**	**19.8**
Football/soccer	185 893	21.4	288 217	12.1	**474 110**	**14.6**
Swimming	132 722	15.3	313 869	13.2	**446 591**	**13.7**
Basketball	161 818	18.6	240 282	10.1	**402 100**	**12.4**
Netball	104 303	12.0	183 870	7.7	**288 173**	**8.9**
Australian Rules football	113 325	13.0	147 363	6.2	**260 688**	**8.0**
Cycling	56 699	6.5	159 191	6.7	**215 890**	**6.6**
Tennis	55 324	6.4	120 295	5.0	**175 619**	**5.4**
Bushwalking	22 157	2.6	139 753	5.9	**161 910**	**5.0**
Volleyball	70 918	8.2	79 802	3.3	**150 720**	**4.6**
Cricket	55 452	6.4	93 498	3.9	**148 950**	**4.6**
Touch football	49 873	5.7	91 784	3.8	**141 657**	**4.4**
Virtual based physical activity	47 099	5.4	76 192	3.2	**123 291**	**3.8**
Rugby League	53 240	6.1	52 594	2.2	**105 834**	**3.3**
Dancing (recreational)	27 045	3.1	55 061	2.3	**82 106**	**2.5**
Yoga	6 961	0.8	75 086	3.1	**82 047**	**2.5**
Surfing	18 381	2.1	63 497	2.7	**81 878**	**2.5**
Rugby Union	37 480	4.3	44 148	1.9	**81 628**	**2.5**

Data sourced from: *AusPlay™ 2022–23 survey*, Australian Sports Commission – www.ausport.gov.au

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 12.3 Sports by gender participation for the total Australian population

Sport	Male		Female		Total	
	Estimate	Participation rate (%)	Estimate	Participation rate(%)	Estimate	Participation rate (%)
Fitness/gym	2 519 299	24.6	3 290 372	31.2	**5 809 671**	**27.9**
Swimming	819 041	8.0	1 091 058	10.3	**1 910 099**	**9.2**
Golf	730 968	7.1	191 322	1.8	**922 290**	**4.4**
Football/soccer	620 529	6.1	217 187	2.1	**837 716**	**4.0**
Running/athletics	414 787	4.0	408 437	3.9	**823 224**	**4.0**
Yoga	101 349	1.0	699 553	6.6	**800 902**	**3.9**
Pilates	69 420	0.7	602 515	5.7	**671 935**	**3.2**
Tennis	368 005	3.6	297 990	2.8	**665 995**	**3.2**
Walking (recreational)	216 070	2.1	405 608	3.8	**621 678**	**3.0**
Netball	76 226	0.7	493 006	4.7	**569 232**	**2.7**
Basketball	371 328	3.6	165 424	1.6	**536 752**	**2.6**
Australian Rules football	339 203	3.3	97 652	0.9	**436 855**	**2.1**
Cricket	364 877	3.6	35 669	0.3	**400 546**	**1.9**
Touch football	167 822	1.6	117 603	1.1	**285 425**	**1.4**
Bowls	166 943	1.6	106 548	1.0	**273 491**	**1.3**
Dancing (recreational)	30 155	0.3	228 167	2.2	**258 322**	**1.2**
Cycling	148 537	1.4	78 856	0.7	**227 393**	**1.1**
Bushwalking	99 096	1.0	124 688	1.2	**223 784**	**1.1**
Boxing	118 746	1.2	97 954	0.9	**216 700**	**1.0**
Volleyball	100 545	1.0	99 888	0.9	**200 433**	**1.0**

Data sourced from: *AusPlay™ 2022–23 survey,* Australian Sports Commission – www.ausport.gov.au

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 12.4 Motivation for physical activity participation

Motivation	Age group (years)					
	15–17		18–24		Total	
	Estimate	Percentage of participants (%)	Estimate	Percentage of participants (%)	Estimate	Percentage of participants (%)
Physical health or fitness	549 906	67.6	1 649 962	76.9	**2 199 868**	**74.4**
Fun/enjoyment	580 408	71.3	1 191 323	55.5	**1 771 731**	**59.9**
Social reasons	324 605	39.9	804 812	37.5	**1 129 417**	**38.2**
Other	191 108	23.5	411 050	19.2	**602 158**	**20.4**
Psychological/ mental health/ therapy	104 618	12.9	462 020	21.5	**566 638**	**19.2**
To lose weight/ keep weight off/tone	58 974	7.2	310 903	14.5	**369 877**	**12.5**
To be outdoors/ to enjoy nature	59 106	7.3	243 328	11.3	**302 434**	**10.2**
Performance or competition	117 443	14.4	166 897	7.8	**284 340**	**9.6**
Hobby	75 136	9.2	182 871	8.5	**258 007**	**8.7**
Way of getting around	49 672	6.1	156 170	7.3	**205 842**	**7.0**
For training purposes	60 590	7.4	125 418	5.8	**186 008**	**6.3**
Walk the dog	26 424	3.2	138 292	6.4	**164 716**	**5.6**
Sense of achievement	35 905	4.4	86 828	4.0	**122 733**	**4.1**
To learn a new skill	38 385	4.7	60 917	2.8	**99 302**	**3.4**
Professional/ part of my job	13 609	1.7	81 704	3.8	**95 313**	**3.2**
Physio/rehab/ physical therapy/post op	8 846	1.1	52 511	2.4	**61 357**	**2.1**
To be a good role model/ to encourage others to participate	4 562	0.6	20 226	0.9	**24 788**	**0.8**

Data sourced from: *AusPlay™ 2022–23 survey*, Australian Sports Commission – www.ausport.gov.au

Figure 12.13 shows participation in physical activity by age. Sporting clubs are not the main choice for participation in sport or physical activity in Australia for adults aged 18 years and over.

ISBN 978-1-009-31125-0 Stewart et al.

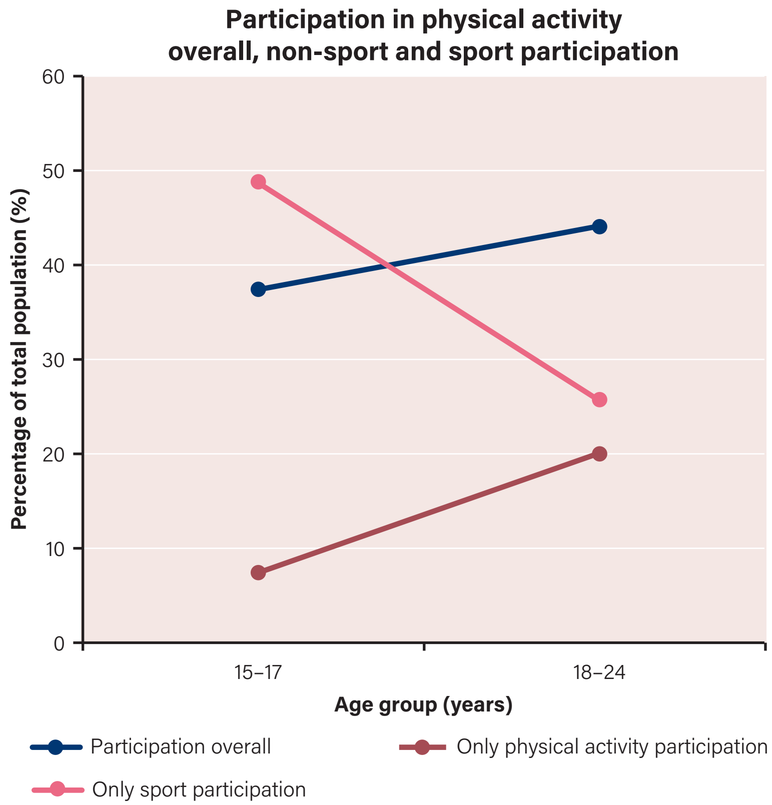


FIGURE 12.13 Participation in sporting activities by age

Data sourced from: *AusPlay™ 2022–23 survey,* Australian Sports Commission – www.ausport.gov.au

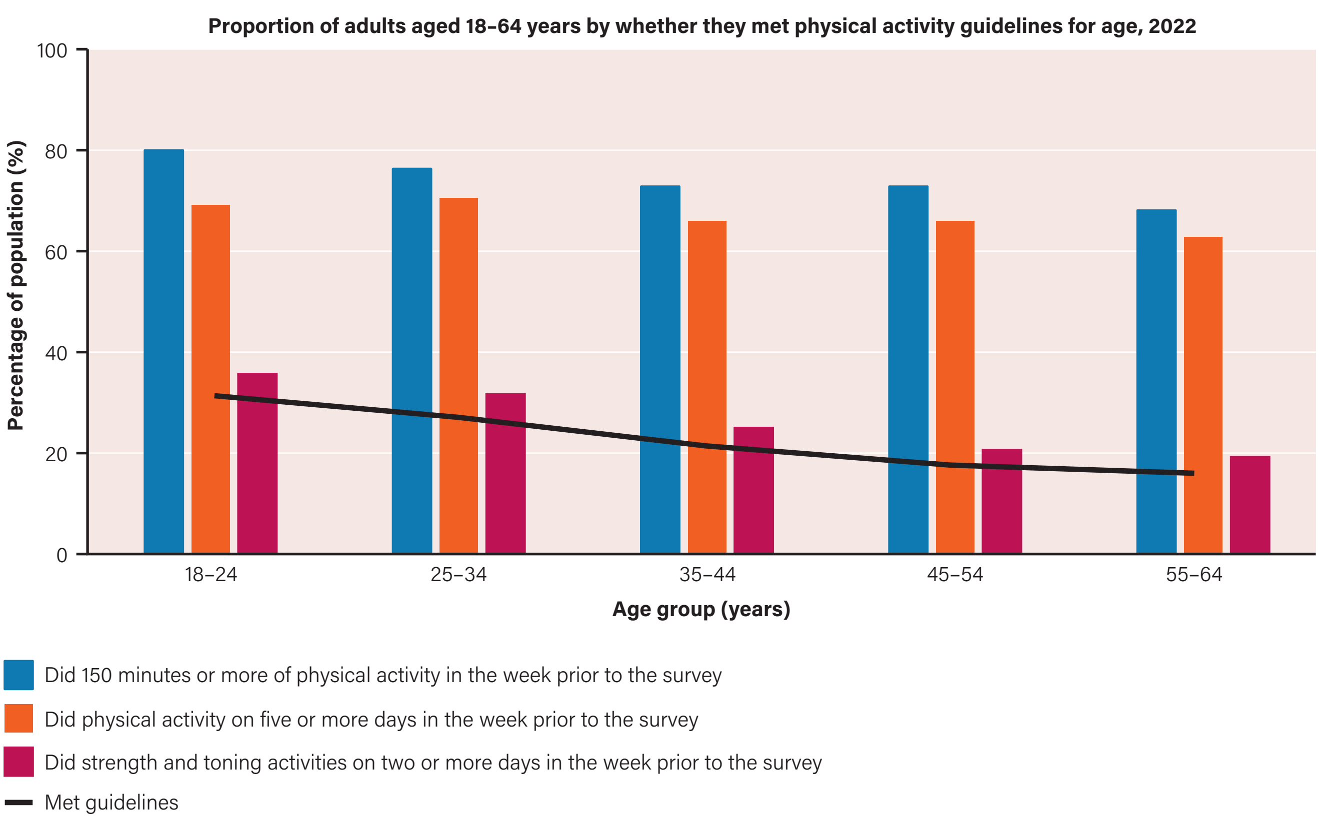


FIGURE 12.14 Activity levels of adults

Source: Australian Bureau of Statistics (2022). *Physical activity*. ABS. https://www.abs.gov.au/statistics/health/health-conditions-and-risks/physical-activity/latest-release

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 12.5

1. Conduct a class poll to collect primary data on what physical activity your peers currently engage in, for how long and to what level.
2. Identify trends among the class or friendship groups.
3. Rank class engagement for those activities in the current version of the senior Physical Education syllabus, then consider the following.
   - Is there a difference for males and females on the preference list? If so, infer why.
   - Are there links between primary and available secondary data on engagement? If not, why not?
   - What might explain any differences between primary and secondary data?
4. Investigate the data presented in Table 12.2, Table 12.3 and Figure 12.13, and do a 3:2:1 protocol:
   - three facts (about what your peers are engaging in)
   - two inferences (about how this data may impact your engagement as either an enabler or a barrier)
   - one projection (how this data might impact you in the future).
5. Undertake research to find additional secondary data about the physical activity preferences of your age group (your peers) in relation to the activities identified above. Consider the amount, type and level of engagement.
6. Consider the primary and secondary data collected. Do they match? If not, why not? What local factors might be influencing the primary data?

12.3 Strategies to enhance social factors for increased physical activity engagement

An equity strategy is a plan of action devised to bring about a determined outcome – in this case, to enhance equity in, access to and/or engagement in physical activity. Devising effective equity strategies to mitigate social factors affecting equity and access requires the development of knowledge on the effect the socialising agents of parents, siblings, friends, peers, teachers and coaches have had on beliefs and values about physical activity and the direct access they have influenced. It also requires information on the social construction of gender, diversity and physical activity preference for the specific physical activity and individual.

When developing equity strategies for social factors, consider:

- ways to remove the stigma of stereotypical participants – what can be done to have the activity seen as available to all genders, ages, abilities and ethnicities
- how traditional negative values or beliefs about the physical activity might be changed
- what rule changes or constraints might allow for engagement and enjoyment from a broader demographic
- how a broader range of participants might be reached and given access to the physical activity
- what additional resources – physical, financial or human – could be utilised to engage more participants
- what target groups are currently experiencing low participation rates, why they are experiencing this (what barriers exist) and how these barriers can be overcome.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 12.1

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: To what extent do peer preferences influence effort and engagement in physical activity?

Recognise and explain

1. From Chapter 11, review the personal factors that affect the choice to access physical activity. (Consider confidence, self-concept and previous experience.) Also look at the influence peers have on engagement as a social factor.
2. As a class, select an activity in which to engage during the next two lessons.

Demonstrate and apply

3. Engage in the activity for the next two lessons, allowing people to sit out or engage as they wish.
4. Make notes on your own personal levels of enjoyment and engagement for the two lessons undertaken.

Analyse and synthesise

5. Identify any personal factors that contributed to your level of engagement.
6. Identify the positive or negative role your peers played in your level of engagement.

Evaluate and justify

7. Did the method of activity selection demonstrate equity? Why or why not?

KEY COGNITION

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

8. Evaluate and justify how engaging the lessons were for you.
9. Identify links between the role played by peers in this activity and their role in physical activity engagement within the general population.

FIGURE 12.15 The social group can be a major influence on physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 12.2

RECOGNISE & EXPLAIN DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: To be formulated as part of the investigation

Recognise and explain

1. As a class, select a specific physical activity for this investigation.
2. Think, pair, share to present strategies to modify the performance environment or rules, or provide constraints that would increase equity for the class group. With regard to equity, consider targeted strategies that embrace one of the following:
   a. abilities within the activity – how the activity can be changed to be inclusive of all ability levels
   b. enjoyment levels of the activity – how the activity can be changed to be more enjoyable for all participants
   c. attitudes about the activity – how the activity can be changed to enhance the way it is viewed by the class.

   This may require some secondary research into strategies different sports use in these areas that could be modified for your class.
3. As a class, decide on one strategy to be implemented for each of the above categories.
4. Word an inquiry question that reflects what you intend to find out from implementing the selected strategy, and devise a method to collect primary data on the effectiveness of the strategy.

Note: This investigation could be undertaken with your own class, or three groups could be allocated an area each, develop their own strategy and simultaneously implement it with different junior Health and Physical Education classes to gauge its effectiveness for others.

Demonstrate and apply

5. Engage in the activity and collect pre- and post-activity data.

Analyse and synthesise

6. Analyse the data gathered to assess the effectiveness of the strategy used with regard to the area of equity it was trying to enhance.

Evaluate and justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

7. Justify what this investigation has established with regard to the inquiry question written earlier.
8. Make one justified recommendation on how the strategy could be modified to enhance the equity experienced by participants.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- The process by which an individual acquires the values, attitudes and behaviours that are acceptable to society is called socialisation.
- The people, organisations or institutes through which values, attitudes and behaviours are learned are called agents of socialisation.
- Social factors act as enablers or barriers to equity and access in physical activity when those around an individual either facilitate or restrict the opportunities presented to the individual.
- The social construct of gender can act as a barrier or enabler to equity and access, when these social views affect how the individual engages with physical activity.
- Diversity in all aspects of society should be embraced, because differences bring a broader range of knowledge and skills to all interactions, including physical activity.
- Accounting for and encouraging diversity is an enabler for equity and access.
- Physical activity preference can have a significant influence on the experience of equity and access, as the popularity of specific activities will have an effect on the amount of human and physical resources available, and also the social aspect of large group acceptance can influence an individual.
- Equity strategies for social factors must work to overcome stereotypes and traditions within physical activity, in order to ensure provision of equity and access for all people to all activities.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Agents of socialisation are:

A. clubs and other facilities that provide areas for players to meet.

B. those through which an individual learns their values, attitudes and behaviours.

C. barriers to physical activity that restrict the number of available participants.

D. people who enable access to physical activity.

2. A social factor that enables access to physical activity is:

A. a good self-concept about sporting ability.

B. positive personal gender stereotypes across society.

C. accessing local clubs.

D. having an effective coach.

3. Which of the following is not a social factor that influences equity and access to physical activity?

A. Confidence

B. Parents

C. Physical activity preference

D. Teachers

4. Diversity and equity are linked through:

A. inclusion.

B. gender.

C. socialisation.

D. ethnicity.

ISBN 978-1-009-31125-0 Stewart et al.

5. Which of the following is a social factor acting as an enabler for equity and access to physical activity?
   A. A small group of friends that play a variety of sports
   B. Living next to a new skate park that is easily accessible at all times
   C. A large number of peers all participating in the same physical activity
   D. Having the confidence to join a team sport

SHORT-RESPONSE QUESTIONS

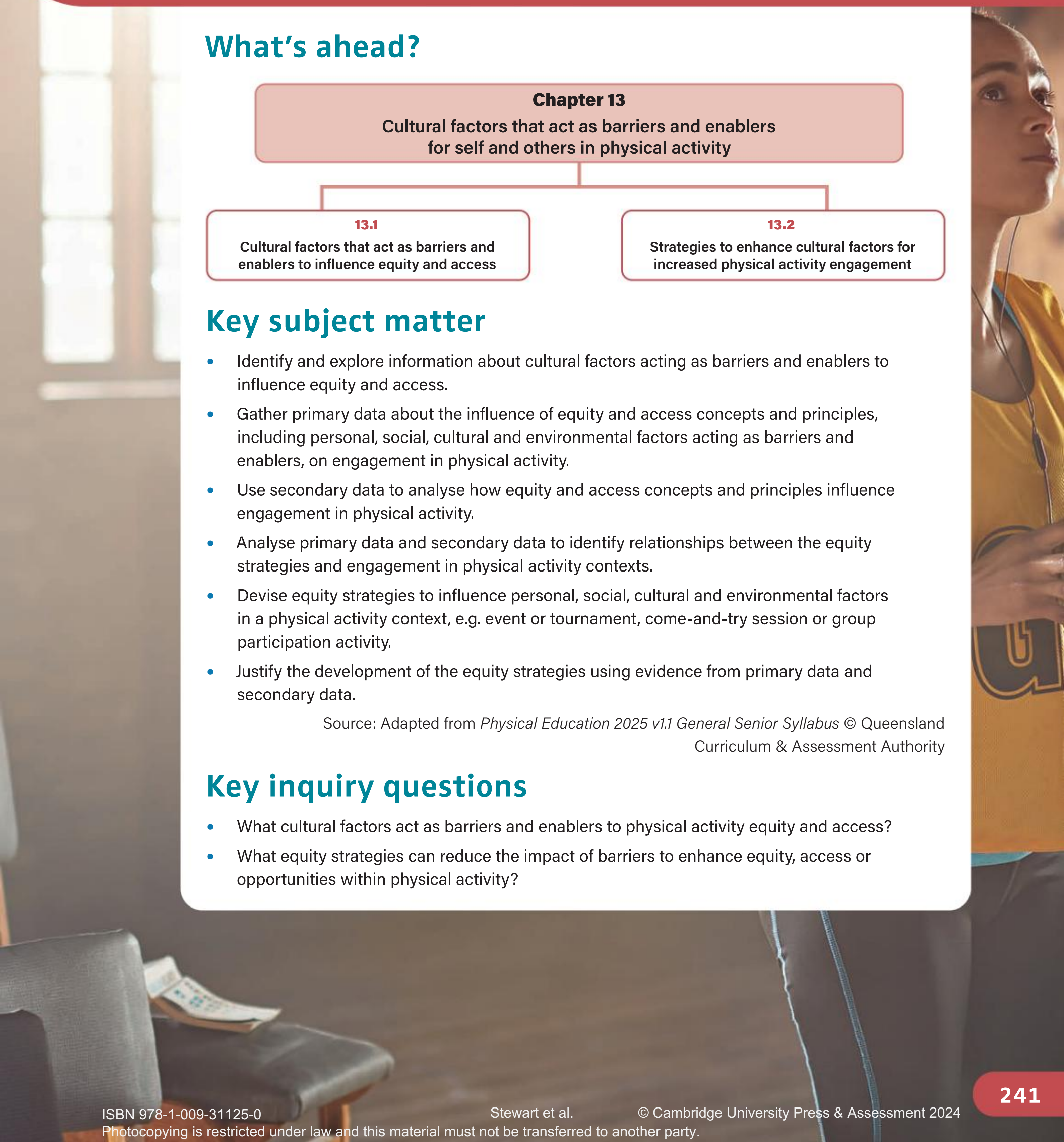
1. Select an attitude that you have towards physical activity and use examples from your own socialisation process to highlight how this attitude has developed for you.
2. In a short paragraph, explain, using examples of specific physical activities, how the social construction of gender can be a barrier to physical activity access.

EXTENDED-RESPONSE QUESTION

Select one of the physical activities in the current version of the senior Physical Education syllabus, and identify the three most significant social factors that have positively influenced your equity and access to this activity. Evaluate each of the three selected factors, and justify how these have acted as enablers for you.

ISBN 978-1-009-31125-0 Stewart et al.

Cultural factors that act as barriers and enablers for self and others in physical activity



What's ahead?

Chapter 13
Cultural factors that act as barriers and enablers for self and others in physical activity

13.1
Cultural factors that act as barriers and enablers to influence equity and access

13.2
Strategies to enhance cultural factors for increased physical activity engagement

Key subject matter

- Identify and explore information about cultural factors acting as barriers and enablers to influence equity and access.
- Gather primary data about the influence of equity and access concepts and principles, including personal, social, cultural and environmental factors acting as barriers and enablers, on engagement in physical activity.
- Use secondary data to analyse how equity and access concepts and principles influence engagement in physical activity.
- Analyse primary data and secondary data to identify relationships between the equity strategies and engagement in physical activity contexts.
- Devise equity strategies to influence personal, social, cultural and environmental factors in a physical activity context, e.g. event or tournament, come-and-try session or group participation activity.
- Justify the development of the equity strategies using evidence from primary data and secondary data.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What cultural factors act as barriers and enablers to physical activity equity and access?
- What equity strategies can reduce the impact of barriers to enhance equity, access or opportunities within physical activity?

ISBN 978-1-009-31125-0 Stewart et al.

13.1 Cultural factors that act as barriers and enablers to influence equity and access

As each person and social group exists within a broader society, it is logical that the surrounding culture will also have a significant influence on the physical activity undertaken by the members of that society. A **culture** can be defined as the values, beliefs, customs and behavioural norms of a group or population. Here, the group or population is much bigger than the social group or peers of an individual and includes the full spectrum of people within a society. As they are representative of a much larger proportion of the population, cultural elements are significant because they represent the defining characteristics of a society – they reflect what makes our population 'Australian'.

> **culture** the values, beliefs, customs and behavioural norms of a group or population

In Australian culture, sport and sporting success have always played a significant role. Historically, sport has been a source of national pride and has helped to establish a national identity. As a result, the cultural values, customs and behaviours that relate to sport and physical activity have a strong influence on individual Australians. As these values, customs and behaviours are considered culturally significant, they are passed from generation to generation through the socialisation process. Yet, while many of these cultural elements act as enablers to access and equity in physical activity, some do create significant barriers that are difficult to overcome.

Demographic, generational and cultural change

It was outlined in Chapter 12 that the physical activity preferences of a social group will influence the personal equity and access of an individual. As each person or social group exists within a broader society, then it stands that cultural trends will also have a significant influence on the physical activity undertakings of the members of that society.

Demographics relate to the characteristics that are particular to a sector of a population. They are typically used when gathering and analysing statistical data. By understanding the demographics of our Australian population, trends of what is culturally significant can be identified. Trends concerning physical activity engagement also establish where enablers and barriers to equity and access exist. Where cultural trends are positive towards physical activity and the types of activities undertaken, access is enabled. However, if engagement for a specific demographic is low, this may indicate that discriminatory practices are creating barriers and a more inclusive approach may be needed to increase equity.

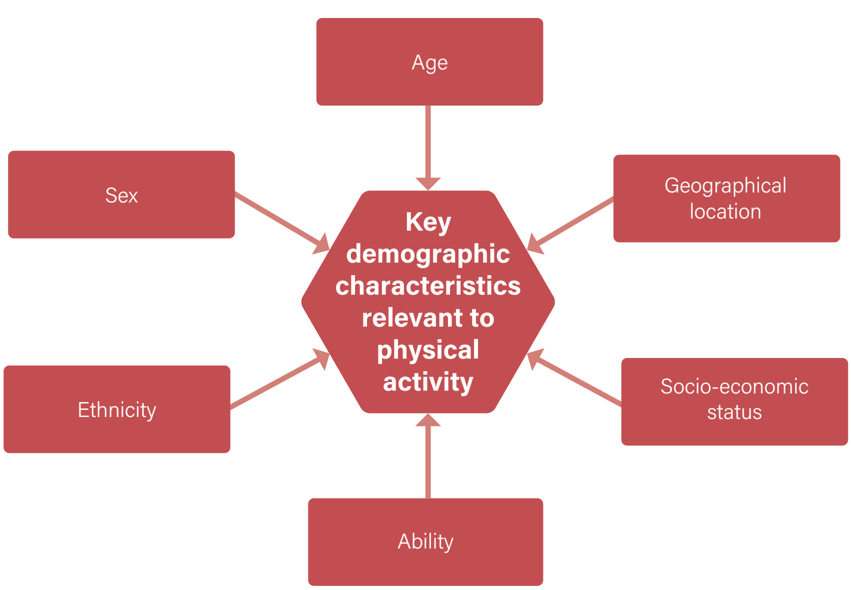


FIGURE 13.1 Understanding the physical activity practices of various population sectors assists in understanding where cultural enablers and barriers for the Australian population may exist.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 13.1

RECOGNISE & EXPLAIN DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE

Inquiry question: Why do generational trends exist for participation in physical activity?

Recognise and explain

1. Undertake some secondary research to identify the types of activities that are popular among different age groups other than your own – for example, under 10, 25–50, over 50.

Demonstrate and apply

2. For each age range, identify a popular activity that you can undertake for a lesson (or part lesson) with your class. For example:
   - under 10: tiggy, cat and mouse, duck-duck-goose
   - 25–50: a fitness training session
   - over 50: hiking, fishing, golf, tennis, lawn bowls.

Analyse and synthesise

3. After each activity, collect class data on the enjoyment and engagement of participants in the activity.
4. As a class, identify the characteristics of the activity and the impact this might have on engagement for different age groups.

Evaluate

KEY COGNITION

Consider: think deliberately or carefully about something, typically before making a decision; take something into account when making a judgement; view attentively or scrutinise; reflect on

5. Consider the activities undertaken at different life stages, then copy and complete the table below.

Life stage	Typical physical activities	What characteristics are present in these activities?	Factors that affect engagement
Child (under 12)			
Adolescent (12–19)			
Adult (20–39)			
Middle-aged (40–60)			
Seniors (over 60)			

Barriers and enablers can also work generationally within a population. When investigating specific age groups within a population, each tends to engage in different activities. As a person ages, their ability and preference for physical activity change, and this is reflected in the participation data for our population. As with other elements, this is an enabler to physical activity access when the individual's activity of choice matches a culturally accepted activity for their age. It is more difficult to engage in an activity when trying to step outside of your generational expectations. For example, how many 65-year-old Moto-X riders are still competing in Australia?

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 13.1 Top 20 sports and activities by regular participation rate and age

	Age 5–14	(000s)	%	Age 15–24	(000s)	%	Age 25–44	(000s)	%	Age 45+	(000s)	%
1	Swimming	1105	33.8	Fitness/gym	1300	40.2	Fitness/gym	2999	41.1	Walking (recreational)	6040	58.9
2	Football/ soccer	640	19.6	Running/ athletics	772	23.7	Walking (recreational)	2558	35.1	Fitness/gym	3140	30.6
3	Australian Rules football	380	11.6	Walking (recreational)	644	19.8	Running/ athletics	1808	24.8	Swimming	1643	16.0
4	Basketball	367	11.2	Football/ soccer	474	14.6	Swimming	1269	17.4	Cycling	1418	13.8
5	Gymnastics	363	11.1	Swimming	447	13.7	Cycling	980	13.4	Running/ athletics	952	9.3
6	Dancing (recreational)	318	9.7	Basketball	402	12.4	Bushwalking	668	9.2	Golf	778	7.6
7	Netball	314	9.6	Netball	288	8.9	Yoga	557	7.6	Bushwalking	720	7.0
8	Tennis	271	8.3	Australian Rules football	261	8.0	Football/ soccer	527	7.2	Yoga	572	5.6
9	Cricket	229	7.0	Cycling	216	6.6	Tennis	375	5.1	Tennis	478	4.7
10	Running/ athletics	228	7.0	Tennis	176	5.4	Basketball	354	4.9	Pilates	425	4.1
11	Rugby League	129	3.9	Bushwalking	162	5.0	Pilates	312	4.3	Bowls	266	2.6
12	Karate	125	3.8	Volleyball	151	4.6	Cricket	285	3.9	Surfing	241	2.4
13	Touch football	95	2.9	Cricket	149	4.6	Netball	275	3.8	Fishing	234	2.3
14	Dancesport	92	2.8	Touch football	142	4.4	Surfing	265	3.6	Canoeing/ kayaking	216	2.1
15	Hockey	87	2.7	Virtual-based physical activity	123	3.8	Golf	245	3.4	Football/ soccer	168	1.6
16	Rugby Union	80	2.5	Rugby League	106	3.3	Australian Rules football	231	3.2	Dancing (recreational)	144	1.4
17	Lifesaving surf	79	2.4	Dancing (recreational)	82	2.5	Virtual-based physical activity	190	2.6	Mountain biking	141	1.4
18	Fitness/gym	62	1.9	Yoga	82	2.5	Touch football	156	2.1	Martial arts	131	1.3
19	Taekwondo	61	1.9	Surfing	82	2.5	Mountain biking	158	2.1	Cricket	129	1.3
20	Martial arts	61	1.9	Rugby Union	82	2.5	Weightlifting	144	2.0	Sailing	115	1.1

* % = the percentage of the total active people in that age range, who participate in that physical activity

Source: Adapted from AusPlay, Data Portal, Australian Sports Commission (2023)

ISBN 978-1-009-31125-0 Stewart et al.

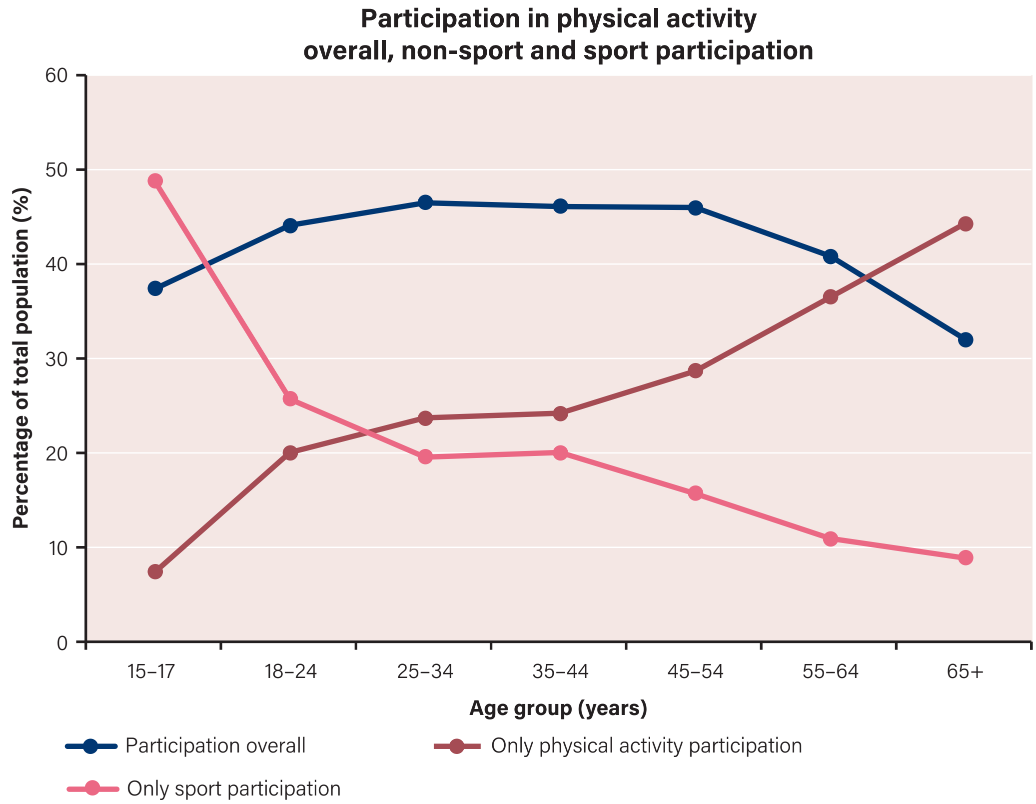


FIGURE 13.2 Participation in sporting activities by age

Data sourced from: *AusPlay™ 2022–23 survey*, Australian Sports Commission – www.ausport.gov.au

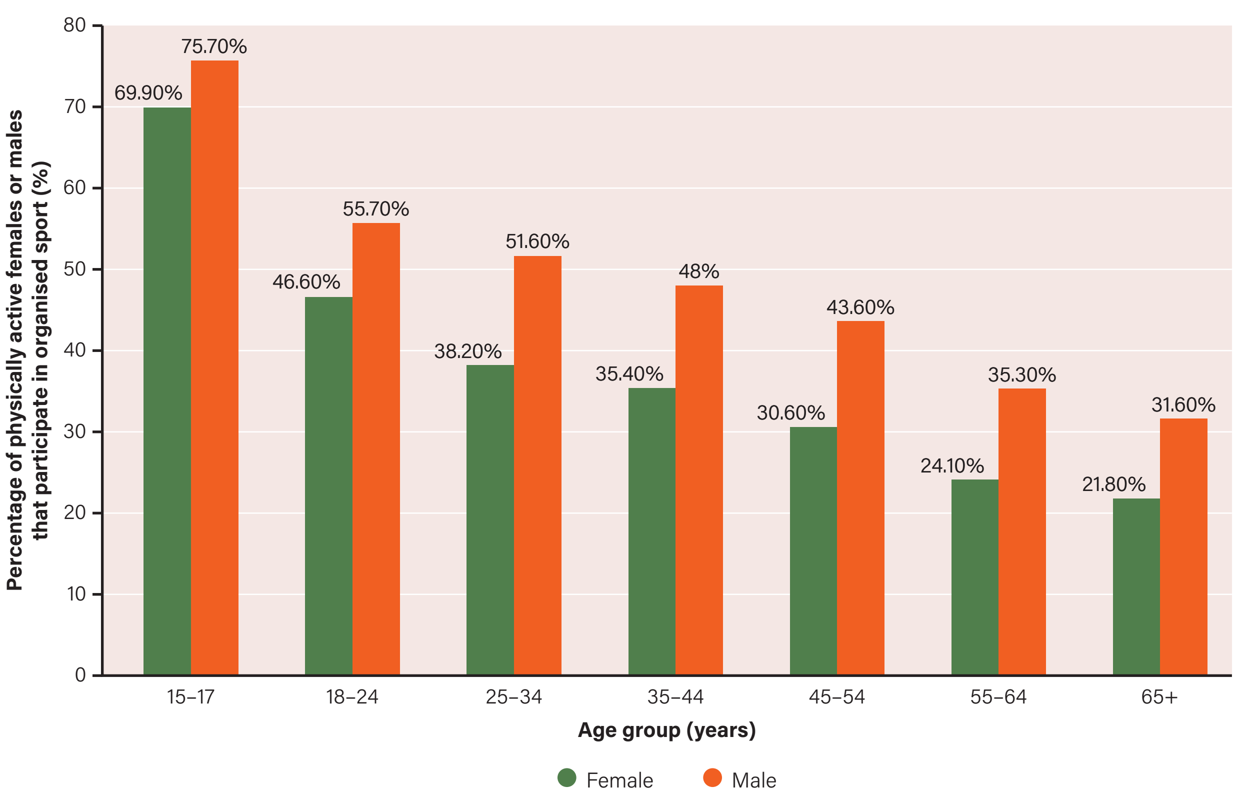


FIGURE 13.3 Participation in organised sport through a club or venue by age group

Source: Adapted from *AusPlay Participation Data 2023*, Australian Sports Commission

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 13.2 Participation in sport and physical recreation by state/territory

State	Male		Female		Total	
	Estimate	Participation rate %	Estimate	Participation rate %	Estimate	Participation rate %
ACT	148 134	85.7	156 295	88.1	**304 429**	**86.9**
NSW	2 592 958	79.7	2 755 684	82.1	**5 348 642**	**80.9**
NT	75 578	72.3	75 111	77.9	**150 689**	**75.0**
QLD	1 593 299	77.4	1 700 969	80.5	**3 294 268**	**79.0**
SA	556 324	78.2	603 816	81.8	**1 160 140**	**80.0**
TAS	165 961	77.2	183 410	82.3	**349 371**	**79.8**
VIC	2 111 888	80.6	2 270 670	83.4	**4 382 558**	**82.0**
WA	896 795	80.2	921 879	82.7	**1 818 674**	**81.4**
Total	**8 140 937**	**79.4**	**8 667 834**	**82.2**	**16 808 771**	**80.8**

Source: Adapted from *AusPlay Participation Data 2023*, Australian Sports Commission

TABLE 13.3 Participation in sport and physical recreation by location

Remoteness	Male		Female		Total	
	Estimate	Participation rate %	Estimate	Participation rate %	Estimate	Participation rate %
Major cities	5 854 435	81.90	6 153 776	83.20	**12 008 211**	**82.5**
Inner regional	1 296 939	75.20	1 477 932	81.30	**2 774 871**	**78.3**
Outer regional	553 351	70.70	623 411	79.40	**1 176 762**	**75.0**
Remote or very remote	105 827	69.10	118 889	77.40	**224 716**	**73.3**
Total	**7 810 552**	**79.6**	**8 374 008**	**82.4**	**16 184 560**	**81.1**

Source: Adapted from *AusPlay Participation Data 2023*, Australian Sports Commission

TABLE 13.4 Participation in sport and physical recreation by annual income

Annual household income	Total	
	Estimate	Participation rate %
<$40 000	1 655 717	73.6
$40 000 – $69 999	1 533 262	79.6
$70 000 – $99 999	1 466 086	82.0
$100 000 – $149 999	1 889 550	83.4
$150 000 – $199 999	1 371 610	86.1
$200 000+	1 891 253	89.1
Not stated	6 274 657	78.6
Total	**16 082 135**	**80.7**

Source: Adapted from *AusPlay Participation Data 2023*, Australian Sports Commission

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 13.5 Top 15 club-based sports in adults aged 55+ years by gender

Women			Men		
Position	**Sport**	**%**	**Position**	**Sport**	**%**
1	Walking (recreational)	68.4	1	Walking (recreational)	54.7
2	Fitness/gym	34.0	2	Fitness/gym	24.6
3	Swimming	15.4	3	Cycling	16.1
4	Yoga	7.8	4	Swimming	13.6
5	Cycling	7.2	5	Golf	13.4
6	Pilates	6.3	6	Running/athletics	6.8
7	Bushwalking	5.7	7	Bushwalking	6.3
8	Golf	4.2	8	Tennis	4.5
9	Tennis	3.8	9	Fishing	4.4
10	Running/athletics	3.8	10	Bowls	4.3
11	Bowls	2.8	11	Surfing	2.7
12	Dancing (recreational)	2.7	12	Canoeing/kayaking	2.3
13	Martial arts	2.3	13	Sailing	1.9
14	Canoeing/kayaking	1.4	14	Yoga	1.6
15	Dancesport	1.1	15	Mountain biking	1.3

Source: Adapted from *AusPlay Participation Data 2023*, Australian Sports Commission

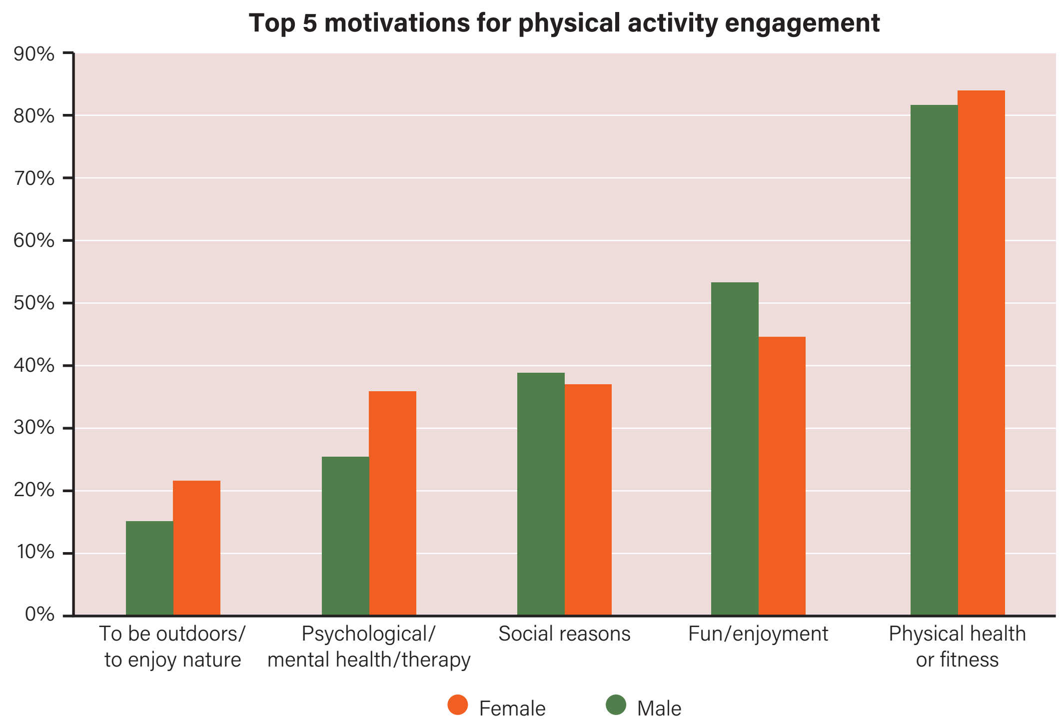


FIGURE 13.4 Top five motivations for participation of adults in physical activity by gender

Source: Adapted from *AusPlay Participation Data 2023*, Australian Sports Commission

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 13.6 Findings from a survey where respondents aged 15+ were asked to identify the barriers they experience to physical activity access

Barrier	Total	
	Estimate	Percentage of non-participants (%)
Not enough time/too many other commitments	667 448	29.2
Poor health or injury	615 300	26.9
Other	432 207	18.9
Physical job	213 299	9.5
Wrong age – too old/too young	169 495	7.4
Not a priority	163 640	7.2
Too lazy	142 875	6.2
Disability	141 152	6.2
Doesn't like physical activity	133 005	5.8
No reason in particular	116 043	5.1
Looking after child/infant	68 963	3.0
Too busy doing child's activities to do activity myself	46 087	2.0
No opportunities/facilities/clubs in my area	38 955	1.7
Pregnancy	35 987	1.6
Can't afford it/can't afford transport	35 052	1.5
Fear of injury	25 164	1.1
No longer interested/don't like it anymore	9 794	0.4
No transport/can't get there	9 174	0.4
The weather	9 065	0.4
Not value for money/not worth it	8 455	0.4
Nobody to do it with	4 319	0.2
Don't know	4 284	0.2
Not good enough	4 203	0.2
Not familiar with activity/rules	2 186	0.1
Fear of discrimination	1 548	0.1
Not culturally appropriate	1 230	0.1
Too competitive	763	0.0

Source: Adapted from *AusPlay Participation Data 2023*, Australian Sports Commission

CHECK-IN 13.1

1. For each data set presented on pages 244–8, identify what the data is representing and make one generalisation that can be inferred.
2. From the data presented on pages 244–8, identify five statistical facts or trends and explain how each one might be a barrier or enabler to engagement for a specific demographic.
3. Undertake secondary research to locate two sources that provide statistical information in relation to physical activity for each of the following demographical characteristics: age, sex, ethnicity, ability, socio-economic status and geographical location. Save the information and reference the source for future activities and assessment tasks. The AusPlay data portal run by the Australian Sports Commission provides extensive secondary data and the ability to run filters to identify key demographics.

ISBN 978-1-009-31125-0 Stewart et al.

AusPlay captures a wide variety of activities, and a distinction is made between sport-related activities (e.g. team sports, athletics, golf) and non-sport related physical activities (e.g. gym memberships, bushwalking). More than 18.5 million Australians aged 15 or over (89 per cent of the population) participated in a sport or physical activity in the last 12 months, with females being slightly more likely to participate.

Males and females are both motivated to engage in sport or physical activity for physical health or fitness, as well as fun and enjoyment. Females are more motivated to be active to lose weight or tone the body, as well as to maintain mental health. Males are more motivated by social reasons and competition.

From a cultural perspective, physical activity, sport and leisure have been undergoing significant cultural changes for at least the last 90 years. Triggered by the increasing mechanisation and automation of labour-intensive tasks, technological innovations throughout the 1930s, 1940s and 1950s first began to reduce the physical effort required in the workforce, a trend that is still continuing. Where life was once physically demanding and people were naturally physically fit and active, towards the end of the 1900s it became easy to live a sedentary lifestyle. Statistical data showed Australians were unhealthy, inactive and overweight. Less inclined to be involved in physical activity, many Australian adults were passing these attitudes on to their children through socialisation, and the concern was that this would lead to a decline in life expectancy. Fortunately, action at all levels of community to highlight the importance of physical activity has seen a steady increase in activity, and in some cases, trends are now showing positive movement for engagement.

As a result, the ways in which our population chooses to be active are changing. Where traditional organised sport was once the choice of physical activity, now the following trends are evident.

- Older Australians who previously were less active are undertaking less structured and more informal activities to remain physically and socially active.
- More older Australians are engaging in activities with increased rigour than previously, in order to sustain physical health.
- Adults who are time-poor and not able to meet the regular demands of weekly organised sport look for activities that fit around their busy lifestyle and suit their needs.
- Virtual physical activity, the use of technology to combine workouts and virtual reality, is becoming increasingly popular for meeting exercise requirements.
- Children engage in activities that are less structured and competitive, and that simply meet their enjoyment and motivational requirements.
- Esports are making a significant surge into the physical activity space, as they can provide many of the elements of traditional physical activity – social camaraderie, competition, a sense of accomplishment.

It is fair to say that Australians are currently experiencing a change to the activities that are culturally acceptable during leisure and recreational time. This continues to act as an enabler for those activities that are culturally favoured, and as a barrier to those where engagement rates are low or declining.

The emerging megatrends in active Australia

Societal change over the past 25 years has resulted in a transformation in the way many Australians incorporate physical activity into their lives. Participation rates in traditional organised sports are changing, with a movement towards fitness and a holistic approach to well-being, and as a result the demographics of physically active Australians are also changing.

Research by the Australian Sports Commission has shown that our population is increasingly engaging in more flexible, non-organised physical activity, with younger Australians moving towards new lifestyle and adventure sports. As social, technological and commercial factors continue to influence physical activity, it is likely that these **megatrends** will continue well into the future.

megatrend an important pattern of social, economic or environmental change

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 13.2

DEMONSTRATE APPLY ANALYSE & SYNTHESISE JUSTIFY

Inquiry question: What are the features of the fitness activities that are emerging in our culture?

Demonstrate and apply

1. Over the next three lessons, undertake three different fitness sessions of approximately 30 minutes – for example, high-intensity interval training (HIIT), boot camp, spin or CrossFit. If possible, use an instructor to conduct your session or travel to a suitable venue outside of school. Use fitness tracking equipment that you may have available to track heart rate, distances travelled and calories burnt.

Analyse and synthesise

2. After each activity:
   - compare any fitness data gathered
   - collect class data on the enjoyment and engagement of participants in the activity.
3. After all three sessions, identify the characteristics of the activities and what might make them appealing and accessible to adults.

Justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

4. In a 150-word statement, justify why the types of activities experienced in this activity may be increasingly popular among adults.

Megatrends in Australian sport and physical activity include:

- more highly individualised sport and fitness activities that can be tailored to the individual and their needs
- the move of extreme, adventure and alternative sports to the mainstream, drawing from participation rates in traditional organised sport
- the use of technology to provide personalised fitness activities and schedules, track progress and goals, and provide holistic health information and data
- an increased appreciation and understanding of the broader benefits of sport to communities by individuals, groups, the corporate sector and government
- age groups naturally participate in different activities; an ageing population changes the demographics of the sports played and how Australians engage with physical activity
- market forces exerting greater pressure on sport in the future. In all sectors of sport and physical activity, commercial interests from participants, industry organisations and external forces will continue to drive change that will influence engagement trends.

ISBN 978-1-009-31125-0 Stewart et al.

Top 10 trends in the fitness industry that are predicted to continue in the future

1. **Fitness in the metaverse** – virtual and augmented reality workouts that provide personalised and immersive fitness experiences.
2. **Wearable technology** – wearable fitness devices like smart watches and fitness trackers will continue to develop and become more effective, integrated and intuitive to the needs of users.
3. **Gamified fitness** – the use of video game-like elements such as points, badges, leaderboards and rewards to motivate and engage users.
4. **Personalised fitness** – artificial intelligence-powered fitness apps that provide customised workout recommendations based on an individual's physical and health levels, as well as personal fitness goals.
5. **Biohacking** – linked closely with wearable technology, biohacking is a do-it-yourself biology practice aimed at improving health, performance and well-being through strategic intervention specific to the individual.
6. **Holistic health** – the emphasis on holistic wellness and the importance of emotional and mental health, with fitness programs that focus on stress management, mindfulness and nutrition coaching in addition to traditional workouts.
7. **The experience economy** – fitness clubs are shifting from selling physical products to selling services and experiences, creating unique, meaningful and memorable experiences.
8. **Fitness for older generations** – as our population ages and is more active for longer, activities focusing on helping seniors stay fit are on the rise and are integrating virtual and augmented reality for sessions.
9. **Time-optimised fitness** – the continued popularity of shorter, optimised workouts and classes that are designed to be efficient and effective in a short amount of time.
10. **The recovery equipment market** – as holistic health has become important, so too has the need to rest and recover, and this is providing equipment and activities to ensure that recovery is effective.

ENGAGE 13.3

RECOGNISE & EXPLAIN | ANALYSE & SYNTHESISE | DEMONSTRATE | APPLY

Inquiry question: How do megatrends interact as barriers or enablers to influence factors related to engagement in physical activity?

Recognise and explain

1. Your teacher will divide the class into four groups and allocate each group one of the megatrends listed below:
   - personalised sport for health and fitness

     Activities that are more about well-being, relaxing or adrenaline, incorporate mental fitness and provide work–life balance, rather than being driven solely by physical fitness or competitive sport
   - the rise of lifestyle sports

     Activities that fit in with the individual and the flexibility needed around life, time, work, cost, family and other social commitments

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

- demographic, generational and cultural change

  The traditional activities for different groups are changing and what Australians like to do is changing as our population ages. We have a more active and technology-adept population, combined with higher levels of health literacy, which provides new options and diverse activity options.

- the attainment of health and community objectives via physical activity.

  The community and personal benefits of physical activity are more predominant and publicised, leading to better resourcing and explicit health strategies to enable physical activity engagement to ensure healthier communities.

KEY COGNITION

Investigate: carry out an examination or formal inquiry in order to establish or obtain facts and reach new conclusions

2. Each group is to investigate their allocated megatrend by:
   - defining what the megatrend incorporates
   - finding relevant and related information in the textbook
   - undertaking secondary research to gain a further understanding of the trend.

Analyse and synthesise

3. As a group, create a short statement that uses the information discovered to explain how the megatrend may act as a barrier and an enabler to physical activity engagement.

Demonstrate and apply

4. Design a 15-minute activity that can be used to demonstrate your group's allocated megatrend.
5. Present your researched information to the rest of the class and have them engage in your activity to highlight your designated megatrend.

CHECK-IN 13.2

Megatrends result from the accumulation of smaller trends or changes in social behaviour, making significant societal trends appear. Keeping the megatrends discussed on the previous pages in mind, explain the impact (positive or negative) on physical activity access or engagement of the following:

- a move to a more casual workforce with longer trading hours
- less disposable income available to families
- busier lifestyles with more to do
- increased promotion of physical activity through the health and education systems
- more research-based activities where science underpins activities
- freedom and personal choice, which bring satisfaction into our lives
- a greater range of physical activities in which to engage
- a move away from competitive sport for social aspects and enjoyment
- a need to achieve fitness results quickly and track progress.

ISBN 978-1-009-31125-0 Stewart et al.

The role of government funding

Government policy and funding significantly influence the equity and access of Australians to physical activity. Each of the three levels of Australian government works for the betterment of physical activity, with billions of dollars spent annually on the sport and recreation industry. The allocation of this money will enable access and participation for some, while barriers will remain for others. However, physical activity is widely accepted as an important facilitator in achieving many health and community objectives, so government funding will be ongoing.

While there is significant government funding available for physical activity, there are always more projects than can be funded. This means that governments must prioritise and allocate funding appropriately, with decisions that are justified and transparent.

While governments endeavour to allocate funds equitably, they may employ different concepts of equity in order to rationalise difficult decisions. For example:

- **equity as equality** – will the decision benefit every individual equally (or the largest possible number)?
- **equity as need** – will the decision address an issue where some are disadvantaged?
- **equity as inclusivity** – will the decision increase participation or engagement?
- **equity as demand** – will the decision meet the requirements of those most frequently involved?
- **equity as market equity** – will the decision produce a financial benefit?
- **equity as efficiency** – will the decision be good value for money?

These different 'interpretations' of equity are not just specific to government decision-making – all organisations responsible for the allocation of funds struggle with exactly how to distribute financial resources equitably. For government decision-making, which involves large sums and affects significant numbers of people, funding allocation is problematic. While some in the community will be pleased, many will be disappointed with where and how government funding is spent.

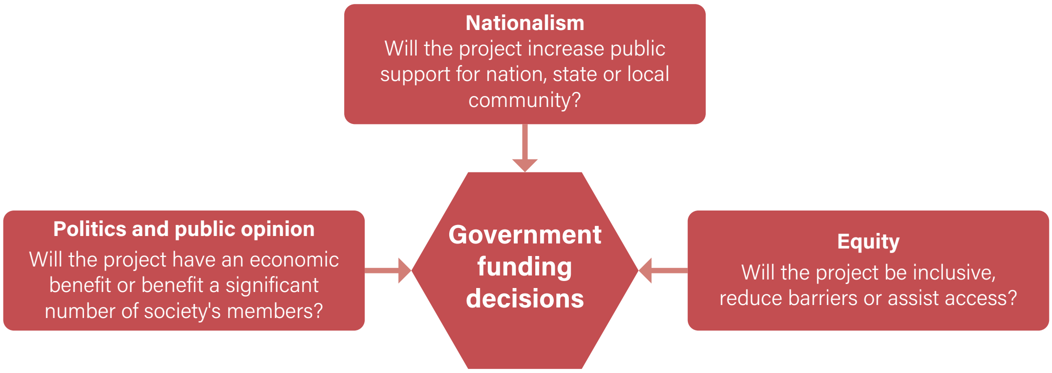


FIGURE 13.5 Funding decisions need to consider a broad variety of factors.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 13.7 As each level of government has its own portfolios and areas of responsibility, each level contributes to physical activity funding in different ways.

Level of government	General objectives for funding	Major methods (departments) to achieve objectives	General purpose for objectives
Federal	• Increase participation in sport, physical activity and leisure activities.	• Development of the Australian Sports Commission to oversee the distribution of funds and provide strategic guidance and leadership for sporting activity in Australia. Divisions of the ASC oversee: – sports participation – high-performance sport (Australian Institute of Sport) – sport management – corporate/commercial services – funding to state and local governments.	• Maintain the health of the population through engagement in physical activity. • Meet the population's demand for physical activity and maintain public support. • Provide athletes with the opportunities and resources to develop their athletic skills to an elite level. • Increase nationalism through improved sporting performance and international success.
State	• Provide funding to support infrastructure development. • Develop sporting programs and initiatives to increase access, engagement and the quality of physical activity.	• Meet objectives primarily through the Department of National Parks, Sport and Racing, and in conjunction with other government departments, such as the Department of Infrastructure, Local Government and Planning and the Department of Agriculture and Fisheries. • Maintain the Queensland School Sport Associations. • Support state sporting bodies, such as the Royal Life Saving Society Queensland.	• Provide facilities and resources for physical activity as a way to develop participation and a sense of community. • Maintain the health of the population through increased engagement in physical activity. • Meet the demands of the population and maintain public support and confidence.
Local	• Sport and recreation infrastructure and maintenance. • Initiatives and funding for local clubs and participants.	• Councils will have individual departments, people and decision-making processes to oversee the distribution of resources and the development and implementation of initiatives.	• Provide facilities and resources for physical activity as a way to develop participation and a sense of community. • Maintain the health of the population through engagement in physical activity. • Assist local clubs to maintain a diverse range of activities that meet the needs of community members. • Assist local participants to maintain engagement and reach higher levels of involvement. • Meet the demands of the population and maintain public support and confidence.

ISBN 978-1-009-31125-0 Stewart et al.

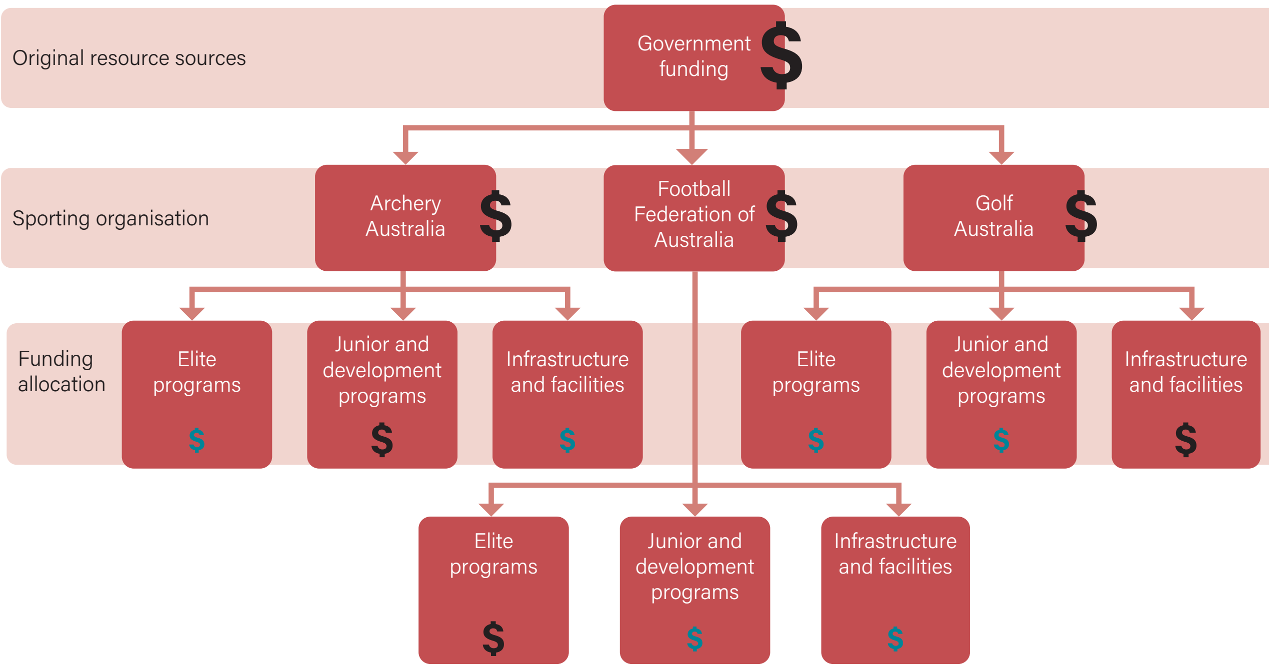


FIGURE 13.6 A simple funding model that demonstrates how the flow of money can be channelled into different aspects of sport, resulting in some receiving more advantages than others

CHECK-IN 13.3

1. Under the *Right to Information Act 2009*, the Queensland Government is required to make public the funding allocation for various programs, including those related to sport and physical activity. Access this information by searching for the Queensland Government's Sport Funding website and look for Approved Funding Applicants.
2. Scan the various organisations and the funding they received. Which physical activities seem to be most frequently represented? Which received the five largest funding grants?
3. Select one specific project that received funding and undertake some further secondary research into its purpose and who benefited.
4. Scan the Queensland Government Funding web pages. Is there any funding that may suit a local club, your school or yourself?
5. Using a specific example, explain how government funding acts as an enabler for some within the community, while for others it may reinforce barriers.

Mass media promotion and marketing

The mass media are a diversified collection of technologies used by outlets to communicate information or data to a large audience. Figure 13.7 on the following page displays the process of **commodification** of physical activity and sport in the marketplace. When the value of a **commodity** is high or is increasing, the media act as an enabler, providing an individual with access and exposure to that commodity. Where the value of the commodity is low or is declining, the media will be a barrier to access and engagement.

commodification the process of transforming a product, person or service to increase its value and potential to make a profit

commodity a product that has value and thus can be bought, sold or traded

ISBN 978-1-009-31125-0 Stewart et al.

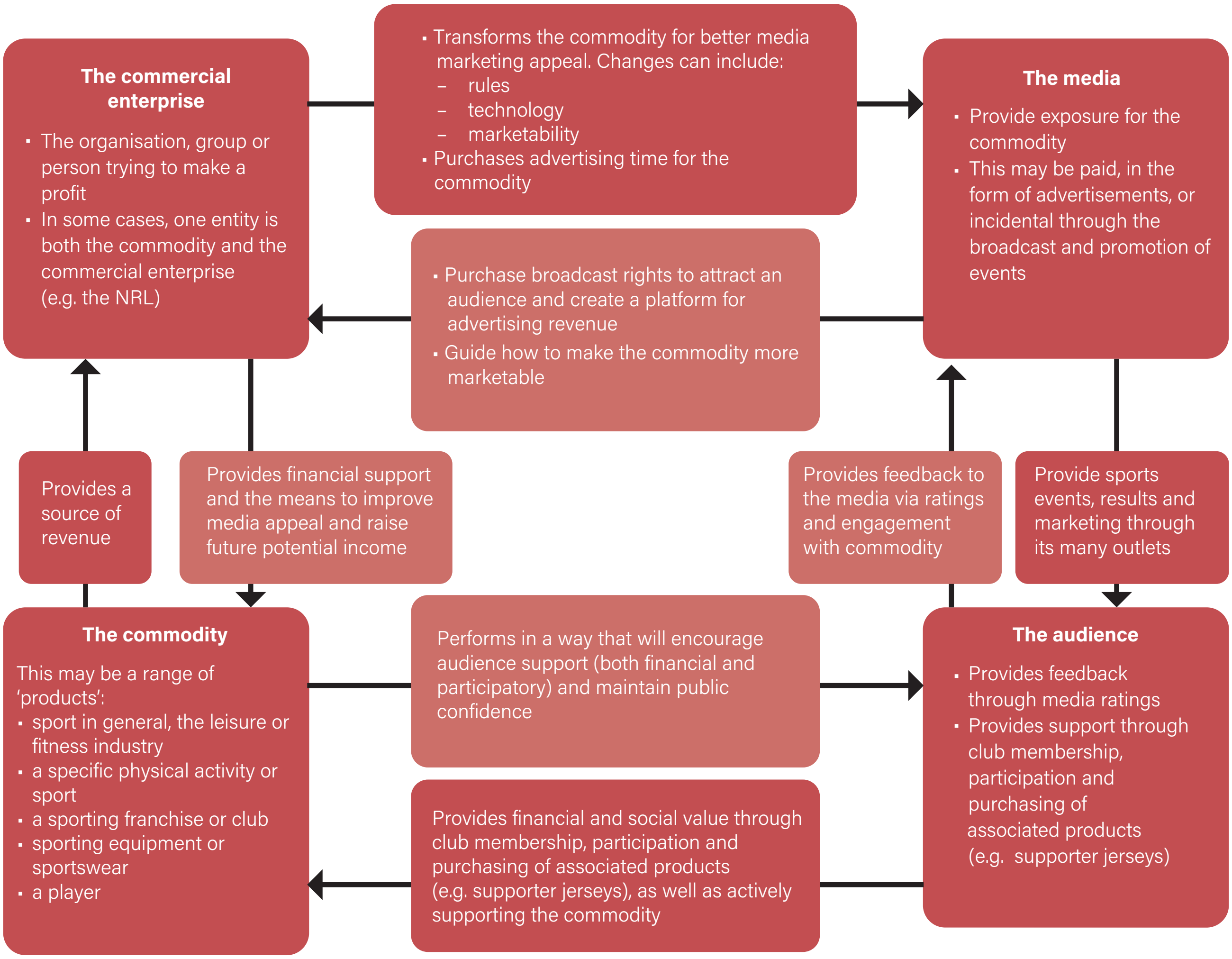


FIGURE 13.7 Commodification of physical activity and sport in a modern, media-centred marketplace

While there is now a vast array of media through which information can be communicated, those more relevant to equity and access in physical activity transmit sporting events, results or marketing related to physical activity, sporting events or its participants. Traditionally, these technologies include television, newspapers, magazines and radio. However, through the live-streaming of events, real-time updates, apps, and pop-up advertisements, the internet is now an essential medium for physical activity.

Where physical activity is viewed as entertainment, it has monetary value and is a commodity. For the commercial enterprises that own or are involved with the commodity, there is no doubt that adding value to the product of ‘sport’ is essential. What is displayed through the media plays a big role in the modern socialisation process. What messages do the images in Figure 13.8 send to young females about beach volleyball as a sport, and women’s sport in general?

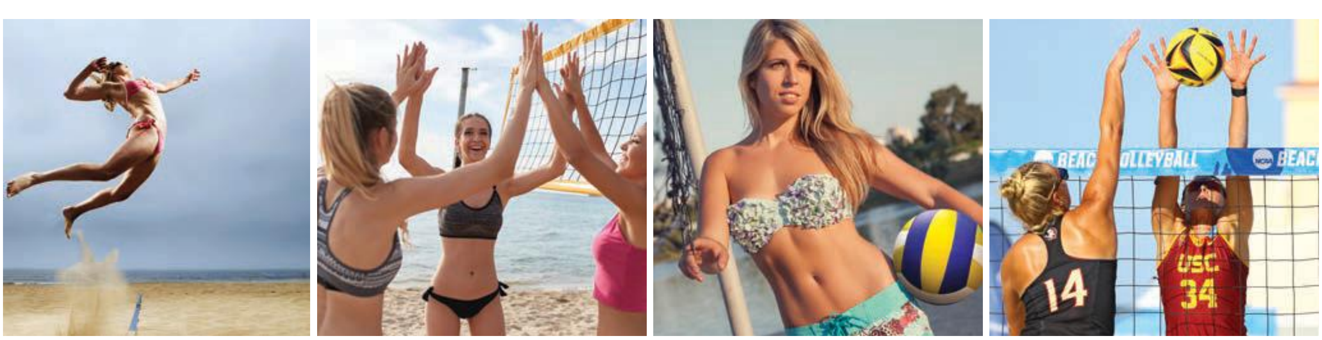


FIGURE 13.8 The sports images shown in the media reflect and reinforce social values, stereotypes and standards.

ISBN 978-1-009-31125-0 Stewart et al.

How physical activity is presented to an audience through the media includes aspects such as the amount of coverage given, the timeslots for the coverage, live or replayed coverage and the quality of the coverage (number of cameras, technology utilised, the quality of commentary). It includes whether the coverage is free to air, paid subscription or live-streaming. Presentation also includes the images themselves, the build-up and advertising surrounding the event and the entertainment that surrounds the broadcast. For print media and the internet, it includes aspects such as story length, number of images included and placement within the publication or feed algorithm. For an audience, each of these aspects is sending a message about the worth of the commodity: that high-quality media coverage must be reflective of a commodity that is of high value to society. Therefore, when an activity receives high levels of media exposure, this acts as an enabler for an individual through increased access.

In a reflection of Australian society, currently three sports – AFL, NRL and cricket – dominate TV exposure, accounting for more than half of all televised sport. Although participation rates in these activities do not support the disproportionate media coverage they receive, they are great 'spectator sports'. Olympic sports, and other sports at which Australians perform successfully at an international level, receive very limited TV exposure outside the Olympic Games and major international championships. Although this exposure is limited, there is a national interest in our sporting success. On a global stage, activities like football (soccer), tennis, golf, F1 motor racing and boxing all have significantly higher interest levels, but varying success through the Australian mainstream media. The influence of US culture, the quality of competition and the coverage provided also see a growing fan base for sports like basketball and American gridiron, despite engagement within Australia being negligible. However, the internet and 'on-demand' sports streaming sites are starting to change the media representation of sport, where many less high-profile physical activities are able to be viewed, many with an enthusiastic fan base.

The big four commercial sports, AFL, NRL, cricket and tennis, receive more than A$1 billion per year for the broadcasting rights to air their product. This has almost tripled over the past 10 years despite a fall in earnings over the same period. This source of revenue significantly increases the financial strength of these activities and reinforces their cultural significance. By contrast, many other sports are experiencing flat or declining media exposure and rights deals. Women's sport, conversely, is currently experiencing a period of high growth and media exposure. A 2022 YouGov study found that almost 70 per cent of Australians had watched women's sport, with 66 per cent increasing their viewing over the past three years. The survey also found that women's sport is gaining in popularity among men, with 72 per cent of male respondents saying they watch women's sport. Some 56 per cent of those who are watching more women's sports attributed their changing viewing behaviours to increased media coverage of female competitions, while 49 per cent credited increased dedicated broadcast coverage.

Television airtime is dominated by commercial sporting codes, and there is a strong correlation between broadcast volume and sponsorship revenue.

Greater wealth generated by some sports will allow them to attract a growing share of participants and future fans, adding further to their commercial attractiveness. This in turn acts as an enabler to access, with individuals experiencing more opportunities. Smaller sports – many of which have high rates of female participation and contribute to our international sporting success – will increasingly be squeezed out, with potentially negative impacts on the diversity of the Australian sports sector. For individuals, this will negatively affect access and create barriers to engagement.

How the media portrays physical activity and sports participants is also essential to the formation of public opinion and attitudes towards sport in general, specifically activities and players. What the media displays will influence the values, attitudes and beliefs held by the audience. Such portrayal can guide the decisions of parents and peers about the types of activities undertaken and how often they engage in them. On a personal level, the media help to create personal stereotypes of the people who play sport, and this influences an individual's self-concept about their own physical abilities and suitability for activities. This makes the media a significant agent of socialisation in Australia.

ISBN 978-1-009-31125-0 Stewart et al.

The 'messages' the media transmit to their audience establish values, attitudes and behaviours about physical activity.

Activities with high media exposure will increase in value, creating opportunities for individuals in these activities.

Activities with low media exposure will struggle commercially, and this creates barriers on many levels.

CHECK-IN 13.4

1. Use an example to explain the link between media coverage, sponsorship and the economic value of a specific physical activity.
2. Undertake some research and use a Venn diagram to compare and contrast the media coverage and messages transmitted by the media for netball and Australian Rules football.
3. Access the list of physical activities in the current version of the senior Physical Education syllabus. Consider the media coverage of the activities listed. Why do you believe there are so many activities in the syllabus that have little cultural value as demonstrated through the media?

Institutional rules, policies and procedures

Society is full of written and unwritten rules that influence the equity of and access to physical activity for Australians. Institutions associated with physical activity create and propagate rules, policies and procedures designed to oversee the effective operation of physical activity and the appropriate behaviours of its participants. While policies may be overt and written for all to follow, routine practices are more covert and surface in the behaviours and attitudes of the members of the institution. Some routine practices are so entrenched that they present as serious barriers to participation for some members of society, to the extent of being considered discriminatory.

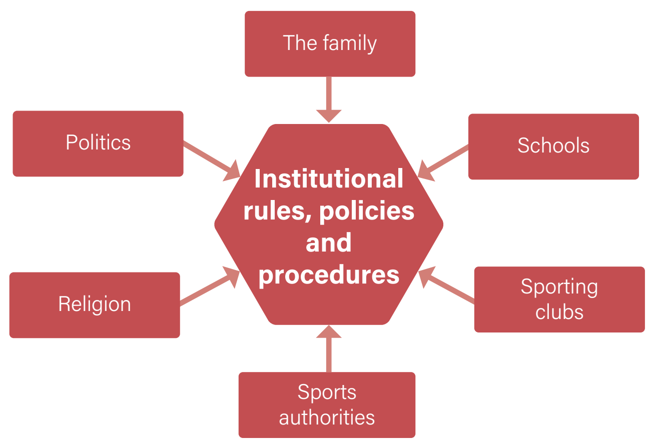


FIGURE 13.9 The rules, policies and procedures of major institutions influence the equity experience and access to physical activity of Australians.

ENGAGE 13.4

DEMONSTRATE APPLY ANALYSE & SYNTHESISE JUSTIFY

Inquiry question: How do the training and playing times set by institutions impact effective engagement?

Demonstrate and apply

1. As a class, select the physical activity in which you will participate.
2. Negotiate a training time that suits the majority of the class to conduct a training session outside of class time (before or after school or during a break).

ISBN 978-1-009-31125-0 Stewart et al.

3. Conduct the session at the agreed time and location.

Analyse and synthesise

4. Review the attendance rate for the training session.
5. Collect primary data for two groups of students: those who attended and those who did not.
    a. For those who attended, consider why they were able to do so. What made it possible?
    b. For those who did not attend, consider what barriers prevented them from attending? Was it the time, other priorities, a lack of interest, a combination of these or something else?

Justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

6. In a 100-word statement, justify a response to the inquiry question for this activity using the data collected.

TABLE 13.8 Institutions influencing equity of and access to physical activity

Institution	Rules, policies, procedures may include	Example
The family Families are the foundation institutions in society. The rules and procedures may not be formalised can be arbitrary and applied at the discrimination of the parents. Each family develops its own 'way of doing things.'  **FIGURE 13.10** The routine practices of the family enable access to specific physical activities.	Where physical activity is prioritised in life	'If you don't finish your assignment, you are not playing this weekend.' *(Barrier)*
	How much physical activity will be engaged in	'Get outside and do something – you've been on that chair all day.' *(Enabler)*
	When activity can be engaged in	'I am not getting up at 4:30 a.m. just so you can do swimming training.' *(Barrier)*
	Allocation of financial resources	'Sorry but we can't afford another lot of registration fees and new uniforms.' *(Barrier)*
	Who can engage in what physical activity	'You can't play netball; your brother and sister are doing soccer and we can't get to both.' *(Barrier)*
	What clubs or players are supported	'Isn't softball a bit girly? Why don't you stick with cricket like your brother?' *(Barrier)*
	What activities are supported	'The house is covered in maroon for State of Origin.' *(Enabler)*
	Freedom of choice	'You can do whatever you like – just pick what you want to play.' *(Enabler)*
	Effort, commitment and persistence	'You just started tennis; you are not quitting until the season is finished.' *(Enabler)*
	Tradition	'I played touch football and so did your sisters; how about you just try it?' *(Enabler)*
While the 'rules' here are generally spoken, an individual can also infer these messages from the actions of others in the family without the rules and procedures being stated specifically. This can be the difference between a family 'expectation' and a family 'influence.'		

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 13.8 *(continued)*

Institution	Rules, policies, procedures may include	Example
Schools 'School rules' are generally thought of as a way to maintain order within the institution. However, it is clear that many rules, policies and procedures exist within schools (and other institutes associated with education) that affect equity and access to physical activity.  **FIGURE 13.11** Simple access to lunchtime equipment at school is an enabler for physical activity.	The size of classes (Education Queensland – policy)	Maximum senior class size of 25. *(Enabler or barrier)*
	Subjects offered and when they are taught in relation to other subjects (school – procedure)	Physical Education is offered at the same time as Biology, Health and Physics. *(Enabler or barrier)*
	The required implementation of the current version of the senior Physical Education syllabus (QCAA – policy)	Each unit of work must be at least 55 hours. Must select activities only from those in the syllabus. Physical activity assessment is only a minor contributor to overall result. *(Enabler or barrier)*
	What is a required prerequisite for further study (TAFE or university – procedure)	Physical Education is not a requirement for an Engineering degree. *(Enabler or barrier)*
	What is a specific prerequisite for a career (individual employers)	Physical activity is not a requirement for attaining a sales and marketing job. *(Enabler or barrier)*
	Students pay a subject fee for Physical Education (school – procedure)	$230 per year subject fee for course. *(Barrier)*
	The organisation of resources (school – procedure)	The main sporting complex is not available for volleyball when Physical Education is scheduled. *(Barrier)*
	The offering of physical activities (school – procedure)	The school does lawn bowls and does not offer archery. *(Enabler or barrier)*
	The level to which activities are engaged in	The school is a school of excellence in touch football, with appropriate staffing and resourcing to maintain this. *(Enabler or barrier)*
	The distribution of resources (school – procedure)	The Sport Department has a budget of $33 000, while the Arts Department receives $8000. *(Enabler)*
	Who is 'allowed' to play	No hat – no play rule. *(Barrier)*
	The additional extra-curricular offerings (school and school sporting organisations – procedure)	Lunchtime access to gym is available. *(Enabler)* No equipment is handed out during break. *(Barrier)* There is no futsal offered for interschool sport by the district school sport organisation. *(Barrier)* There is no senior interschool sport offered. *(Barrier)* The school does not engage in the Champion Basketball School of Queensland Competition. *(Barrier)*
While school rules, policies and procedures are not designed to hamper access to physical activity, sometimes they do place barriers in the way of participation for many students.		

ISBN 978-1-009-31125-0 Stewart et al.

Institution	Rules, policies, procedures may include	Example
Sporting clubs Clubs form as the result of a common interest among a group of people. As a result, these people may also have similar values and attitudes. As a club develops its rules, policies and procedures, these values and attitudes may work their way into its operations. However, when rules, policies and procedures develop from a one-dimensional perspective, they may lack consideration for diversity – favouring people with a similar view to those already associated with the club, while disadvantaging others who are outside this demographic.	Resources	Money this year will be spent on upgrading facilities and we can no longer offer free come-and-try clinics. *(Barrier)*
	Coaching	The athletics club is going to pay for five parents to become qualified at the start of this season so our athletes can get better assistance. *(Enabler)*
	Administration	The archery club will pay to have a person write and submit grants to government so that we can get the fields upgraded. *(Enabler)*
	Fundraising	As parents are not supporting the fundraising initiatives required, next year an $80 fundraising levy will be charged. *(Enabler or barrier)*
	Behaviours of players, officials and parents	Developing a code of conduct – for example, any disrespect to a referee will invoke a minimum two-week suspension. *(Enabler)*
	Expectations for players, officials and parents	Players who do not attend training will not start the match. *(Enabler or barrier)*
FIGURE 13.12 Investing in coach development in clubs can help players develop skills and increase enjoyment.	Club constitution	Golfers must be members to participate in competitions; membership can only come through an application, endorsement from current members and payment of fees. *(Barrier)*
For some sporting clubs and organisations, what is displayed and tolerated can be different from what is written in a code. For example, does a club enforce policies about drinking alcohol, or does it tolerate players drinking prior to matches or to excess? This can sometimes give rise to a negative 'club culture', where antisocial behaviours are acceptable 'behind closed doors' if individuals do not abide by the set expectations.		
Sports authorities These governing bodies oversee the administration of a sport as a whole. Their rules, policies and procedures mandate and guide competitions, participation and funding to advance the image of the sport.	Competition structure	Clubs must organise age-based, not ability or weight-based competitions. *(Enabler or barrier)*
	Funding structure	How much money stays with a club at the grassroots, vs. how much goes to higher bodies for administration and elite-level development. *(Barrier)*
	Policy development	Develop codes for diversity, participation, standards of behaviours, which are then set as guidelines for clubs. *(Enabler or barrier)*
	Activity development	Come-and-try days – targeted programs for minority participation groups. *(Enabler)*
	Activity marketing	How much is spent on advertising and what image is presented. *(Enabler or barrier)*
FIGURE 13.13 Age-based competitions can cause barriers for younger children where a large difference in size may be apparent.	Activity marketplace	Do we target new participants, advertise to existing clients or try to get into schools through becoming an acknowledged Queensland school sport? *(Enabler or barrier)*
	Activity rule development To be more inclusive To make a better spectacle (increased marketability) For safety	Let us change the timeout rule to two minutes instead of one minute, 20 seconds; this will allow for more advertising during the telecasts of our elite matches. *(Enabler)*

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 13.8 *(continued)*

Institution	Rules, policies, procedures may include	Example
Religion When religious groups set expectations for their followers, a conflict can result, particularly when an individual's faith is more highly valued than participation in physical activity.  **FIGURE 13.14** Strict religious dress rules for some Muslim females present an institutional barrier to engagement in many physical activities.	Set times for worship	Sundays are a time for deep reflection and connection to the religious faith; therefore it is inappropriate to engage in other activities on this day. *(Barrier)*
	Dress or personal adornment expectations	Hair must not be cut and is worn long; it should be covered in a certain way. *(Barrier)*
	Dietary guidelines	In order to demonstrate faith, you must not eat or drink between sunrise and sunset during Ramadan. *(Barrier)*
Politics Government oversees the development of laws and sets policy for social stability and change to advance the population. Many government rules, policies and procedures impact on physical activity equity and access.  **FIGURE 13.15** Funding allocation policies for facility development affect access to physical activity at all levels.	The development of a just, equitable and inclusive society	Anti-Discrimination Acts Equal Opportunity Acts Other laws Federal, state and local policies *(Enablers)*
	The development of a healthy society	Federal, state and local policies and funding associated with health and physical activity *(Enablers)*
	Distribution of wealth	Creation of the Australian Sports Commission (including the Australian Institute of Sport) Funding policies and decisions concerning resources, activity development and school funding *(Enablers)*

CHECK-IN 13.5

1. Using three examples outlined in Table 13.8, explain how the rules, policies and procedures of an institution act as enablers to equity and access.
2. Using three examples outlined in Table 13.8, explain how the rules, policies and procedures of an institution act as barriers to equity and access.
3. Select one institution that has a major influence over equity and access to physical activity. Conduct further research into the specific rules and routine practices that influence equity and access. Present your findings as a mind map with examples that enable on the left and examples that are barriers on the right.
4. The current version of the senior Physical Education syllabus has mandated 20 possible activities to study along with rules about how and when these can be studied. Explain how this enables access to some activities while creating barriers to others for Physical Education students. Hypothesise what criteria might have been used to select these activities.

ISBN 978-1-009-31125-0 Stewart et al.

13.2 Strategies to enhance cultural factors for increased physical activity engagement

An equity strategy is a plan of action devised to bring about a determined outcome – in this case, to enhance equity, access and/or engagement to physical activity. Devising effective equity strategies to mitigate cultural factors affecting equity and access, would require:

- research on the demographics of those engaged, and not engaged, in a specific physical activity or physical activity in general; as well as an understanding of the barriers and enablers that are affecting that engagement
- research into the cultural practices and expectations with regard to the specific physical activity, or physical activity engagement in general, for the population or a specific microcosm of society
- an understanding of the funding available for the physical activity, and potential for increasing funding levels
- an evaluation of the current and potential promotion and marketing of the physical activity
- an investigation of institutional rules, policies and procedures for a specific physical activity that may be acting as barriers to equity, access and engagement for individuals or specific groups.

Equity strategies for cultural factors must then seek to limit or remove the impact of any cultural barriers identified, or enhance enablers to increase equity, access and engagement. In a **class context**, a **school context** or a **community context**, this may involve:

- undertaking better promotion or marketing to raise the interest in, awareness of and profile of an activity
- rebranding the activity to make it more appealing to a specific demographic (this may require modifying rules or procedures to make the activity more engaging)
- redistributing current funding to overcome identified issues of equity
- sourcing more funding to enhance the physical activity through better physical or human resources – for example, better equipment, facilities or coaches, or reduced fees
- creating an event or tournament, come-and-try session or group participation activity to change perceptions about the physical activity
- adjusting rules to make the physical activity more appealing to the individual's needs –for example, more success experienced, better relationships formed, less competitive for beginners, frequent rewards
- adjusting the physical activity to make it more appealing to the individual based on current physical activity trends – for example, flexible times, limited training, incorporating technology or gamification
- changing how and when the physical activity is offered, or how the activity is organised, when institutional practices are creating barriers.

class context the circumstances that form within your Physical Education cohort or faculty that provide a setting for an event, situation or idea

school context the circumstances that form within your school that provide a setting for an event, situation or idea

community context the circumstances that form within your local population and geographical location that provide the setting for an event, situation or idea

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 13.1

Inquiry question: Can removing institutional barriers increase ongoing engagement in physical activity?

Recognise and explain

1. As a class, identify barriers that currently exist within the rules and routine practices of your school that prevent students from participating in lunchtime play for a specific physical activity.
2. Think, pair, share to develop a strategy to reduce these barriers and provide students with the opportunity to engage with the activity.
3. In the planning of your strategy, consider how to make the activity itself more engaging, how timing may be a factor and how to effectively promote your strategy.

Demonstrate and apply

4. Implement your engagement strategy, collecting pre- and post-strategy data. Consider:

   Pre-strategy:

   - how much they have played before
   - how much they value the activity
   - how much they think they will enjoy being involved.

   Post-strategy:

   - whether they would do the activity again
   - how the activity could have been better
   - whether they like the activity more now
   - whether they would be more likely to get involved in the future.

   Note: You could split the class in half and have one group work with a popular sport (e.g. basketball) and one that is not so common (e.g. badminton, tennis or archery).

5. Consider collecting data from a sample of students in the school who did not attend to ascertain why they had been absent.

Analyse and synthesise

6. Analyse the data gathered to assess the effectiveness of the strategy for increasing engagement.

Evaluate and justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

7. In a 300-word statement, justify the effectiveness of your strategy as a one-off event to decrease institutional barriers. Predict whether your strategy was able to increase ongoing engagement for the activity, and identify any strengths or weaknesses that would apply if your strategy were to become an ongoing event.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 13.2

Inquiry question: How can effective equity strategies for engagement be developed within schools?

Recognise and explain

1. For a specific physical activity that can be undertaken at school, identify a specific demographic (age, sex or ability) for which secondary data indicates there are access barriers.
2. Design a survey to collect primary data on the level of participation for students at your school and the barriers that may be hampering their engagement.
3. Undertake secondary research to design an equity strategy that is inclusive of students and encourage participation through the removal of identified barriers for the identified demographic.

Demonstrate and apply

4. Implement your equity strategy, collecting relevant pre- and post-strategy data that will allow you to judge the effectiveness of your strategy.

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

5. Analyse the primary and secondary data collected to evaluate the effectiveness of the equity strategies in achieving a determined outcome.

Evaluate and justify

6. In 500 words, do the following.
   a. Using evidence from primary and secondary data on the barriers faced by your selected demographic, justify the development of your equity strategy.
   b. Justify the maintenance or modification of your equity strategy based on evidence collected through implementation.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Cultural factors that influence equity and access to physical activity include the types of activities undertaken by the Australian population and how people engage with sport and recreation.
- Trends in Australian physical activity are showing a change in the type and amount of physical activity being undertaken.
- The distribution of government funding works as both an enabler and a barrier for individuals, depending on the benefit they experience.
- The media promotion and marketing of physical activity serves as a barrier to those activities that suffer from poor media exposure, but an enabler for physical activities that enjoy more coverage.
- Policies, rules and routine practices of institutions need to reflect high levels of equity and create access for individuals; however, this can be difficult to achieve, given the diversity of individuals.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Which of the following factors influencing equity, access and engagement can be classified as cultural?

A. Genetic predisposition

B. The influence of teachers

C. Group physical activity preference

D. The routine practices and rules of a school

2. The media:

A. present role models to positively influence the socialisation process.

B. reflect the physical activities most valued by their audience.

C. enable access and opportunities for all physical activities.

D. by saturating an individual's life, act as a limiting factor in the socialisation process.

3. A cultural factor that is not acting as an enabler is:

A. increased media exposure for women's sport.

B. parents funding players' costs of a sports tour.

C. changing competition structure to have local mixed netball tournaments.

D. changing the rules of basketball to make it appeal to a more diverse range of abilities.

4. A cultural factor that may act as a barrier to engagement is:

A. funding grants available from the state government.

B. increasing local popularity for archery.

C. local access to high-level sporting facilities only on the weekends.

D. virtual physical activity options given to people over 50 to be completed at home.

5. An equity strategy to enhance the cultural factors that influence equity, access and engagement will:

A. target friends and peers.

B. improve the self-esteem and confidence of the individuals participating.

C. limit barriers that are identified for target groups found in the demographics of participants or non-participants.

D. use socialisation to increase the importance of physical activity for the community.

ISBN 978-1-009-31125-0 Stewart et al.

SHORT-RESPONSE QUESTIONS

1. Using one example from a sporting club and one from school, explain how policies and rules can be modified to enhance equity.
2. Explain how the media can negatively influence engagement in a physical activity by using a local example in relation to a specific physical activity.

EXTENDED-RESPONSE QUESTION

Identify cultural factors that are currently influencing engagement for students in your school context for a specific physical activity. This activity may be either currently very popular with significant engagement, or marginalised with limited engagement. In a 300-word response, evaluate three significant cultural factors that are influencing the level of engagement experienced in your selected physical activity, and make one recommendation for a modification to current practices that might enhance the engagement that students at your school experience.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 14

Environmental factors that act as barriers and enablers for self and others in physical activity

What's ahead?

Chapter 14
Environmental factors that act as barriers and enablers for self and others in physical activity

- **14.1** Environmental factors that act as barriers and enablers for self and others in physical activity
- **14.2** Strategies to enhance environmental factors for increased physical activity engagement

Key subject matter

- Identify and explore information about environmental factors acting as barriers and enablers to influence equity and access including built and natural environments, green space.
- Gather primary data about the influence of equity and access concepts and principles, including personal, social, cultural and environmental factors acting as barriers and enablers, on engagement in physical activity.
- Use secondary data to analyse how equity and access concepts and principles influence engagement in physical activity.
- Analyse primary data and secondary data to identify relationships between the equity strategies and engagement in physical activity contexts.
- Devise equity strategies to influence personal, social, cultural and environmental factors in a physical activity context, e.g. event or tournament, come-and-try session or group participation activity.
- Justify the development of the equity strategies using evidence from primary data and secondary data.

Source: *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What environmental barriers are reducing access to physical activity for others and myself?
- What environmental factors are increasing equity and enabling access to physical activity for others and myself?
- What strategies can reduce the impact of barriers to enhance equity, access or opportunities within physical activity?

ISBN 978-1-009-31125-0 Stewart et al.

14.1 Environmental factors that act as barriers and enablers for self and others in physical activity

The Australian environment provides a unique situation for participation in physical activity. With Northern parts of our country straddling the Tropic of Capricorn, Australians enjoy both tropical and sub-tropical conditions that support many outdoor activities. In addition, Australia is a large land mass with a relatively low population, resulting in low **population density**. A low population density ensures that there is plenty of outdoor space available for physical activity, even within populated areas. Australia's environmental conditions, coupled with adequate space, are optimal for a population that values and enjoys the outdoors and the leisure, recreational and sporting opportunities this brings.

population density a measure of the number of people who make up a population in a defined area

FIGURE 14.1 Councils and developers look for opportunities to provide green space and areas within the community to enable the population to be physically active.

CHECK-IN 14.1

1. Brainstorm a list of recreational, leisure and sporting activities that are enabled through the weather conditions experienced in Australia. Group each activity based on how much damage is caused to a totally natural environment in order to have the necessary facilities to participate. Use the following headings: 'Minimal environmental change required', 'Moderate environmental change required', 'Considerable environmental change required.'
2. Identify three other countries that are situated on the Tropic of Capricorn and research the top sports participated in by the citizens of these countries. Are there similarities between the activities in these countries and those that are popular in Australia? Can any similarities be attributed to environmental factors?

Environmental factors that influence equity and access to physical activity

- The type and location of built environments
- The number and quality of built environments
- The amount and location of natural environments and green space
- The quality of and access to natural environments and green space

FIGURE 14.2 Environmental factors that influence the equity of and access to physical activity experienced by an individual

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 14.1

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How does the Australian environment act as an enabler for specific physical activities?

Demonstrate and apply

1. Over a number of lessons, participate in three different physical activities: one that can be conducted indoors; one that requires an outdoor court or restricted area; and one that is played on a large, open field.
2. Collect some primary data from the class by surveying the types of environments in which students like to participate – for example, indoors, natural, oval/field.
3. Before commencing each activity, take note of the time of day, temperature, wind conditions, humidity and general condition of the playing areas (hard, grassy, purpose-built).
4. Engage in the activities as fully as possible.
5. Collect primary data for each activity on the levels of motivation and enjoyment experienced.

Analyse and synthesise

6. From the data collected, infer the impact of the environment on participation in physical activity. Present your inference in an appropriate format, referring to the data that formed it.

Evaluate and justify

KEY COGNITION

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

7. From your current knowledge, evaluate the role the Australian environment played in the development of Australian Rules football in this country. Justify your evaluation in a 100-word response.

The environmental factors that impact on equity, access to and engagement in physical activity stem from the environment being both a resource and facility for physical activity. Where the required environment for a specific physical activity is readily available, close at hand and of adequate quality, this acts as an enabler. Consider an individual who lives next to a public golf course, across from the touch football fields or near a park with a basketball half-court. In each of these situations, the locality and availability of the required environment provides an individual with greater access to the associated physical activity and consequently they may be more likely to engage. Conversely, consider an individual living in an inner-city apartment in Brisbane. How much access will they have to the snowy slopes required to ski or the large downhill courses required for mountain biking? While it is not impossible for them to undertake these activities, the lack of easy access to the environment required certainly acts as a barrier to engagement.

Built environments

Built environments have been constructed specifically for engagement in physical activity.

built environments facilities or highly modified natural environments that have been constructed specifically for engagement in physical activity

ISBN 978-1-009-31125-0 Stewart et al.

This refers to facilities such as stadiums, indoor and outdoor courts, school halls, skate or water parks, community pools, ovals or tracks. These environments are constructed as a result of funding, whether through different levels of government, local clubs and groups, private businesses or individuals.

Communities usually develop these facilities in response to popular demand. Local councils generally build and maintain resources that engage the largest percentage of their population. This presents barriers for less-popular activities, particularly if they also require expensive facilities. Consider the financial commitment to build and fit out a purpose-built indoor facility for gymnastics. Members of rural or isolated communities also experience inequities due to a lack of funding. In smaller areas, councils and sporting groups must frequently compromise and prioritise facility development. For example, a local council may need to decide between maintaining Rugby League fields and change facilities, building a skate park and repairing the community pool.

Natural environments and green space

Natural environments occur inherently in nature. As with built environments, the abundance and quality of these environments will serve as either an enabler or a barrier to the physical activities that use these environments. For many, the enjoyment of these physical activities comes from being in a natural and unspoiled environment. Consider how important an 'untouched' environment is to bushwalking, snow skiing, surfing or snorkelling on a reef. Again, governments and organisations work to preserve the natural features of such spaces.

However, for most physical activities conducted in a natural environment, there must be a trade-off between retaining a truly unspoiled environment and providing the facilities required for the activity. For example, the construction of bushwalking trails or mountain bike tracks, or the setting of anchor points for outdoor rock climbing all require some manipulation of the natural environment. Even within urbanised areas, councils work to maintain areas of natural vegetation for recreational purposes and plan to provide **green space** for community members.

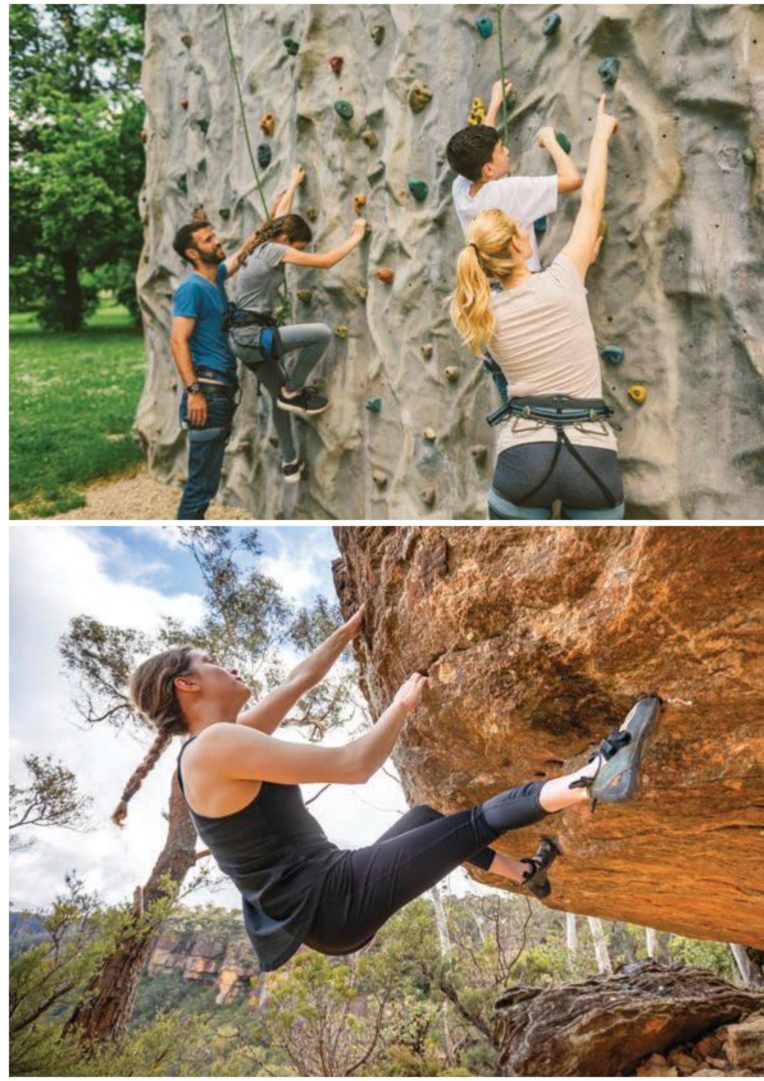


FIGURE 14.3 Engaging in physical activity in built environments (top image) or through getting in touch with the natural environment (bottom image) can be an important factor that influences personal enjoyment.

natural environments environments that occur inherently in nature

green space an area of grass, trees or other vegetation set apart for recreational or aesthetic purposes in an otherwise urban environment

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 14.2

1. Place all the physical activities from the current version of the senior Physical Education syllabus on the following continuum, based on the type of environment they require.

Natural environment *(Totally unspoiled)*	Natural environment *(Minor adjustments)*	Built environment *(Oval)*	Built environment *(Indoor)*

2. For each factor below, provide one specific physical activity as an example of how the environment can act as a barrier to engagement in physical activity, and one activity that demonstrates how it can act as an enabler. Present your response as a table.
   a. Australia's climate
   b. Australia's low population density
   c. The types of facilities built within the environment
   d. The number of facilities built within the environment
   e. The quality of facilities built within the environment.
3. Using a mapping search engine, such as Google Maps or Google Earth, investigate the natural and green space in your local area. Count the number of natural spaces (natural bushland) within 1 km and then 5 km of your house. Do the same for green spaces (allocated parks or ovals).

14.2 Strategies to enhance environmental factors for increased physical activity engagement

An equity strategy is a plan of action devised to bring about a determined outcome – in this case, to enhance equity, access and/or engagement to physical activity. Devising effective equity strategies to mitigate environmental factors affecting equity and access can be difficult as they typically require:

- the funding to manipulate the environment to make it better suited for a specific physical activity
- the funding and approval to build new facilities for the specific physical activity
- enhancing the amenities and resources within the environment to ensure that they meet or exceed the expectations of participants
- increasing the number of facilities in which the physical activity can be performed to ensure that locations are more readily available to a larger proportion of the population.

Equity strategies for enhancing environmental factors may also incorporate removing barriers and supplying resources to enable physical activity engagement. For example, many schools have an oval with football goals or Rugby League posts that may be underutilised during breaks. However, adding a simple storage system with balls that is self-managed and can be accessed by students, as well as installing drinking taps nearby, may encourage greater use of these environmental resources.

FIGURE 14.4 Urban recreational spaces are often highly valued in the local community.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 14.1

Inquiry question: What significance does the environment have on engagement in physical activity?

Recognise and explain

1. In one lesson broken into three segments, your class will participate in three different physical activities: one that is conducted indoors; one that requires an outdoor court or restricted area; and one that is played on a large, open field.
2. Before you begin the activities, take note of the time of day, temperature, wind conditions, humidity and general condition of the playing areas (hard, grassy, purpose-built).

Demonstrate and apply

3. Engage in the three activities as fully as possible.
4. For each activity, collect primary data on your level of motivation, enjoyment and engagement.

Analyse and synthesise

5. Analyse the data gathered, looking for trends. Consider the validity of your data by allowing for the external factors identified previously.

Evaluate and justify

KEY COGNITION

Consider: think deliberately or carefully about something, typically before making a decision; take something into account when making a judgement; view attentively or scrutinise; reflect on

6. Consider the primary data gathered and infer the impact the type of environment has on physical activity participation. Present your inference in an appropriate format, referring to the experiences that informed it.
7. Undertake secondary research into the participation rates of and the activities undertaken by teenage Australians. Group these activities together according to the types of environments in which they are undertaken. Link this secondary statistical data to your inference above.

FIGURE 14.5 Outdoor spaces can be highly dependent on other environmental factors.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 14.2

RECOGNISE & EXPLAIN ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What strategies can enhance access to natural areas or green spaces in our local area?

Recognise and explain

1. Identify a natural area or an allocated green space within walking distance of your school.
2. Over a series of lessons, go on in-class excursions to explore this area and, where possible, engage in a variety of activities that can be undertaken there.

Analyse and synthesise

3. As a class, use a SWOT analysis to evaluate the quality of the space identified and its ability to meet the physical activity needs of the surrounding community. Identify strengths, weaknesses, opportunities and threats.

Evaluate and justify

KEY COGNITION

Appraise: evaluate the worth, significance or status of something; judge or consider a text or piece of work

4. In a 200-word statement, appraise the value of the space to the community. Consider how much it is being accessed, what activities are undertaken there, what barriers exist that may affect its use and whether it is being utilised effectively.
5. In 100 words, outline a proposal that would increase access to the area based on current engagement and perceived barriers. Consider improvement to facilities and a wider variety of activities, better local publicity or starting an activity group to use the space.

FIGURE 14.6 A simple strategy for increasing usage of this community area might be to install barriers for increased safety and protection of participants.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- The location, quantity and quality of the environments required to undertake physical activity act as an enabler or barrier to access physical activity.
- Where there are ample facilities of suitable quality for physical activity engagement, the environment is acting as an enabler.
- Where facilities are sparse, poorly distributed or maintained, or are not of suitable quality for the physical activity, the environment is acting as a barrier.
- Equity strategies to enhance environmental factors will focus on improving the environment required for specific physical activities.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. One reason why Australia can plan green spaces within its communities for physical activity is:

A. a cooler climate.

B. low population density.

C. government funding.

D. our location on Earth.

2. Which of the following is not a type of natural environment or green space?

A. A local park with recreational equipment

B. Natural bushland

C. A swimming pool

D. A golf course

3. Which of the following is not an environmental factor that influences equity and access to physical activity?

A. The number and quality of players available to participate

B. The type and location of built environments

C. The number and quality of built environments

D. The number and location of natural environments and green spaces

4. What is a built environment in relation to the environmental factors that affect equity and access to physical activity?

A. A natural environment that is closed to allow the vegetation to regenerate

B. A resource, such as a toilet or change room, built as part of a natural recreational area

C. A natural environment that is set aside by council for physical activity when planning for new urban areas is being undertaken

D. A resource, such as a pool or sporting hall, where physical activity can take place

5. Which of the following is an equity strategy to enhance the environmental factors that influence equity, access and engagement?

A. Changing the rules of futsal to provide a smaller field with bigger goals to provide a greater chance of success of scoring

B. Providing a free come-and-try day at the local archery range

C. Upgrading the walking tracks within a local national park

D. Providing funding for better coaches

SHORT-RESPONSE QUESTIONS

1. Explain how the environment can be both a barrier and an enabler to physical activity in general.

2. Select a locally available physical activity, and use examples to explain how the environment required for this activity is acting as an enabler to access for the local population.

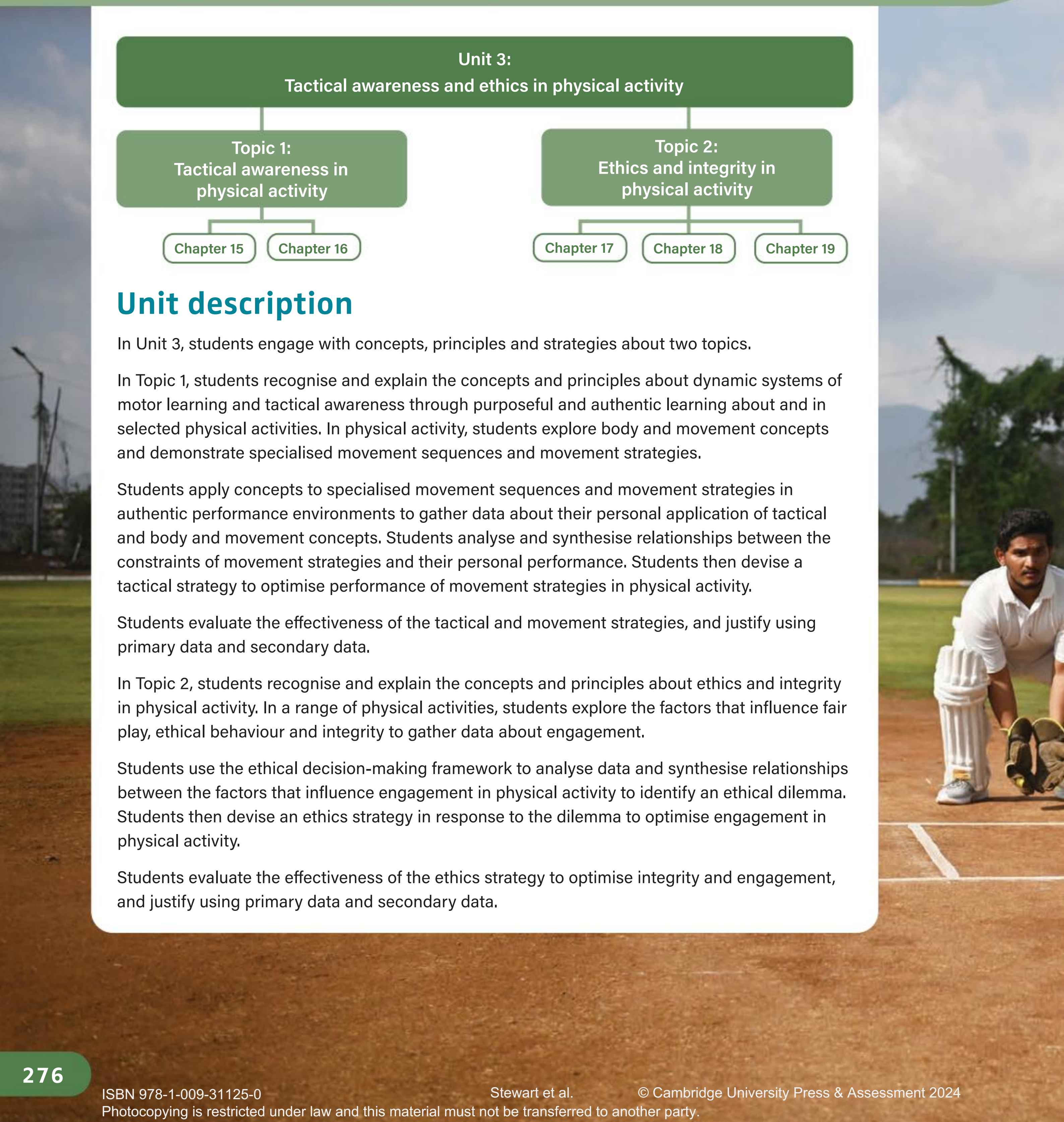
EXTENDED-RESPONSE QUESTION

Select a physical activity that is available to study in the current senior Physical Education syllabus. Engage in some primary and secondary research and, in a 300-word response, evaluate the significance of environmental factors to the access experienced by students to the selected physical activity. Devise one strategy to manipulate an environmental factor to enhance access to the physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

UNIT 3

Tactical awareness and ethics in physical activity



Unit 3:
Tactical awareness and ethics in physical activity

- **Topic 1:** Tactical awareness in physical activity
  - Chapter 15
  - Chapter 16
- **Topic 2:** Ethics and integrity in physical activity
  - Chapter 17
  - Chapter 18
  - Chapter 19

Unit description

In Unit 3, students engage with concepts, principles and strategies about two topics.

In Topic 1, students recognise and explain the concepts and principles about dynamic systems of motor learning and tactical awareness through purposeful and authentic learning about and in selected physical activities. In physical activity, students explore body and movement concepts and demonstrate specialised movement sequences and movement strategies.

Students apply concepts to specialised movement sequences and movement strategies in authentic performance environments to gather data about their personal application of tactical and body and movement concepts. Students analyse and synthesise relationships between the constraints of movement strategies and their personal performance. Students then devise a tactical strategy to optimise performance of movement strategies in physical activity.

Students evaluate the effectiveness of the tactical and movement strategies, and justify using primary data and secondary data.

In Topic 2, students recognise and explain the concepts and principles about ethics and integrity in physical activity. In a range of physical activities, students explore the factors that influence fair play, ethical behaviour and integrity to gather data about engagement.

Students use the ethical decision-making framework to analyse data and synthesise relationships between the factors that influence engagement in physical activity to identify an ethical dilemma. Students then devise an ethics strategy in response to the dilemma to optimise engagement in physical activity.

Students evaluate the effectiveness of the ethics strategy to optimise integrity and engagement, and justify using primary data and secondary data.

ISBN 978-1-009-31125-0 Stewart et al.

Unit objectives

Objectives	Activity icons
1. Recognise and explain tactical awareness and ethics and integrity concepts and principles about selected physical activities.	
2. Demonstrate specialised movement sequences and movement strategies in selected physical activities.	
3. Apply concepts to specialised movement sequences and movement strategies in selected physical activities.	
4. Analyse and synthesise data to devise strategies about tactical awareness and ethics and integrity.	
5. Evaluate tactical, ethics and movement strategies.	
6. Justify tactical, ethics and movement strategies.	
7. Make decisions about and use language, conventions and mode-appropriate features for particular purposes and contexts.	

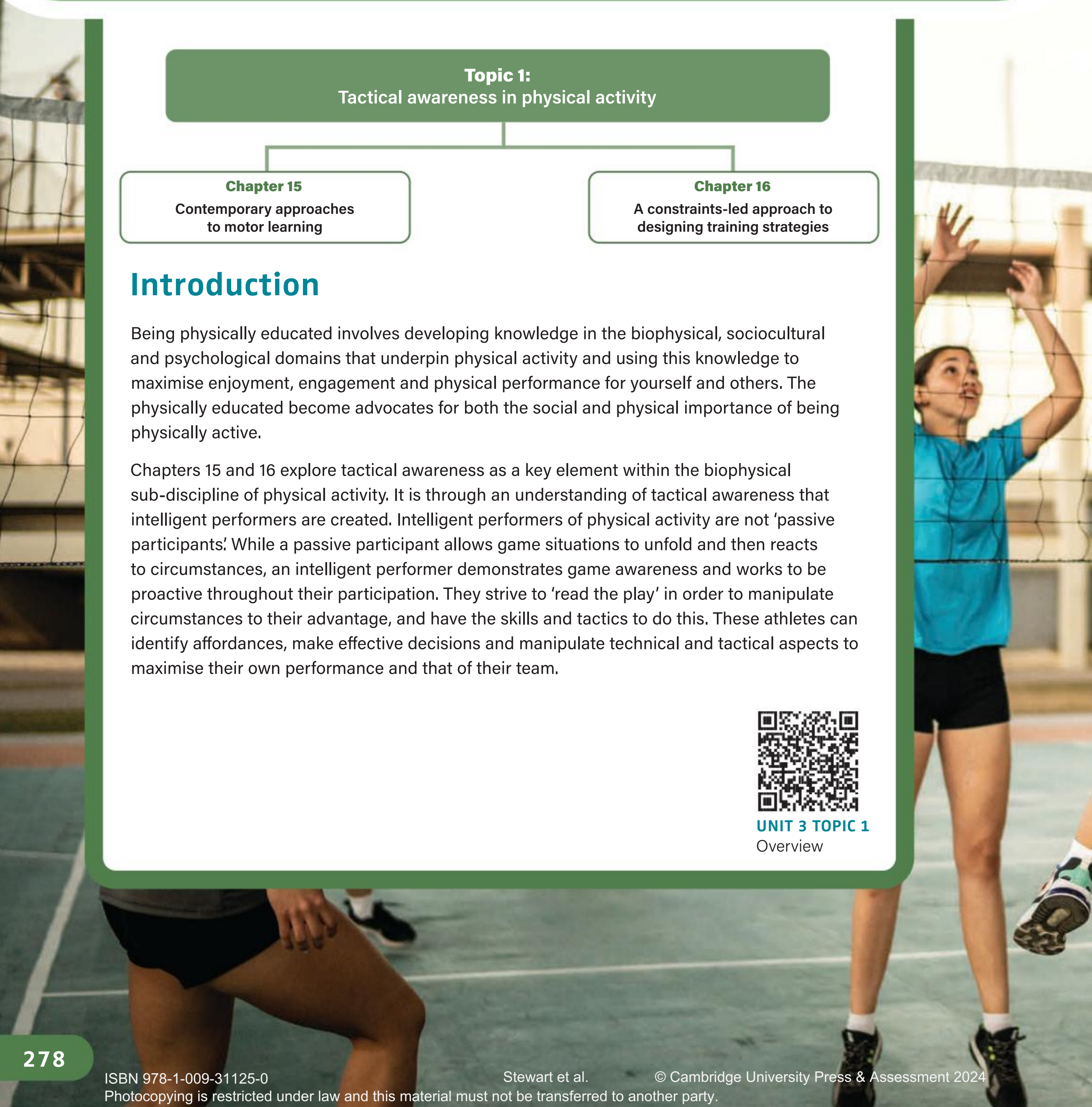
Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

ISBN 978-1-009-31125-0

UNIT 3

TOPIC 1

Tactical awareness in physical activity



Topic 1:
Tactical awareness in physical activity

Chapter 15
Contemporary approaches to motor learning

Chapter 16
A constraints-led approach to designing training strategies

Introduction

Being physically educated involves developing knowledge in the biophysical, sociocultural and psychological domains that underpin physical activity and using this knowledge to maximise enjoyment, engagement and physical performance for yourself and others. The physically educated become advocates for both the social and physical importance of being physically active.

Chapters 15 and 16 explore tactical awareness as a key element within the biophysical sub-discipline of physical activity. It is through an understanding of tactical awareness that intelligent performers are created. Intelligent performers of physical activity are not 'passive participants.' While a passive participant allows game situations to unfold and then reacts to circumstances, an intelligent performer demonstrates game awareness and works to be proactive throughout their participation. They strive to 'read the play' in order to manipulate circumstances to their advantage, and have the skills and tactics to do this. These athletes can identify affordances, make effective decisions and manipulate technical and tactical aspects to maximise their own performance and that of their team.

UNIT 3 TOPIC 1
Overview

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 15

Contemporary approaches to motor learning

What's ahead?

Chapter 15
Contemporary approaches to motor learning

- **15.1** Two major approaches to investigate motor learning
- **15.2** Dynamic systems approach to motor learning
- **15.3** The ecological model
- **15.4** Skill acquisition, tactical awareness and intelligent performers

Key subject matter

- Recognise and explain that two major approaches to investigate motor learning have developed over time: cognitive systems and dynamic systems.
- Recognise and explain that tactical awareness is a personal response to the interaction of constraints of the learner, task and environment during goal-directed behaviour in physical activity.
- Recognise and explain the alignment of dynamic systems to the complex nature of authentic game play.
- Identify and explore ecological models of learning, including dynamic systems.
- Recognise and explain that dynamic systems theory views the learner as a complex movement system of many independent and interacting parts, and that this system self-organises in response to the constraints placed upon it.
- Analyse and synthesise primary data and secondary data about the influence of the constraints-led approach to learning and tactical awareness concepts and principles on movement sequences and movement strategies in physical activity.
- Recognise and explain that the ecological model focuses more on how an individual interacts with the environment and proposes that information to control action is consistently and directly available from our senses through a perception–action coupling.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What are the two major learning approaches to motor learning?
- What are the key features of the cognitive approach?
- What are the key features of a dynamic systems approach to motor learning?
- What is self-organisation and how does it drive motor learning?
- How can we develop affordance recognition and perception–action coupling to optimise performance?

ISBN 978-1-009-31125-0 Stewart et al.

15.1 Two major approaches to investigate motor learning

Motor learning is concerned with the processes involved in acquiring and refining movement skills. It provides an understanding of how humans develop the motor control necessary to enact and function in their environment. Over time, two major approaches to investigate motor learning have developed. These two approaches were comprehensively outlined in Chapter 2 of this textbook. Table 15.1 provides a brief reflective comparison between the two approaches. It should be remembered that the dynamic systems approach (or ecological model) provides a more contemporary understanding of motor learning and, as such, provides the basis for the remainder of this chapter and Chapter 16.

CHECK-IN 15.1

1. Use examples to explain what is meant by linear and non-linear motor learning.
2. Outline one key difference between a cognitive systems approach and a dynamic systems approach to motor learning.
3. Justify why a dynamic systems approach to motor learning more accurately accounts for how participants learn motor skills.
4. Outline why learners should participate in problem-solving activities to increase learning outcomes.

TABLE 15.1 Comparing the cognitive and dynamic systems approaches to motor learning

	The cognitive systems approach (also referred to as the cognitive model)	**The dynamic systems approach (also referred to as the ecological model)**
	A more traditional approach to understanding motor learning	A more contemporary approach to understanding motor learning
Basic underlying assumptions about learning	• Involves a hierarchical model of control where higher control centres pass commands to lower control centres where the brain processes information to enact a response as a reaction to the environment. • Requires an understanding of the processes that occur in making decisions, planning and executing movement. • Results in linear changes in movement; progress is seen as always improving as feedback is gathered and used from one experience to the next.	• Where movements emerge or self-organise through the dynamic interaction of the environment, the task being performed and the individual. • Learning emerges as a result of this complex dynamic system and the interaction between these three components. • Movements are not produced and organised hierarchically, but involve ongoing assessment of environment, task and performer to constantly manipulate and adjust responses searching for a successful outcome. • Involves non-linear and unpredictable changes to movement solutions that can see a progression or regression of learning as different solutions are trialled or different environments or individual capabilities are experienced.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 15.1 *(continued)*

	The cognitive systems approach (also referred to as the cognitive model)		The dynamic systems approach (also referred to as the ecological model)		
Associated models	The **information processing model**, which assumes that the central nervous system enables a performer's decision-making to occur prior to any action; and controls the movements of the body through stages involving perception, decision-making and response execution.	**Fitts and Posner's stage model of motor learning**, based on learning as a continuous process of information processing and that this processing changes as learning progresses through the cognitive, associative and autonomous stages.	**Newell's stages of learning model**, which identifies three stages in motor learning: **1.** Assembling a coordination pattern **2.** Gaining control of coordination structure **3.** Skilled optimisation of control.	**Dynamic systems theory** views the learner as a complex movement system of many independent and interacting parts, and that this system self-organises in response to the constraints placed upon it by the environment, task and self searching for a successful response.	The **ecological model** focuses more on how an individual interacts with the environment and proposes that information to control action is consistently and directly available from our senses through perception–action coupling. The learner searches for affordances within the environment to maximise the chance of a successful movement outcome.
Associated practice types – coaching pedagogy	• Massed practice and distributed practice • Whole practice and part practice • Blocked practice and random practice • Constant practice and varied practice • Drills *For more information on these practice types, see Table 3.1 in Chapter 3.*		• Problem-solving practice • Specificity and variability of practice		

15.2 Dynamic systems approach to motor learning

As a specific learning model, dynamic systems theory proposes that the learner adapts their movement sequences in response to variations in the environment, the task to be achieved and the learner themselves, to provide a successful solution to the problem or challenge the situation has presented. This process is called **self-organisation**. This approach is considered non-linear as the learner will progress and regress in their performances as they attempt to self-organise. They will experiment with different physical responses and strategies to gauge effectiveness; they will deal with changes in the environment or even the learner's own changes in skill and physical development. It is known through observation that learning is not a linear progressive improvement, and dynamic systems theory accounts for this non-linear progression.

self-organisation a dynamic systems view that humans will instinctively formulate a physical response when confronted with their environment and that, given practice, this response will be modified to be more successful

ISBN 978-1-009-31125-0

TABLE 15.2 Examples of environmental, task and learner constraints

Environmental constraints	Task constraints	Learner constraints
• Own position on court or field • Opponent's positioning on court or field • Implement's position on court or field and its movement (e.g. speed or trajectory) • Who is in possession of the implement • Abilities of teammates and opposition • Weather conditions • Time of day • Pitch/court conditions – quality of facilities	*Fixed:* • Rules of the game • Playing area – available space • Overall game objective • Available equipment *Variable:* • Stage of game (i.e. time) • State of game (e.g. score – winning/losing) • Current goal or objective (e.g. maintain possession)	• Technical ability • Tactical ability • Perceptual ability • Physical ability • Psychological ability • Physiological capacity

The aspects of environment, task and learner are three categories within dynamic systems theory, into which the **constraints** of performance can be placed. Constraints are the boundaries that exist within the situation that guide the learner's cognitions, decision-making and movement patterns. Constraints inevitably determine the course of action that is implemented. In dynamic systems theory, the many constraints affecting movement at any stage highlight that performance is the result of humans, as a complex movement system, interacting with the dynamic nature of the environment.

Dynamic systems theory also highlights that a successful solution in dynamic situations that feature many constraints may not be the result of implementing one specific skill or tactic; rather, multiple alternatives could be used in response to the constraints, all of which may produce a successful outcome. For example, a netball goal shooter when faced with a goal keeper in defence, may choose to perform a step-in shot or a step-back shot or play the ball back out of the circle using a chest pass or bounce pass, with all of these options allowing for possible success given the constraints faced. This notion suggests that there is no 'correct' response, but that any response that achieves the goal at the time could be deemed successful, and that a similar situation might utilise completely different responses that could be successful solutions to the problem or challenge presented by the environment. The notion of multiple solutions to the same situational problem also incorporates the concept that learning is non-linear – that, while learning and experimenting with skills, an individual may show progress, but then revert as technical proficiency is sought through refining techniques or when implementing different tactical strategies.

Over time, through ongoing and dynamic interaction between the constraints (the learner, their environment and the task), the learner's self-organising skills develop and the system organises into a specific yet **stable pattern**, or preferred method of movement, when specific constraints are present. Through practice, humans naturally develop the ability to respond to a situation in a way that is most likely to bring about success for them.

Dynamic systems approaches present a concept of motor learning that better accounts for the development of motor skill in activities that are performed in complex, constantly changing environments, such as batting in cricket. Dynamic systems approaches, therefore, better account for the motor learning seen in the authentic game-play environments of invasion, striking and fielding, and net and court games, and can better assist in the development of learning strategies.

constraints boundaries that shape a learner's self-organising movement patterns, cognitions and decision-making processes

stable pattern (of movement) a preferred method of movement that emerges for a performer through self-organisation

ISBN 978-1-009-31125-0 Stewart et al.

15.3 The ecological model

The ecological model to motor learning builds from a non-linear, dynamic systems basis to focus more specifically on how the motor control system interacts with the environment. **Ecological psychology** examines how the body's systems coordinate actions with the environment, objects and surfaces. Athletes perceive – for example, through vision – and coordinate actions with their environment. It proposes that humans engage in a process of constantly interpreting or giving meaning to information available from our senses about our environment to create, implement and adapt specific actions. This process is termed **perception–action coupling**.

It is understood that **affordances** are environmental characteristics that offer opportunities for action. In day-to-day activity, our experiences allow these opportunities to become obvious. For example, we learn the affordance of stairs offers the opportunity to move up or down between levels in a building. However, less familiar and more complex situations require learning to occur so that a performer can understand what opportunities they might have on offer. Take, for example, a six-year-old playing their first few games of soccer. As a beginner, they may not recognise many environmental cues that might help them – their own position on the field, the ball speed or trajectory, player positions from both the opposition and their own team. All of these affordances provide the opportunity to develop a course of action, whether that be to shoot, pass, dribble or break to space. Developing the skill to recognise affordances and the opportunities they present is known as **attunement**. The more skilled a performer becomes at attunement, the more options they have for their performance, and the more likely it is they'll find a successful solution to their situation.

Overall, the ecological model explains that as learners progress, they develop their:

- perception – they recognise more environmental cues that influence performance quicker and with more accuracy
- attunement (affordance recognition) – they recognise what actions or strategies are available to use in the situation and what is most likely to be successful for them
- action modification – as part of perception–action coupling, the performer can adapt a movement sequence for the specific situation as it is implemented to increase chances of success.

As skill is learned, and these aspects of perception–action coupling are developed, individuals become more attuned to the environment and the affordances that are available for movement. This enables the learner to identify opportunities for action from the environment and react with a successful action, demonstrating a highly skilled performance.

ecological psychology how the body's systems coordinate actions with the environment, objects and surfaces

perception–action coupling a direct link between the process of interpreting or giving meaning to information from the environment and an action

affordances the opportunities for action provided by the environment or task in relation to the learner's ability

attunement the ability to perceive information from the performance environment and identify the available affordances

FIGURE 15.1 The skill of affordance recognition is developed over time through practice in representative environments.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 15.1

RECOGNISE & EXPLAIN ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How can perception–action coupling improve motor learning?

Recognise and explain

1. Read the following extract.

Perception and action are coupled

“In ecological psychology the theory of direct perception signifies the tight coupling of perception and action systems in individuals (Savelsbergh, Davids, Van Der Kamp & Bennett, 2003). In essence, information drives movements, but movements also influence what information can be picked up by performers/learners. This principle has meaningful implications for the design of coaching practice. Athletes need to be provided with opportunities to learn to perceive the key specifying information sources to enable the emergence of functional movement solutions. This point can be illustrated by observing what happens under practice conditions that do not include specifying information sources. In a study of cricket batting, we demonstrated that batting against bowling machines compared to real bowlers led to a re-organisation of the timing and co-ordination of a forward defensive shot (Renshaw, Oldham, Davids, & Golds, 2007). The former task constraints did not facilitate opportunities for batters to pick up specifying information from the bowler's actions – a key component of expert batting performance (Müller, Abernethy, & Farrow, 2006). These findings support the principle of perception–action coupling and suggest that coaches should design practice tasks that keep specifying information sources and actions together … In this regard it is important for coaches to use a strategy of 'task simplification' rather than 'task decomposition' when designing practice sessions (Davids et al., 2007). Task simplification signifies that information–movement couplings utilised during performance are preserved by requiring learners to practice in simulated performance conditions. In task simplification key performance variables such as velocity of balls and opponents, number of players in the game and size of playing areas are maintained and managed to simplify the task … This approach contrasts with the traditional strategy of breaking up actions into arbitrary units by reducing skills to practice in static drill activities that are not relevant to game situations. In summary, the key point of task simplification is that it enables learners to practice in a managed environment with all key information sources present.”

Source: Renshaw et al. (2009, pp. 540–602)

2. Summarise and understand the following key points.
   a. What is perception–action coupling?
   b. What is task simplification and task decomposition?
   c. How does this approach differ from traditional approaches to teaching or learning activities for developing skilled movement?

Analyse and synthesise

3. Recall a perception–action coupling demonstrated in the text and identify one within your selected physical activity.
4. Identify and explain a task in your physical activity where a traditional approach of task decomposition occurs for a technical skill.

ISBN 978-1-009-31125-0 Stewart et al.

5. Design, implement and explain a task in your physical activity where a task simplification occurs for a technical skill.

Evaluate and justify

KEY COGNITION

Appraise: evaluate the worth, significance or status of something; judge or consider a text or piece of work

6. Appraise the effectiveness of the tasks you chose in tasks 4 and 5 for developing motor learning in an authentic environment.

15.4 Skill acquisition, tactical awareness and intelligent performers

ENGAGE 15.2

RECOGNISE & EXPLAIN | ANALYSE & SYNTHESISE

Inquiry question: What is intelligent performance?

Recognise and explain

1. Read the following excerpt.

What is intelligent performance?

" Before we can discuss how to develop intelligent performance we first need to try to define intelligent game play. To exemplify some of the issues, we will look at what on face value would seem to be a straightforward exercise, a typical 2 vs. 1 in Rugby. A Rugby player who draws the defender and then passes the ball to his team mate when faced with a 2 on 1 attacking opportunity could be said to have made an intelligent choice – or perhaps not! This is because the **individual constraints**, **task constraints** and **environmental constraints** in any specific performance must be considered when judging the appropriateness of a decision. In our example, the player on the ball may not have the perceptual skills to (a) spot the isolated defender or (b) the technical skill to have the ability to pass the ball accurately or with the required speed to the player as the pass needs to be made with his weaker left hand. In this situation, the better option for the attacker might be to attempt to feint a pass and then beat

individual constraints the unique mental and physical abilities of the individual that affect their decision-making and movement patterns, and that can be displayed during performance

task constraints the rules, equipment and goal or purpose of an activity that limit the decision-making and movement patterns that can be displayed by an individual during performance

environmental constraints the social or situational factors that limit the decision-making and movement patterns that can be displayed by an individual during performance

Continued »

ISBN 978-1-009-31125-0

the opponent using his superior side step. Similarly, the action capabilities of team mates and opponents will impact on the decision-making process of the player. For example, if the team mate is much slower than the defender, giving him the ball could result in the attack failing. The task constraints, i.e. the state of the game and the position on the pitch must be considered. Finally, the environmental conditions will influence the final decision. The wind may be so strong that a pass of more than a few metres would be blown off line and have little chance of ever reaching the team mate. In summary, what should be clear from this discussion is that movement solutions will vary as each individual strives to satisfy the unique constraints on him/her. Additionally, small changes to individual structural or functional constraints (such as increased strength), task rules or equipment, or environmental constraints can lead to dramatic changes in movement patterns adopted by learners to solve performance problems. ”

Source: Renshaw and Clancy (2008, pp. 2–3)

2. Examine the information from the Renshaw and Clancy source and construct a table with the following headings: 'Task constraints', 'Learner constraints' and 'Environmental constraints'.
3. Formulate examples of constraints that might be able to be categorised under each heading.

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

4. Explain how this information may affect the learning environment constructed by a teacher or coach.
5. Devise one learning activity that would facilitate intelligent performance development for your current physical activity.
6. Examine the following learning environments and analyse whether intelligent performance would be developed.
   a. Practising forward defensive shots in cricket batting when facing a bowling machine
   b. Practising 100 jump shots from the top of the key way
   c. Playing 1 vs. 1 basketball in a half-court
   d. Playing 4 vs. 4 touch in a park of approximately 20 m × 20 m

Consider an elite performer in your sport. What constitutes a 'skilled performer'? Are they able to complete a skill with high proficiency? Are they able to apply and implement the skill at the right time, having selected the right option? Are they able to show adaptability in the execution of the skill, thus providing an optimal outcome for the situation? As seen, there are many uses for the word 'skill'.

In simple terms, **skill acquisition** refers to voluntary control over movements of joints and body segments in an effort to solve a motor skill problem and achieve a task goal. **Motor learning** describes how skill acquisition is developed, and this learning can be observed through the qualities of improvement, consistency, stability, persistence and adaptability.

skill acquisition the voluntary control over movements of joints and body segments in an effort to solve a motor skill problem and achieve a task goal

motor learning the study of the processes involved in acquiring and refining skills; the field of study concerned with understanding changes in motor control

ISBN 978-1-009-31125-0 Stewart et al.

> Skill acquisition requires us to interact effectively with our environment, detect important information, and time our responses appropriately. It thus should result in coordination patterns that are adaptable to a range of varying performance characteristics. Adaptive behavior is important because conditions like the environment, task requirements, and our motivations can change every time we perform a motor skill.
>
> Source: Davids et al. (2006)

> Cognitive and experimental psychology ... refers to the establishment of an internal state or representation of an act which is believed to be acquired as a result of learning and task experience ... ecological perspective which suggests that the term skill acquisition may not refer to an entity but rather to the emergence of an adaptive, functional relationship between an organism and its environment ... In this respect, the terms 'skill adaptation' or 'skill attunement' might be more suitable to describe this process.
>
> Source: Araújo and Davids (2011, p. 1)

From the extracts above, and previous information presented on the dynamic systems and ecological models of learning, it can be seen that a modern understanding of skill acquisition and motor learning relies heavily on the interaction between the learner, the environment and the task. It should also be noted that learning a 'skill' in a modern sense is not simply the refining of functional specialised movement sequences, but contains two elements to be developed:

1. **Technical proficiency** – concerned with developing the movement sequence
2. **Tactical awareness** – concerned with identifying and utilising the affordances within the current constraints of specific dynamic situations.

Dynamic systems approaches to learning identify that both these elements must be developed in unison for higher-level learning to result. Therefore, taking a dynamic systems approach to the learning of motor skill, and the development of learning activities, is now more widely accepted as producing better learning outcomes for performers.

It is this type of learning environment, based on a dynamic systems approach, that aids in the development of tactical awareness and **intelligent performers**. The goal of any training activity or learning program designed to develop motor skills and promote motor learning should be to create intelligent performers. Intelligent performers of physical activity are proactive in their game play, not 'passive participants'. While a passive participant allows game situations to unfold and then reacts to circumstances, an intelligent performer demonstrates game awareness and works to be proactive throughout their participation. They strive to 'read the play' in order to manipulate circumstances to their advantage, and have the skill and tactics to do this. These athletes can identify affordances in highly complex and dynamic situations, make effective decisions about how these can be exploited and which affordance to utilise; they then manipulate technical and tactical aspects to produce successful outcomes in their own performance and that of their team.

Tactical awareness is a large and essential component of developing intelligent performers. It relies on the performer perceiving the affordances available to them in specific situations, and having the decision-making capabilities to select and adapt the affordance that is most likely to bring success given the constraints of the situation. The performer must also possess the technical proficiency to implement the motor sequence required to enact the affordance (*the tactic*) selected.

technical proficiency the level to which a specialised movement sequence has been refined in order to produce consistently successful outcomes, and the level to which the performer can adapt the sequence to effectively suit the situation

tactical awareness a personal response to the interaction of constraints of environment, task and player during goal-directed behaviour in a physical activity

intelligent performers those who can accurately read the play to assess affordances (opportunities), then select and appropriately adapt a motor sequence that will be successful given the rules and required task goal

ISBN 978-1-009-31125-0

It should be clear that a training environment that replicates game play is most likely to be beneficial in promoting learning and developing intelligent performance. That is, practising in game-like open environments enables players to learn, succeed and fail in applying the rules, skills and strategies of a game to succeed. As Yoda states in *Star Wars: The Last Jedi*, 'The greatest teacher, failure is'.

> KEY MESSAGE
> Motor skill requires the development of technical proficiency and tactical awareness.

> KEY MESSAGE
> Tactical awareness is essential in developing intelligent performers of physical activity.

> KEY MESSAGE
> Developing tactical awareness requires an understanding of the dynamic systems approach in order to develop learning activities.

FIGURE 15.2 Professional athletes, such as volleyball players, develop coordination patterns that they can adapt to many conditions.

ENGAGE 15.3

DEMONSTRATE APPLY EVALUATE JUSTIFY

Inquiry question: How do individuals perform in authentic environments?

Demonstrate and apply

1. Capture digital evidence of your performance in a variety of modified game and match situations. Consider 1 vs. 1, 2 vs. 2, 3 vs. 3 situations as appropriate for your physical activity of study.

Evaluate and justify

> KEY COGNITION
> **Critique**: review (e.g. a theory, practice, performance) in a detailed, analytical and critical way

2. Critique the digital data and justify two technical and two tactical strengths and weaknesses of your play, citing specific examples from the footage.
3. Justify one modification you would make to your play to enhance your performance outcomes.

ISBN 978-1-009-31125-0 Stewart et al.

What constitutes a skilled performance?

ENGAGE 15.4

Inquiry question: How does tactical awareness contribute to being an intelligent performer?

Demonstrate and apply

Apply: use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation

1. Participate in a game of Keep Away.

   Aim: To keep the ball away from the defender

   Three attackers vs. one defender

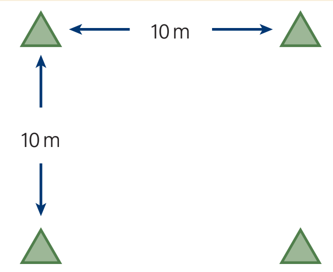
   Equipment: 1 ball, 4 markers

   Space: 10 m × 10 m square as a playing area

   Rules: No contact, three-minute engagement

   Change rules: Must make four passes; three-minute engagement

   Change rules: No running with ball; three-minute engagement



Analyse and synthesise

2. Undertake a post-match reflection on the following.
   - **a.** What strategies proved to be successful for you or your team?
   - **b.** What other strategies could have been an option?
   - **c.** What characteristics of Keep Away make it an **invasion game**?
   - **d.** Create a mind map highlighting the **principles of play** that are reflected in the Keep Away game.

Evaluate and justify

3. Using examples from the Keep Away game, justify how tactical awareness is a key component for intelligent performance.

invasion games team games whereby the main objective is for participants to invade their opposition's territory in striving to score more points within the allocated time frame

principles of play fundamental movement strategies used by individuals or teams to effectively adapt to any tactical situation in authentic performance environments

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Two major approaches to investigate motor learning have developed over time: cognitive systems and dynamic systems.
- The dynamic systems approach asserts that:
  - movements emerge, or self-organise, through the dynamic interaction of the environment, the task being performed and the individual
  - movements are not organised hierarchically, involve non-linear and unpredictable changes, and emerge as part of a complex dynamic system
  - changes and progressions are non-linear as they involve abrupt changes from one stable state to another.
- The ecological model adds to dynamic systems by exploring in more detail the inseparable link between the individual and the environment.
- Perception–action coupling provides a direct link between the process of interpreting or giving meaning to information from the environment and a specific action.
- Affordances are the opportunity for action that are found in the environment.
- Affordance recognition is the ability to accurately perceive environmental cues and the opportunities for action they present, and this ability develops with practice.
- Tactical awareness is a personal response to the interaction of constraints of environment, task and player during goal-directed behaviour in a physical activity.
- Tactical awareness is an essential skill for an intelligent performer.
- Technical proficiency is the level to which a specialised movement sequence has been refined in order to produce consistently successful outcomes, and the level to which the performer can adapt the sequence to effectively suit the situation.
- Tactical awareness and technical proficiency should be developed in unison for optimal learning by using representative practice in learning activities.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Learning is:
   A. linear in nature.
   B. able to automatically progress from one stage to the next.
   C. when an individual is attuned to information only from the environment.
   D. when a coordinated movement pattern occurs in a non-linear progression.
2. The dynamic systems belief that humans will instinctively formulate a physical response when confronted with their environment, is known as:
   A. perception–action coupling.
   B. affordance recognition.
   C. self-organisation.
   D. constraint processing.
3. The rules of the game is an example of which type of constraint?
   A. Task
   B. Learner
   C. Environmental
   D. Perceptual
4. Perception–action coupling is:
   A. a link between decision-making and the motor program used in the response.
   B. a direct link between the process of interpreting or giving meaning to information from the environment and an action.
   C. the coordinated action that results from an understanding of the ecological approach to learning motor skills.
   D. the process of self-organisation where learning progresses through experiences in dynamic learning activities.

ISBN 978-1-009-31125-0 Stewart et al.

5. Intelligent performers develop both:
   A. self-organisation and perception–action coupling skills.
   B. tactical awareness and technical proficiency.
   C. technical perfection and perception skills.
   D. constraints recognition and tactical awareness.

SHORT-RESPONSE QUESTIONS

1. Categorise and give examples of the constraints from your current physical activity.
2. Explain why the use of skill and drill type practice activities might not be beneficial for invasion games.

EXTENDED-RESPONSE QUESTION

Devise a learning activity that uses representational practice for your current physical activity. Ensure that the activity targets both a specific tactic for the activity and the development of at least one specialised movement sequence. Justify how the activity will enhance the self-organisation of the participants towards improved performance, and how it will improve technical proficiency and tactical awareness.

FIGURE 15.3 Tess Madgen drives towards the basket under pressure during a match between Australia and China.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 16

A constraints-led approach to designing training strategies

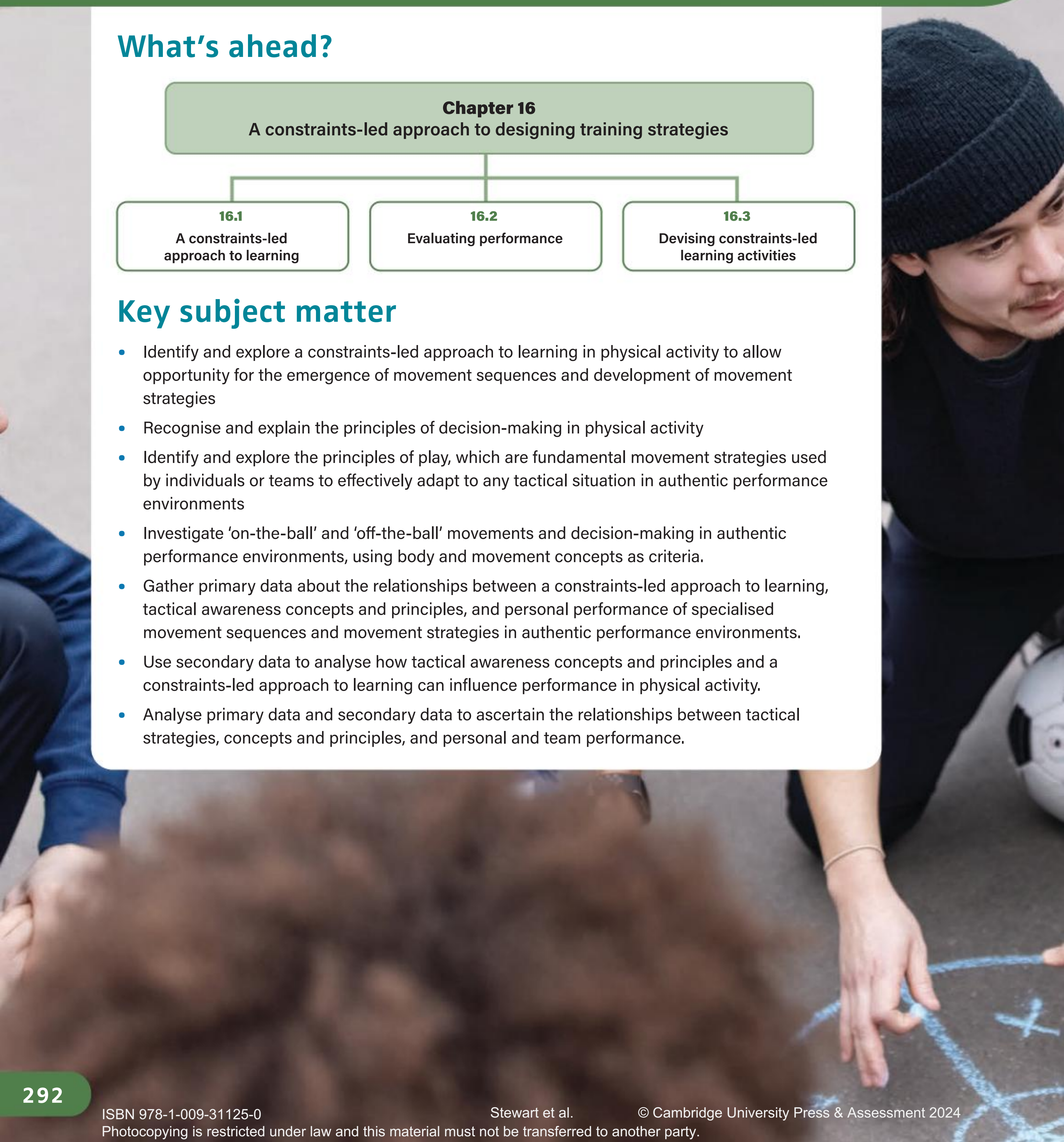
What's ahead?

Chapter 16
A constraints-led approach to designing training strategies

- **16.1** A constraints-led approach to learning
- **16.2** Evaluating performance
- **16.3** Devising constraints-led learning activities

Key subject matter

- Identify and explore a constraints-led approach to learning in physical activity to allow opportunity for the emergence of movement sequences and development of movement strategies
- Recognise and explain the principles of decision-making in physical activity
- Identify and explore the principles of play, which are fundamental movement strategies used by individuals or teams to effectively adapt to any tactical situation in authentic performance environments
- Investigate 'on-the-ball' and 'off-the-ball' movements and decision-making in authentic performance environments, using body and movement concepts as criteria.
- Gather primary data about the relationships between a constraints-led approach to learning, tactical awareness concepts and principles, and personal performance of specialised movement sequences and movement strategies in authentic performance environments.
- Use secondary data to analyse how tactical awareness concepts and principles and a constraints-led approach to learning can influence performance in physical activity.
- Analyse primary data and secondary data to ascertain the relationships between tactical strategies, concepts and principles, and personal and team performance.



ISBN 978-1-009-31125-0 Stewart et al.

- Optimise performance in physical activity by devising personal and team tactical strategies
- Justify the development of tactical and movement strategies using evidence from primary data and secondary data.
- Implement tactical and movement strategies to gather primary data about the outcomes, and limitations of decisions.
- Reflect on primary data and secondary data to evaluate the effectiveness of tactical strategies to achieve a determined outcome
- Make decisions to maintain or modify the tactical and movement strategies to optimise performance in physical activity.
- Justify maintenance or modification of the tactical and movement strategies using evidence from primary data and secondary data.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What is a constraints-led approach to coaching or teaching methodology?
- How can constraints be manipulated to enhance the emergence of specific movement sequences and movement strategies?
- How can you develop a constraints-led learning activity?
- Why is decision-making a key skill to develop through constraints-led learning activities?
- How can a constraints-led approach assist performance?
- What is your level of decision-making and perception–action coupling?
- What is your performance level of movement sequences and movement strategies?
- How can the effectiveness of tactical and movement strategies be assessed?

ISBN 978-1-009-31125-0 Stewart et al.

16.1 A constraints-led approach to learning

ENGAGE 16.1

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: Does motor program practice in a closed environment develop skilled performances?

Option A – Invasion games

Demonstrate and apply

This activity can be applied across any invasion game with some simple adaptations, focusing on either kicking or passing.

Participate in Drill 1 and Drill 2.

Aim: To develop technical ability

Equipment: 2 balls, 8 markers

Space: Drill 1 – 10 m, Drill 2 – 10 m × 10 m grid

Rules: No contact, no running with the ball

1. **Drill 1:** Use the markers to set up a receiving zone 10 m apart. In pairs, complete 60 stationary passes that are received inside the zone. Identify what was needed to complete this task successfully in comparison to a game situation. Consider tracking the ball, tracking of team member, tracking of opponent, movement to space.

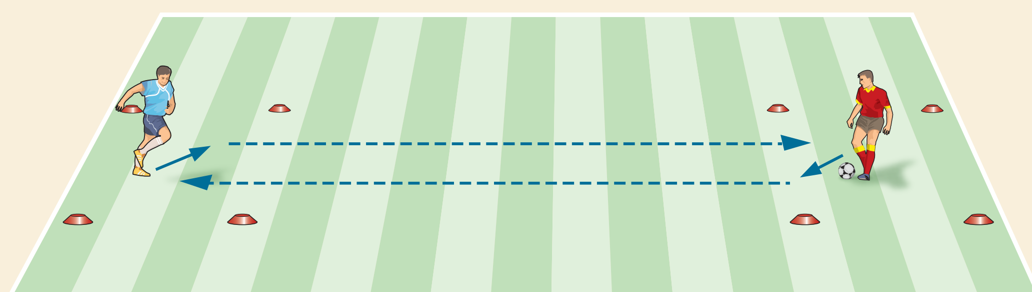


FIGURE 16.1 Drill 1 as a soccer activity

2. **Drill 2:** Use the markers to set up a 10 m × 10 m grid. In fours, complete 60 passes to a moving player around the outside of the grid, by passing the ball anticlockwise. The receiver should move off their marker to receive the ball in front as they move towards the next marker, then immediately pass the ball to the next player who is also leading. Identify what was needed to complete this task successfully in comparison to a game situation. Consider tracking of ball, tracking of team member, tracking of opponent, movement to space.

ISBN 978-1-009-31125-0 Stewart et al.

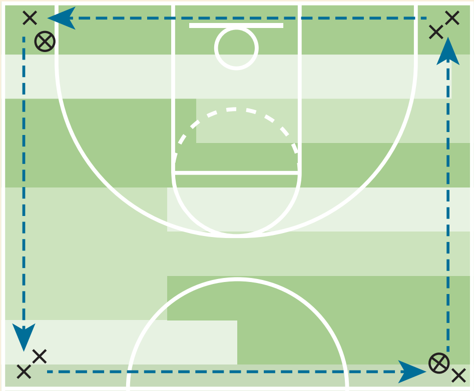


FIGURE 16.2 Drill 2 as a basketball activity. This could be a straight passing activity in a 10 m × 10 m grid, or dribble and pass using a half-court.

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

3. After the drills, reflect on the following.
   a. Was technical proficiency developed in each drill?
   b. How closely aligned were the tasks to a game environment?
   c. Consider what other factors are involved when successfully completing these techniques in a game environment.
   d. How do these other factors affect the successful performance of the movement sequence?

Option B – Net and court games

Demonstrate and apply

Participate in Drill 1 and Drill 2

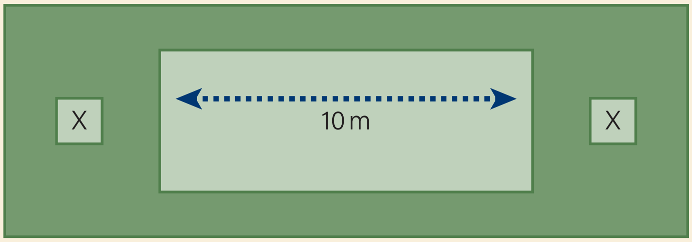
Aim: To develop technical ability of a finger pass (a set) in volleyball

Equipment: 1 ball

Space: Drill 1 – 10 m, Drill 2 – 10 m × 10 m grid

Teacher explains three key points of passing.

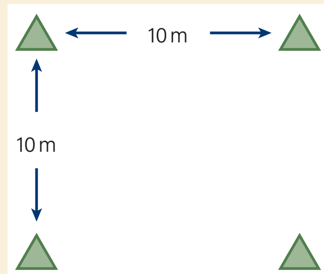
1. **Drill 1:** Complete 60 stationary finger passes in pairs. If ball drops, start again. Identify what was needed to complete the task successfully – for example, tracking of ball, tracking of team member, tracking of opponent, movement into space. Continue the drill for 10 minutes.



Continued »

ISBN 978-1-009-31125-0 Stewart et al.

2. **Drill 2:** Complete 60 finger passes in pairs. Pass around the grid. Once you have passed the ball, go to where you passed it. If the ball drops, start again. Identify what was needed to complete the task successfully – for example, tracking of ball, tracking of team member, tracking of opponent, movement into space. Continue the drill for 10 minutes.



Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

3. After the drills, reflect on the following.
   a. Was technical proficiency developed in each drill?
   b. How closely aligned were the tasks to a game environment?
   c. What other factors are involved when successfully completing these techniques in a game environment? How do these other factors affect the successful completion of the skill?

In Chapter 15, it was clearly established that a contemporary approach to motor learning through the dynamic systems and ecological approach more accurately describes the learning process. This is particularly true in highly complex and changing performance environments, such as those found in the invasion, striking and fielding and net and court categories of physical activity. However, these modern motor learning approaches also account for the learning in the more stable environments of aesthetic, performance and target sports.

Engage 16.1 highlights a more traditional, cognitive approach to coaching and teaching for motor development. Chapter 15 discussed why these skill-drill repetitive type practice activities are not ideal for developing tactical awareness, and therefore are not likely to produce intelligent performance. For intelligent performance to develop, a learner must be exposed to more contemporary training activities, which reflect representative practice and involve decision-making and problem-solving.

How can we develop intelligent performance?

> “Intelligent performance can be developed by creative coaching that promotes emergent decision making through a process of attunement to key information available in the performance environment. This process can only take place if the practice environments are representative of the performance environment with all key information sources present. Coaches should create variability in the practice environment by manipulating individual, task and environmental constraints forcing performers to explore the practice environment and come up with new functional solutions.”
>
> Source: Renshaw and Clancy (2016, pp. 4–5)

ISBN 978-1-009-31125-0 Stewart et al.

It is understood that humans instinctively self-organise to find an effective movement response to their situation. The situation may be any general circumstances we encounter as we undertake daily activities, or the movements required by the situation presented within a specific physical activity. Constraints are the boundaries that shape a performer's self-organising processes, dictating the movement possibilities, the thinking and decision-making about how to move and, inevitably, the movement pattern produced. Constraints can be found in the environment, learner or task.

The constraints found within any situation therefore present affordances (opportunities for action), and it is these opportunities that enable the emergence of movement behaviours through self-organisation to occur. Constraints can either enable or limit performance based on the affordances they present to the learner, the learner's ability to recognise these affordances through the process of **attunement**, and their ability to utilise these affordances through perception–action coupling.

> **attunement** the ability to perceive information from the performance environment and identify the available affordances

This understanding has implications for teachers and coaches. In Chapter 15, the importance of representative practice was explored as a method for enhancing motor learning. It is important to understand that teachers and coaches, through representative practice, can manipulate constraints to create learning scenarios where affordances emerge for the learner and they can practise the ability to self-organise. Through this type of practice, a performer will develop their self-organisational skills for specific game scenarios to produce effective and successful motor responses – both through improved technical proficiency and tactical awareness. Manipulating constraints, to allow specific affordances to emerge, so that a learner can practise their self-organisation in representative practice, is a modern coaching pedagogy, known as a **constraints-led approach**. It is important to note that within a constraints-led approach a coach does not prescribe solutions; they do not instruct the learner on what to do to be successful. Instead, the learner will problem-solve (self-organise) to find their own optimal solution based on self, teammates and the desired goal. The ecological belief is that, given enough practice within the learning environment, the learner will gain the skill to find a response, which will be modified to be successful on each specific occasion. They will form a specific yet stable pattern, or preferred method of movement, when specific constraints are presented. It is through this approach to motor learning that intelligent performers are created.

> **constraints-led approach** a pedagogical framework that utilises a dynamic systems approach and ecological psychology to design learning activities that develop all aspects of movement skill (technical, tactical and perceptual)

The constraints-led approach framework

The constraints-led approach is a pedagogical framework for developing movement skills. It is underpinned by several key assumptions about skill acquisition, which should be considered when devising learning activities.

Characteristics of a constraints-led learning activity:

- Activities must be learner-centred.
- The design of practice tasks must be representative of an authentic environment.
- Learning tasks should simplify rather than deconstruct.
- Learning requires the learner to assemble a unique movement solution that will help satisfy task constraints in a particular situation.
- Effective learning activities manipulate constraints to promote particular affordances from the performance environment, allowing the learner to develop technical and tactical skills through self-organisation.
- Learning requires continual exploration by the learner in practice as repetition with variation.
- There is no ideal movement pattern to learn; the correct movement pattern is the one that is successful in the current situation.

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 16.3 How would practicing and training on a grassy soccer ground prepare players for this particular game scenario?

ENGAGE 16.2

RECOGNISE & EXPLAIN

ANALYSE & SYNTHESISE

Inquiry question: How do we develop tactical understanding and awareness?

Recognise and explain

Watch the video on constraints learning vs. isolated practice, available at https://cambridge.edu.au/redirect/10372, and answer the following questions.

KEY COGNITION

Summarise: give a brief statement of a general theme or major point(s); present ideas and information in fewer words and in sequence

1. Summarise data from the following sections.
   a. Introduction
   b. Skill and training
   c. Procedures: Closed drills and open drills
   d. Skill demands
   e. Discussion.

Analyse and synthesise

2. Appraise the difference between closed and open drills and assess their value in developing tactical awareness.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 16.3

Inquiry question: How can we develop tactical understanding?

Recognise and explain

1. Review your notes taken from the video in Engage 16.2, particularly those associated with open and closed drills.

Demonstrate and apply

2. Design and implement two five-minute training activities (one closed and one open) that target the development of a specific tactic for your physical activity of study. Consider targeting the same principle of play – for example, creating space.

Analyse and synthesise

3. Appraise the value of open training environments and evaluate how this information may affect the development of learning tasks for your physical activity.

FIGURE 16.4 Training activities that simulate authentic match environments enable tactical development.

Evaluate and justify

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

4. Reflect on each training activity and use the evidence collected to evaluate its effectiveness for developing the specific tactic targeted.

5. Reflect on both training activities and determine which was more fun. Consider whether this would impact learning.

6. In 100 words, present and justify two important aspects that need to be considered when developing the training activities for tactical development that presented themselves in this activity.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 16.4

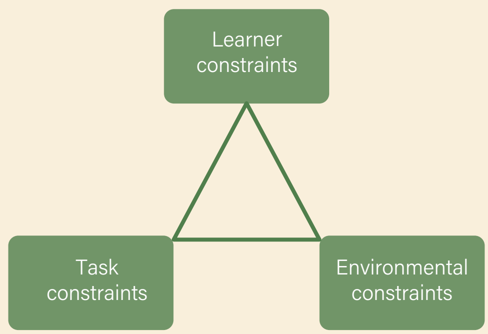
Inquiry question: What constraints exist within the constraints-led approach?

Recognise and explain

1. Read and review the information presented in Table 15.2 on p. 282 concerning constraints.

Analyse and synthesise

2. Draw the diagram below.



3. Using Table 15.2, add specific constraints for you and your current physical activity into the text bubbles at each apex.
4. From each apex bubble, draw three associated bubbles (like a mind map) and in each provide an example of how to manipulate a constraint from that apex. For example, a task constraint for touch might be the rule of six players on each team. A variation might be to play 4 on 4, but using the same playing space. What affordances would emerge from this example?

FIGURE 16.5 What new affordances may emerge when playing 4 on 4 touch football on a standard size field?

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 16.5

RECOGNISE & EXPLAIN | EVALUATE | JUSTIFY

Inquiry question: Can task constraints be manipulated to develop a desired affordance?

Recognise and explain

1. Read the following extract.

> "Manipulating task constraints is perhaps the most common way in which teachers and coaches have attempted to improve learners' performance from this theoretical viewpoint. Often, teachers introduce artificial rules in order to emphasise a specific aspect of performance (e.g. requiring teams to make 10 passes before scoring). However, from the point of view of nonlinear pedagogy, changes to game rules must be based on the key pillar of task representativeness in order to provide learners to attune to key affordances in order to develop appropriate information–movement couplings. A good example of a coach who uses this approach in rugby is Wayne Smith, the All Blacks coach. He manipulates task constraints in training games that require players to work out task solutions for themselves; 'You think of a way, e.g. if you want to work on your forwards picking the ball up and going through the middle of the defence, you create ways to spread the defence at training' (Kidman 2005, 196). In invasion games, task simplification by reducing the number of players in teams is a common strategy used by teachers in order to reduce the attentional demands on players. However, this approach has encountered some resistance from adults who want to see the children play the 'adult version' of games as soon as possible. The importance of playing small-sided games has recently been highlighted in the context of football by Fenoglio (2003). In a recent report on the use of 4 vs. 4 games at the Manchester United academy, Fenoglio (2003) showed that by playing 4 vs. 4 rather than 8 vs. 8 games, players made 135% more passes, had 260% more scoring attempts and scored 500% more goals. In addition, the number of 1 vs. 1 encounters between attackers and defenders increased by 225% while the number of dribbling tricks demonstrated by learners increased by 280%. The increased frequency of these important sub-phases of football during practice tasks clearly allows learners greater opportunities to practice basic skills and to gain more experience of tactical requirements in game contexts. The advantages of small-sided games for physical conditioning have also been demonstrated. A recent study by Impellizzeri et al. (2006) found that using small-sided games, compared to interval training for example, resulted in similar levels of improvement in aerobic fitness and match performance for junior soccer players."
>
> Source: Renshaw et al. (2010)

2. Under the headings of the three different categories of constraints, recall and identify the constraints mentioned in the article.

Evaluate and justify

3. Consider the information above and evaluate the advantages of small-sided games as a learning environment. Use the table on the next page to help guide the evaluation through a four-step process.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Evaluate = Appraise, judge, examine, determine

- *Step 1: Appraise.* Identify the criteria to be applied in this evaluation as shown in the left-hand column of the table.
- *Step 2: Judge.* Assign a rating for each criterion to judge the advantages of small-sided games. E.g. 5 = very good, 4 = good, 3 = okay, 2 = poor, 1 = very poor.
- *Step 3: Examine.* Consider each criterion and give a weighting if appropriate – meaning is one criterion more important than another? For example, variation in practice might be considered twice as important as task simplification. Variation in practice would receive a weighting of 2, while task simplification would receive a weighting of 1. Write this in the weighting column.
- *Step 4: Determine.* Multiply the rating by the weighting in order to find the score for each criterion. Individual criteria with larger scores would provide a good argument that small-sided games do provide learning advantages. Add the scores from each criterion to determine an overall score. Again, a high overall score would indicate, that in general, small-sided games offer advantages for learning. Reflect on the scores from both columns and, in the evaluation column in the table, describe the level of advantages small-sided games offer a learner – 'few advantages,' 'limited advantages,' 'some advantages' or 'many advantages.'

Criteria	Rating	Weighting	Score
A learner-centred approach			
The design of practice tasks representative of authentic environment			
Task simplification rather han deconstruction			
The manipulation of constraints to match the learner and promote emergent affordance to challenges through self-organisation			
The continual exploration by the learner in practice as repetition with variation			
The concept of no ideal movement pattern			
Overall score			
Evaluation			

4. From your current physical activity, identify an affordance that is commonly seen in the environment – for example, a teammate breaking from a defender to move to space.
5. Suggest two ways that constraints could be manipulated in a training activity that would allow this affordance to emerge more frequently.

ISBN 978-1-009-31125-0 Stewart et al.

The principles of decision-making in representative practice

A key skill to develop for an intelligent performer is effectively using the **principles of decision-making**. Enacting these principles during performance is essential for ecological concepts of attunement and perception–action coupling. These principles reflect the ongoing process of situational recognition, affordance recognition, strategy selection, motor program implementation and the skill adjustment required when linking circumstances and action.

> **principles of decision-making** a collection of cognitive processes resulting in a course of action influencing outcomes in physical activity

Developed by Dr Tim Hopper, the 4 R model presents the principles of decision-making in physical activity, and include:

- **Read** the play – assess what is happening and where to be positioned within the playing area.
- **Recognise** information and **respond** – identify the relevant environmental cues, associated affordances, and decide on a movement strategy and the associated motor program to enact it (the stable pattern for preferred movement that the performer may have already developed) – that is, perception–action coupling.
- **React** to implement movement – make modifications and fine adjustments to the motor program during the performance to refine the performance to best suit the situation, based on environmental elements such as ball speed and trajectory or player movement.
- **Recover** with appropriate movements to set up for the next read phase – includes on-the-ball movements, where the performer moves out of the movement sequence being performed, efficiently allowing for the transition to the next required movement, and off-the-ball movements, which include how to position themselves in relation to others.

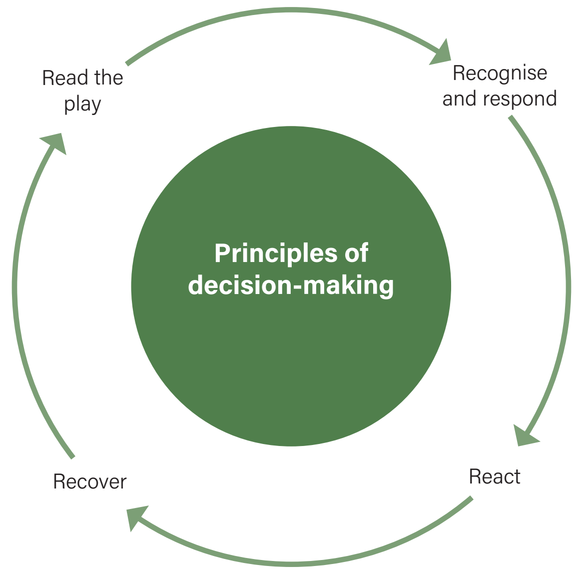


FIGURE 16.6 The 4 R model of decision-making

This model of decision-making supports a more dynamic, non-linear view of motor control and reflects the more contemporary ecological view of motor learning. As the skill of decision-making progresses, the learner becomes more attuned to themselves and their environment, they become more tactically aware, and this allows for more effective responses and successful performance outcomes.

Constraints-led learning activities inherently allow for this type of decision-making development if they are designed properly. The qualities of effective constraints-led learning activities have been highlighted earlier in this section. For the emergence of effective decision-making skills, attunement, affordance recognition and perception–action coupling, it is worth restating that the learning activity must:

- be learner-centred
- reflect the complexity of authentic game play (be representative)
- present a movement problem to be solved
- require attunement and affordance recognition
- allow the performer/learner to solve the movement problem, and not be 'given' the solution by the coach or teacher
- contain variation in practice and not repetitive predictable circumstances.

ISBN 978-1-009-31125-0 Stewart et al.

> Transfer of practice to the game environment depends on the extent to which practice or training resembles the game. If the athletes do not practice in game-like scenarios, they will not play the game well, yet, if practice is too game-like, it may be too difficult to integrate and perform the emphasized skills. The resolution of this implication is that practice needs to occur at a level that incorporates as much of the game as the players can successfully manage.
>
> Source: Rink et al. (1996, p. 502)

> Traditional training methods usually prepare athletes for certainty about their actions instead of preparing them for uncertainty. However, given that team sport is unpredictable by nature, uncertainty should be embraced by coaches in training and used to enhance the learning and performance of athletes. The best decision-makers in sport adapt their decisions and actions to a changing environment, and perform in unstable or uncertain situations. Coaches need to emphasise adaptability and variability in training, rather than the traditional approach that focuses mainly on repetition and stability of athlete decisions and actions.
>
> Source: Shuttleworth (2013, p. 25)

ACTIVE INVESTIGATION 16.1

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: How can analysis and implementation of strategies improve individual/team performance?

Recognise and explain

1. Read the following extract.

Traditional decision-making training

> One main issue with traditional methods to training decision-making is that they involve repeating decisions and actions in practice against static or predictable opponents, usually until they seem errorless, but with little emphasis on what problem they help solve.
>
> Another issue is the balance in coaching between providing 'stability' or structure (game plans, zones, etc., that act to constrain an athlete's decision-making), and 'instability' or variation (creativity needed for generating uncertainty in opponents) has moved more towards structure. This has led to higher levels of predictability in training and performance, reduced creativity in decision-making and, even more importantly, an inability to adapt to sudden changes.
>
> As a result, athletes are evolving from being good decision-makers who can read the game, adapt and play what they see into pre-programmed robots who are sequenced and patterned, performing specific roles with a rather limited skill set. In some cases, athletes are not able to make decisions based on basic principles of the game (that is, possession, progression, compression, delay, etc.) as they did in their backyards and during unstructured practice.
>
> Source: Shuttleworth (2013, p. 25)

ISBN 978-1-009-31125-0 Stewart et al.

2. From the extract on the previous page, locate the issues that Shuttleworth identifies with traditional decision-making training.
3. Identify two constraints from a specific specialised movement sequence for the physical activity that is your current focus.
4. Identify two constraints, both positive and negative, from your movement strategies in relation to the principles of play (setting up attack, defending against attack, creating, defending and exploiting space, attacking opposition space and scoring. Ensure that your selections cover separate principles of play.
5. Review the principles listed below in relation to constructing small-sided games that are learner-centred and use the non-linear constraints-led approach.

> **Key elements**
>
> ***Individual learner is essential***
>
> - Consider the abilities of every individual taking part in the session.
> - Students' ability will be across Newell's stages of learning: coordination, control or skill.
>
> ***Constraints shape emergent affordances***
>
> - Individual, environmental and task constraints shape performance.
>
> ***Perceptions and actions must be linked***
>
> - Movements must be developed with key perceptual information being present – for example, batting in cricket, bowler's hand action.
> - Techniques and tactics must be developed together and should occur early in learning.
>
> ***Representative practice design***
>
> - Practices must reflect the authentic game environment – defence, net, etc.
> - Practice needs to occur at a level that incorporates as much of the game as the players can successfully manage.
>
> ***Variability***
>
> - Creating variability in the learning environment develops skilful and adaptable performers.
> - Variability can create instability to improve performance.
>
> ***Self-organisation***
>
> - The individual should be given repetitive variable practice to solve the problems.
>
> ***Co-adaptability***
>
> - Players need to learn to react to the movement of teammates.
> - The actions of individuals and opponents are linked.
>
> ***Rate limiters determine decision-making ability***
>
> - The key to designing effective practice environments is to identify the key factors that are limiting performance at this moment in time.
>
> ***Team patterns develop via a process of self-organisation***
>
> - Teams (and individuals) develop strategies that become stable.
>
> ***Actions are decisions***
>
> - Give individuals choices – let them make decisions.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Instructions should not be limiting

- Specific instructions can limit the emergence of the best solutions.

Feedback

- Feedback should focus on developing awareness.
- May be in several formats – internal, external, knowledge of results, knowledge of performance.
- May be verbal – information or question or visual. ”

Source: Shuttleworth (2013, p. 26)

Demonstrate and apply

6. Design two small-sided games for your identified movement sequences for games of 1 vs. 1, 2 vs. 2, 3 vs. 3 and/or 5 vs. 5.

7. Design two small-sided games for your identified movement strategies for games of 1 vs. 1, 2 vs. 2, 3 vs. 3 and/or 5 vs. 5.

8. Copy and complete the table to critique whether designed games meet the key elements for improvement in your performance.

Key element	Evident	Not evident	Explanation of why and how
Individual learner's needs are essential			
Constraints shape emergent affordances			
Perceptions and actions are linked			
Representative practice design			
Variability			
Self-organisation			
Co-adaptability			
Rate limiters determine decision-making ability			
Team patterns develop via a process of self-organisation			
Actions are decisions			
Instructions are not limiting			
Feedback			

9. In small groups, implement and demonstrate specialised movement sequences and movement strategy games.

10. Capture digital data of your performance in the small-sided games and authentic performance environments. Remember to store primary data in at least two locations.

Analyse and synthesise

11. Analyse data in relation to performance, and identify opportunities and successful outcomes of affordances.

ISBN 978-1-009-31125-0 Stewart et al.

Evaluate and justify

12. Judge whether the learning scenario was representative of an authentic environment for your physical activity of study.

13. Appraise whether the introduction of the constraint enabled you to self-organise in solving the problem.

Reflect: think about deeply and carefully

14. Reflect and explain any changes that occurred to your performance in relation to principles of play through the application of constraints.

15. Justify the level of success your constraint-based game had in developing the desired affordances and improving your performance.

Designing activities to develop tactical awareness and intelligent performers

Specific physical activities require different contribution levels from both technical proficiency and tactical awareness. For example, in a performance activity, such as javelin, a 'skilled' thrower develops high technical proficiency but, due to the nature of the activity, requires limited tactical awareness. However, the touch player must develop both technical proficiency and tactical awareness. In addition, due to the nature of this type of activity, technical proficiency is less concerned with developing a 'perfect technique' and more focused on a motor program that can be adapted and manipulated to the specific circumstance at the time. This explains why tactical awareness is so important to invasion activities, such as touch, or net and court games, where cognitive learning models don't hold up and dynamic learning models more effectively account for the learning process. It also demonstrates that modern dynamic learning approaches can be just as effective in performance-type sports like javelin, shot-put or archery. There is just less tactical awareness required.

To assist in developing constraints-led learning activities, a physical activity could be placed on two bands that explore these features:

- **Does my sport require high or low technical proficiency?**
  - Does it need a refined technique that can be repeated for accuracy, and that biomechanically suits my body composition to maximise power and speed; or
  - does it need an adaptable technique that can be adjusted in response to affordances to achieve successful outcomes?

  Specialised motor sequences for any sport could be placed on a continuum from highly technical to highly adaptable.
- **Does my sport require high or low tactical awareness?**
  - Is it performed in a dynamic performance environment with a huge number of variables to consider with many constraints and therefore affordances for success; or
  - is it performed in a closed and predictable environment with limited constraints and therefore limited decisions to make?

  Sports could be placed on a continuum based on the affordances available – consider Australian Rules Football at one end, with shot-put towards the other.

Understanding the different contributions of these two elements of skill helps us to target training for skill acquisition and maximise motor skill development – a shot-putter might use more of a traditional approach when completing a biomechanical analysis, looking for small refinements to seek improvement, while the touch player is coached using a more dynamic systems, constraints-led approach that enables both technical and tactical

ISBN 978-1-009-31125-0 Stewart et al.

elements to improve simultaneously. The aim of training is to enable the individual to develop the self-organising skills to produce a successful movement response considering the affordances available within the constraints of the environment, task and performer themselves.

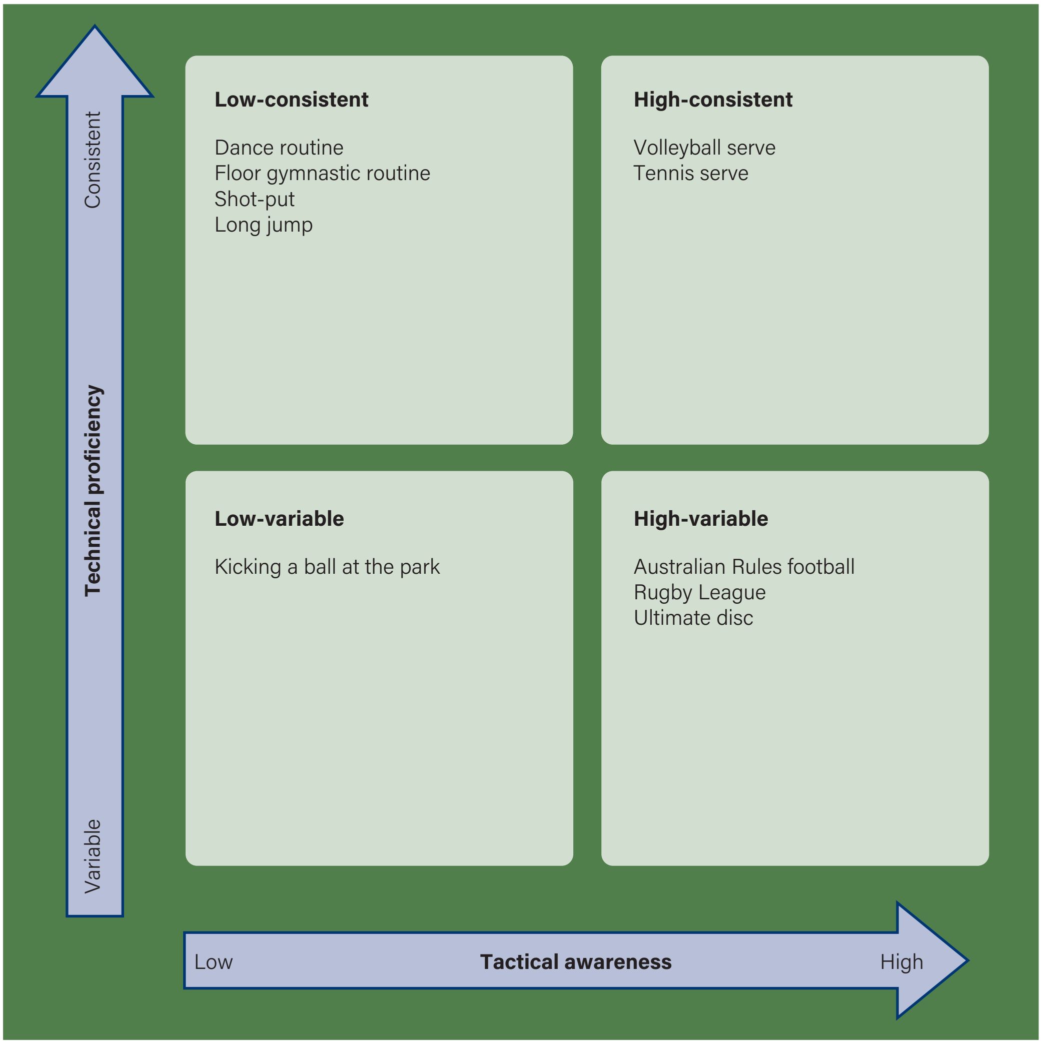
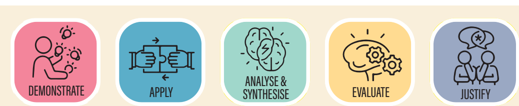


FIGURE 16.7 Due to the nature of the physical activity, different movement sequences and strategies may require different levels of technical proficiency and tactical awareness to implement them successfully. This may be reflected in the learning and training activities developed.

How can a constraints-led approach assist performance?

ACTIVE INVESTIGATION 16.2



Inquiry question: How can we manipulate constraints in the learning environment to develop adaptable technical abilities with decision-making for authentic environments?

Option A – Invasion games

Demonstrate and apply

1. Capture digital evidence in the performance domain while completing a 5 vs. 5 End Ball Netball Passing Game: 20 m length × 10 m width.

ISBN 978-1-009-31125-0 Stewart et al.

Game 1: Rules –

- The ball must be passed on the full.
- If the ball is knocked down by an opponent, you maintain possession.
- If your team drops the ball, the opponents receive possession.
- When you catch the ball, you must stand still but may pivot on the spot.
- A player has only one second in possession of the ball.

Game 2: Add constraint that teams are now 6 vs. 4 and when the player gains possession of the ball, they have 10 seconds with the ball and may move 1 m.

Game 3: Repeat Game 1, 5 vs. 5; however, increase the width of the field to 20 m (20 m length × 20 m width).

Game 4: Change Game 3 by adding the rule that a player may run 5 m with the ball.

Analyse and synthesise

2. Post-game:
   a. Ascertain what type of constraint was manipulated in Games 1–4.
   b. Compare and contrast the affordances that emerged in each game – that is, what opportunities remained constant throughout and which emerged in Games 2–4. Identify if movement sequences or strategies changed as a result of the changing affordances, and whether this affected the performance outcomes for the better or worse.
   c. Review what effect the various constraints had on completing the goal of passing the ball and scoring.

Evaluate and justify

3. Evaluate whether each game was representative of invasion games. Why?

KEY COGNITION

Critique: review (e.g. a theory, practice, performance) in a detailed, analytical and critical way

4. In 300 words, critique whether the game would develop the technical ability of passing in an invasion game and determine why. (Use primary and secondary data.)
5. In groups of four, review individual critiques and provide feedback on the effectiveness of the primary and secondary data used.
6. In your group of four, suggest the maintenance and modifications required to make these games more effective as a learning activity to develop intelligent performers.

Option B – Net and court games

Demonstrate and apply

1. Capture digital evidence in the performance domain while completing a 1 vs. 1 game of badminton.

Game 1: Rules –

- Play in half of the court
- 1 vs. 1
- A point is only scored if the shuttle lands *between* the short service line and long service line for doubles.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Game 2: Change rules – a point is only scored if the shuttle lands *between* the short service line and the net or the long service line for doubles and the back, boundary line.

Game 3: Repeat Game 1; however, increase the width of the field to full singles game.

Game 4: Repeat Game 2; however, increase the width of the field to full singles game.

Analyse and synthesise

2. Post-game:
   a. Ascertain what type of constraint was manipulated in Games 1–4.
   b. Compare and contrast what performances emerged from the original game and Games 2–4.
   c. Review what effect the various constraints had on completing the goal of underarm and overarm clears and drop shots.

Evaluate and justify

3. Evaluate whether games completed were representative of net and court games. Why?

KEY COGNITION

Critique: review (e.g. a theory, practice, performance) in a detailed, analytical and critical way

4. Use both primary and secondary data in a 300-word critique of the task's capacity to develop adaptable technical ability of underarm and overarm clears and drop shots.
5. In groups of four, review individual critiques and appraise effective use of primary and secondary data.
6. In your group of four, suggest the maintenance and modifications required to make these games more effective as a learning activity to develop intelligent performers.

ENGAGE 16.6

RECOGNISE & EXPLAIN

ANALYSE & SYNTHESISE

Inquiry question: How can we develop adaptable technical abilities for authentic environments?

Recognise and explain

1. Read the following extract.

Technique change

“Would you suggest to Tiger Woods that he change his golf swing to improve his game? At what stage should you begin to teach young swimmers a new stroke? Practitioners must continually address questions such as these regardless of the performer's current ability. In these kinds of situations, practitioners tend to rely on a preconceived image of an idealized technique to determine whether a change is required. Research has shown, however, that even in highly stable skills such as rifle shooting

ISBN 978-1-009-31125-0 Stewart et al.

or golf putting, common optimal coordination patterns do not exist (Brisson & Alain, 1996; Ball, Best & Wrigley, 2003; Fairweather, Button, & Rae, 2002). This is because each time a skill is performed, it must be adapted to subtle differences in initial conditions (e.g. changes in body sway, physiological status, or psychological factors) and in the environment (e.g. a slight breeze, different temperatures, different surfaces). Given the multitude of constraints that can alter the behavioral manifestation of a movement skill, even elite performers need to display a significant amount of functional movement variability (Button, Macleod, Sanders & Coleman, 2003; Davids, Glazier, Araújo & Bartlett, 2003). This idea has strong implications for a learner model and suggests that the emphasis during learning should be on encouraging change and adaptation rather than achieving some hypothetical, idealized state. ”

Source: Davids et al. (2008, p. 98)

2. Examine the information in the extract and explain an isolated idealised technique (specialised movement sequence) for your current physical activity.

Analyse and synthesise

KEY COGNITION

Consider: think deliberately or carefully about something, typically before making a decision; take something into account when making a judgement; view attentively or scrutinise; reflect on

3. Consider the information gathered and distinguish what parts of your personalised technique may need to be different from the idealised technique due to personal constraints – refer to those constraints identified in Table 15.2 for assistance.
4. Spend some time in the performance environment and collect some footage of your performance of the selected technique. Review your footage in comparison to the ‘idealised’ technique that you explored earlier.

CHECK-IN 16.1

Copy and complete the table below in relation to important implications for implementing a constraints-led approach.

Implication	Explanation in own words	Example
A learner-centred approach		
The design of practice tasks representative of authentic environment		
Task simplification rather than deconstruction		
The manipulation of constraints to match the learner and promote emergent affordances to challenges through self-organisation		
The continual exploration by the learner in practice as repetition with variation		
The concept of no ideal movement pattern		

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 16.8 Gold Coast Suns players engaging in representative practice while training for the AFLW.

ENGAGE 16.7

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: Is it possible to develop technical learning in open environments?

Option A – Invasion games

Demonstrate and apply

1. Participate in a small-sided game – 3 vs. 3 of End Ball

   Aim: To score by passing the ball to own team member over the line.

   Equipment: 1 ball, 4 markers

   Space: 30 m × 15 m grid

   Rules for Australian Rules football, basketball, netball and touch – initial rules are:

   - The ball must be passed on the full.
   - If the ball is knocked down by an opponent, you maintain possession.
   - If your team drops the ball, the opponents receive possession.
   - When you catch the ball, you must stand still but may pivot on the spot.
   - Defenders cannot contact the player in possession and must be 1 m away.

   Rules for futsal and soccer – initial rules are:

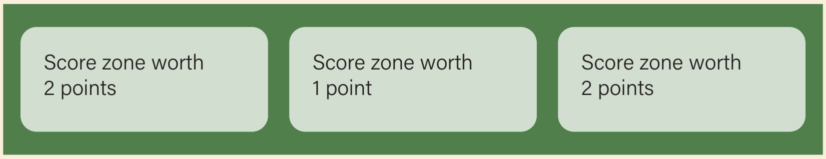
   - The ball must be kicked.
   - When in possession, players cannot dribble the ball; they trap the ball and stand still, but may pivot around the ball to pass.
   - A defender must be a minimum of 1 m away.
   - If a team member does not stop the ball, possession is lost.

2. Teacher explains three key points of passing.

   Game 1: Play for 15 minutes.

ISBN 978-1-009-31125-0 Stewart et al.

Game 2: Change of team numbers to End Ball 5 vs. 5. Change the scoring system so points scored in the corner are worth more. Play the game for 15 minutes.



Game 3: End Ball 5 vs. 5 – for Australian Rules football, basketball, netball and touch football.

Change of scoring system: different points system, dependent on type of pass used – for example, Australian Rules football: using a kick to pass instead of a handball is worth three points; pass over 10 m worth three points, for futsal and soccer – change of rules: when in possession, players cannot dribble the ball but are only allowed two touches (two contacts with the ball).

Play game for 15 minutes.

Analyse and synthesise

KEY COGNITION

Make decisions: select from available options; weigh up positives and negatives of each option and consider all the alternatives to arrive at a position

3. Complete a post-game reflection on the following.
   a. Identify what was needed to complete the task successfully.
   b. Review critically how well you, your partner and your team manipulated the rules for an affordance/advantage.
   c. Make a decision about how effective was your and your team's demonstration of intelligent performance in this activity.

   Note: Remember, intelligent performance = manipulation of rules, time, score, principles of play, affordances (technical and tactical, individual and team) and limitations (technical and tactical, individual and team).

Option B – Net and court games

Demonstrate and apply

1. **Game 1**: Participate in a small-sided game – 5 vs. 5 Newcombe Ball

   Aim: To have the ball hit the floor inside the court on the opposite side of the net

   Equipment: 1 ball

   Space: 1 volleyball court or similar

   Rules:

   - Each point begins with the ball being thrown from behind the baseline.
   - Team catches the ball.
   - Team is allowed to have three catches on their side of the net.
   - Players cannot move with the ball.

   Teacher explains three key points of passing.

   Play the game for 15 minutes.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

2. **Game 2**: Participate in a small-sided game – One-bounce Volleyball

To have the ball hit the floor inside the court on the opposite side of the net

Equipment: 1 ball

Space: 1 volleyball court or similar

Rules:

- Each point begins with the ball being thrown from behind the baseline.
- The ball cannot be caught, and must be hit – dig, set or spike.
- The ball is allowed to bounce once between each shot.
- Team is allowed to have three shots on its side of the net.

Teacher explains three key points of passing.

Play the game for 15 minutes.

Analyse and synthesise

KEY COGNITION **Make decisions**: select from available options; weigh up positives and negatives of each option and consider all the alternatives to arrive at a position

3. Complete a post-game reflection on the following.
   a. Identify what was needed to complete the task successfully.
   b. Review critically how well you, your partner and your team manipulated the rules for an affordance/advantage.
   c. Make a decision about how effectively you and your team demonstrated intelligent performance during this activity.

Note: Remember, intelligent performance = manipulation of rules, time, score, principles of play, affordances (technical and tactical, individual and team) and limitations (technical and tactical, individual and team).

ENGAGE 16.8

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE

Inquiry question: Can a simple manipulation of constraints develop affordances within a sport to encourage specific technical and tactical development?

Option A – Invasion games

Demonstrate and apply

Participate in a game of Two Goal/Bucket Ball – 5 vs. 5.

1. **Game 1**: The aim is to score by passing the ball to catch the ball in a rubbish bin or to score inside a small goal area.

ISBN 978-1-009-31125-0 Stewart et al.

Rules for Australian Rules football, basketball, netball and touch football – initial rules:

- The ball must be passed on the full.
- If the ball is knocked down by an opponent, you maintain possession.
- If your team drops the ball, the opponents receive possession.
- Defenders cannot contact the player in possession and must be 1 m away.

Rules for futsal and soccer – initial rules:

- The ball must be kicked.
- When in possession, players cannot dribble the ball; they can trap the ball and stand still, but may pivot around the ball to pass.
- A defender must be a minimum of 1 m away.
- If a team member does not stop the ball, possession is lost.

2. **Game 2**: One goal is worth two points and is a small area; another goal is worth one point and is a larger area.
3. **Game 3**: Increase the size of the two-point scoring zone.

Analyse and synthesise

4. Critique what effect the rule constraint had on the game – what affordances were developed?
5. Change teams so that the numbers are now 6 vs. 4 or 7 vs. 3. For the team with lower numbers, increase goal sizes.
6. Critique the impact on both teams from the change in numbers.

Evaluate

KEY COGNITION

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

7. Evaluate whether the manipulation of constraints led to emergent affordances in the invasion games, and if any affordances that emerged brought about changes in performance that would be utilised in game play.

Option B – Net and court games

Demonstrate and apply

Participate in a game of volleyball – 5 vs. 5.

1. **Game 1**: Participate in a small-sided game – 5 vs. 5 Newcombe Ball

   Rules:

   - The ball is thrown from behind the base line to commence each point.
   - Team catches the ball.
   - Team is allowed to have three touches on its side of the net; the first two can be catches; the last shot must be a hit.
   - Players cannot move with the ball.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

2. **Game 2**: Participate in a small-sided game – One-Bounce Volleyball

   Rules:
   - The ball is thrown from behind the service line to commence each point.
   - The ball is allowed to bounce once between each shot.
   - Team is allowed to have three shots on its side of the net. The last shot must be a hit over the net.
3. **Game 3**: As for Game 2; however, any time a point is won from a spike, it scores four points.

Analyse and synthesise

4. Critique what effect the rule constraint had on the game – that is, what affordances were developed.
5. Change teams so that the numbers are now 6 vs. 4. For the team with lower numbers, a winning point from a spike is now worth six points.
6. Critique the impact on both teams of the change in numbers.

Evaluate

KEY COGNITION

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

7. Evaluate whether the manipulation of constraints led to emergent affordances in the invasion games, and if any affordances that emerged brought about changes in performance that would be utilised in game play.

FIGURE 16.9 Volleyball players participating in a 5 vs. 5 small-sided game during training may be encouraged to develop their ability to set up attack and use a spike to score if four points are given any time a point is won using a spike. This is a manipulation of a task constraint.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 16.3

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: Can we manipulate task constraints to develop a desired affordance?

Demonstrate and apply

1. In groups of seven, collaborate on the design of a 2 vs. 2 or 3 vs. 3 learning scenario within the game. The aim of the game should be to attune learners to themselves, their task or the environment by applying a constraint to promote an affordance in the game – for example, increase width of field to promote lateral movement.
2. Implement the game and capture digital data.

Analyse and synthesise

3. Analyse data in relation to performance and identify opportunities and successful outcomes of the targeted affordance.

Evaluate and justify

KEY COGNITION

Judge: form an opinion or conclusion about; apply both procedural and deliberative operations to make a determination

4. As a group of seven:
   a. Appraise whether the introduction of the constraint enabled the learner to self-organise when solving the problem – that is, did they work out a successful action for the situation for themselves?
   b. Judge whether the learning scenario was representative of the authentic environment.
   c. Determine whether the implementation of the constraint developed the desired affordance.
5. In your group, present one modification to your activity that might make it more effective for the learners' affordance recognition and self-organisational skill.

16.2 Evaluating performance

In Topic 1 of Unit 3, you engage with concepts, principles and strategies about dynamic systems of motor learning and tactical awareness. This will allow for the development of purposeful and effective learning activities that utilise a modern constraints-led approach to optimise performance outcomes. It will allow for the development of intelligent performers who can self-organise motor programs to produce successful responses across complex environments. A key element of this learning is being able to evaluate and justify the effectiveness of learning activities and of performance.

To make evaluations on the effectiveness of strategies and performance in Physical Education, a variety of subject-matter elements must be applied. These include:

- the body and movement concepts
- specialised movement sequences
- movement strategies and the principles of play.

These have been comprehensively explained in Chapter 4 should additional information be required. However, in Table 16.1 on the following page is a summary of these concepts and why they are important to evaluating the effectiveness of strategies and performance in this unit.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 16.1 The body and movement concepts can be used as criteria to judge movement. Each different aspect can be applied to a movement, and this provides a method to track changes or improvement over time, or they can be applied to compare different performances of similar movements.

<table>
<tr><th colspan="2">Body and movement concepts</th></tr>
<tr><td colspan="2">Body and movement concepts are a framework for enhancing movement performance. They incorporate four different aspects and can be used in a number of ways. One way they can be used is as criteria to judge movements.</td></tr>
<tr><td>Quality of movement refers to how the body moves. The elements associated with quality of movement usually take a biomechanical view to help assess the movement.</td><td>Quality of movement elements include:
• accuracy
• continuity and outcome of movement
• effect
• efficiency
• effort
• flow
• force development
• sequence
• time or speed.</td></tr>
<tr><td>Body awareness can be described as what the body can do, or how the body is moving.</td><td>Body awareness elements include:
• balance
• flight
• stability
• transfer of weight
• weight bearing.</td></tr>
<tr><td>Space awareness describes where the body can move.
General space is the playing or performance area.
Personal space is the direct area surrounding a participant.</td><td>Space awareness also includes:
• the direction of movement within the space; such as up or down, forward or backward, or left or right
• the height of the body in relation to the playing surface or equipment, such as ‘low’, ‘medium’ or ‘high’
• the pathways or lines of movement used through the space – for example, straight, curved or zig-zag
• the plane through which the movement occurs – for example, circular, vertical or horizontal.</td></tr>
<tr><td>Relationships are about the performer’s interaction and connection with opponents, other players and/or implements and objects.</td><td>• Relationships can be described as close or distant, above or below, or in front of or behind the performer.
• Participants may be engaged in a task, working together or apart, working in unison or as opposites. A participant may be a leader or follower in the activity.</td></tr>
</table>

As criteria, the body and movement concepts are applied to specialised movement sequences and movement strategies in Physical Education. For example, an Australian Rules drop punt (specialised movement sequence) could be assessed based on its accuracy (quality of movement); or running between defenders to create space for a support player (movement strategy) could be assessed for the distance between the ball carrier and defenders when the ball is passed (relationships).

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 16.2 Specialised movement sequences and movement strategies are what is judged for improvement or effectiveness by applying the body and movement concepts.

Specialised movement sequences are a combination of fundamental movement skills and movement elements particular to a playing position or event to enable a body and/or objects to move in response to a stimulus; a planned order of movements.	• These are the 'techniques' applied in physical activities. • They are enacted through motor programs. • The goal of skill acquisition is to develop a preferred stable motor program that can be effectively implemented and adjusted to each unique situation.
Principles of play are fundamental movement strategies used by individuals or teams to effectively adapt to any tactical situation in authentic performance environments.	The principles of play for invasion games and net and court games include: • setting up attack • defending against attack • creating, defending and exploiting space • attacking opposition space and scoring.
Movement strategies are the variety of approaches that assist a player or team to successfully achieve a movement outcome or goal.	• These more specifically describe how the principles of play are achieved for a specific activity or position. • These strategies can also be evaluated by using aspects of the body and movement concepts.

It is worth remembering, that the effectiveness of learning can also be evaluated by using criteria, including:

- **improvement** – the degree of progress observed in a movement
- **consistency** – the degree to which the performance does not vary
- **stability** – the state of being stable and resistant to change
- **persistence** – lasting for a long time, the act of being persistent
- **adaptability** – ability or willingness to change.

By collecting primary data through a variety of methods, such as videos and GPAIs (see digital Chapter 23), the body and movement concepts can be applied to specialised movement sequences, movement strategies and performance to evaluate their effectiveness. The process of analysis of primary data, and the synthesising of secondary data, then provide the justifications required to support these evaluations. Typically, evaluation of performance is required twice for assessment, once initially to assess your level of performance, then again following a period of strategy implementation to assess if any improvement has been demonstrated as an outcome of the strategy.

ENGAGE 16.9

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How can we evaluate a performance of physical activity?

Demonstrate and apply

1. Gather video evidence of your performance in a 20-minute match of your current physical activity.
2. At the conclusion, draft a table using the principles of play.
3. Under each heading, provide at least three examples of ways of demonstrating the specific principle of play for your selected activity – that is, what are three 'tactics' used to achieve each principle?

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

4. Review the game footage and identify one movement strategy that was utilised during the match. Note the movement strategy, the purpose or goal of the strategy and the principle of play the strategy belongs to.
5. Review the game footage and identify one specialised movement sequence that is demonstrated throughout your play.

Evaluate and justify

6. Using the body and movement concepts, evaluate the effectiveness of the selected movement strategy for achieving its purpose by looking at the outcomes and limitations observed.
7. Using the body and movement concepts, evaluate the effectiveness of the specialised movement sequence selected by looking at the outcomes and limitations observed.
8. Justify one modification that could be made to either the movement strategy or the specialised movement sequence that would enhance future performances.

ENGAGE 16.10

RECOGNISE & EXPLAIN

ANALYSE & SYNTHESISE

Inquiry question: How can we evaluate performances?

Recognise and explain

1. Read the information relating to a game performance assessment instrument (GPAI).

Game Performance Assessment Instrument

" Ability to make strategic and operational decisions is essential to effective game play. The flaw of anthropometric and physiological testing of team sport athletes has been the absence of better predictors of performance such as technical and tactical abilities (Hoare and Warr, 2000; Regnier, Selmela, and Russel, 1983). Mednis (2001), Fry (1997) and Wisemantel (1997) suggested that fitness and skill testing is of limited value in assessing a player's potential to play particular sports. Attempts therefore to identify talent need to be multi-faceted with respect to all performance contributors.

The GPAI is a multi-dimensional system designed to measure athlete's tactical understanding and skill level within game environments (Oslin et al., 1998). The GPAI provides researchers with a means of observing and coding performance behaviours. For any game wishing to be analysed, important tactics and skills need to be selected from seven prescribed game components (Base, Adjust, Decisions Made, Skill Acquisition, Support, Cover, Guard/Mark). These will be observed throughout the game. These components are given further detail to make them specific to the sport being analysed. A pro forma for End Ball is shown in the table on the following page. Every time a player makes an appropriate or inappropriate decision it is tallied within the table. Players are individually assessed according to the criteria. On completion of the Game the following results can be derived.

ISBN 978-1-009-31125-0 Stewart et al.

Game performance will be the measure used for this test.

Game involvement = total appropriate responses + number of efficient skill executions + number of inefficient skill executions + number of inappropriate decisions made.

Decisions made index (DMI) = (number of appropriate decisions made) ÷ (number of inappropriate decisions made).

Skill execution index (SEI) = (number of efficient skill executions) ÷ (number of inefficient skill executions).

Support index (SI) = (number of appropriate supporting movements) ÷ (number of inappropriate supporting movements).

Overall performance = (DMI + SEI + SI) ÷ 3 ”

Source: Oslin and Mitchell (1998, p. 27)

Sample data sheet for game performance assessment – invasion game: End Ball

Category – criteria for appropriate/efficient rating:

- Game involvement – for example, number of touches made
- Decisions made: attack – for example, passing; defence – for example, rush
- Technical – for example, catch
- Support – for example, runs to space.

Game involvement		Decisions made index		Skill execution index		Support index	
		A	IA	E	IE	A	IA
Touches made	||	Attack-pass 卌 |	|||	Catch |||	||	Runs to space ||||	|||
		Defence					
Totals							

Key: A = appropriate, IA = inappropriate, E = efficient, IE = inefficient

2. Compete in a game of End Ball. Capture digital evidence.
3. In pairs, draft up a GPAI for End Ball.
4. View video evidence and, with your partner, capture primary data in the table.

Analyse and synthesise

5. In pairs, reflect on the GPAI table you designed. What technical and tactical aspects would you add in that would make it more comprehensive?
6. Analyse the data and examine what the individual and overall performance figures suggest regarding your performance.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

7. Construct a GPAI based on your selected physical activity using the following headings:
   - Awareness – for example, movement execution, pass or shot selection
   - Space – for example, movement pathways, use of space, when to run into space or when to pass
   - Quality of movement – for example, force development, efficiency and outcome
   - Relationships – for example, interaction with opponents and team members.

ACTIVE INVESTIGATION 16.4

Inquiry question: How do we asses levels of performance in authentic environments?

Demonstrate and apply

Undertake this Active investigation over a series of lessons where you alternate between collecting video evidence (primary data) through performance and analysing the footage as described below.

1. Using the digital captured data, assign your movement sequences to the GPAI as either A = appropriate, IA = inappropriate, E = efficient, IE = inefficient for each of the categories.
   - Awareness – for example, movement execution, pass or shot selection
   - Space – for example, movement pathways, use of space, when to run into space or when to pass
   - Quality of movement – for example, force development, efficiency and outcome
   - Relationships – for example, interaction with opponent and team members
2. Finalise a game performance score:

   Game performance = (Awareness + Space + Quality of Movement + Relationships) ÷ 4.

Analyse and synthesise

3. Analyse the primary data collected and identify strengths and weaknesses in your performance.

Evaluate and justify

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

4. Where poor performance is identified, justify the cause – that is, you
   a. didn't recognise the affordances available
   b. recognised an affordance but selected the wrong skill or tactic for the situation; or recognised the affordance and selected the appropriate response, but an issue in application caused an error – technique issue
   c. recognised the affordance and selected the appropriate response, but an issue in application caused an error – tactical implementation issue.

ISBN 978-1-009-31125-0 Stewart et al.

5. Justify which stage of learning (Newell's) you demonstrated in decision-making and tactical awareness by synthesising data from your GPAI in relation to the following movement strategies:
   a. reading play
   b. recognising information and responding
   c. reacting to implement movement
   d. recovering with appropriate movements – for example, on-the-ball and off-the-ball recovery movements.
6. Make decisions about which movement strategies would be most suitable to focus on in order to optimise your performance.
7. Select one of the movement strategies identified and recommend how constraints in a small-sided game could be manipulated for emergent affordances to occur in your performance.

16.3 Devising constraints-led learning activities

Devising and evaluating a constraints-led learning activity to optimise performance of one movement strategy is the assessment task required for Internal Assessment 1. A comprehensive deconstruction of how to address this assessment piece, along with a response strategy, can be found in digital Chapter 23. However, the process to devise an effective constraints-led learning activity is outlined below.

1. Evaluate current performance levels.
   a. Undertake game analysis – what are the movement requirements for the physical activity? What are the typical movement strategies and associated sequences required?
   b. Collect primary data through video collection, GPAIs and other data collection methods of your performance in authentic game-play situations.
   c. Gather secondary data about the movement strategies and movement sequences and what makes them effective.
   d. Analyse the data collected to identify strengths and weaknesses about performance in relation to tactical awareness. Consider investigating elements including decision-making, affordance recognition and attunement, perception–action coupling; as well as applying the body and movement concepts to the movement sequences and movement strategies.
   e. Make an evaluation about key aspects of performance, appraising the outcomes and limitations found in the analysis.
   f. Identify one movement strategy that will become the focus of the constraints-led learning activity to be developed.
2. Devise the constraints-led learning activity.
   a. Clearly articulate the purpose of the learning-activity.
      i. What movement strategy is to be improved?
      ii. What associated movement sequence/s will also be incorporated?
      iii. What affordance(s) need to be present in the learning environment to encourage the emergence of the selected movement strategy?
      iv. What aspects of the principles of decision-making need to be enhanced?
   b. Review the key components of constraints-led learning activities (see section 16.1).
   c. Undertake secondary research to find learning activities that may have been used to develop similar movement strategies in the same or similar physical activities.
   d. Synthesise the primary data about the needs of yourself or team, as well as secondary data on the requirements for constraints-led learning and the activities researched, to devise and clearly articulate a learning activity.

ISBN 978-1-009-31125-0 Stewart et al.

e. Justify the activities developed using the information gathered to date.

3. Implement the constraints-led activity.
   a. Undertake a period of 'training', using the constraints-led learning activity.
   b. Collect primary data during the implementation phase about the constraints-led activity (see digital Chapter 23).
   c. Following the 'training' period, undertake further primary data collection to provide post-learning activity information on the new level of performance in the performance environment. Use the same data collection methods from step 1 to allow for comparisons between pre- and post-activity performance.
4. Evaluate the constraints-led activity.
   a. Analyse the data gathered during the implementation of the constraints-led activity and the post-strategy performance in game-play situations.
   b. Make an evaluation on the effectiveness of the constraints-led activity by appraising the outcomes and limitations in relation to the activity's purpose as outlined in step 2. Ensure that you evaluate the activity's effectiveness in presenting the affordances required to allow the emergence of the **tactical strategy** targeted.
   c. Based on the evaluation, justify the modification and maintenance required for the personal tactical strategy if it is to optimise performance of the selected movement strategy.

tactical strategy the variety of approaches that assist a player or team to successfully optimise performance through the application of specialised movement sequences, movement strategies from principles of play, and body and movement concepts

ACTIVE INVESTIGATION 16.5

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: At what levels are our performances in authentic environments?

Option A – Invasion games

Demonstrate and apply

1. Digitally capture performance in the following situations. Demonstrate specialised movement sequences through game play of 1 vs. 1, 2 vs. 2, 2 vs. 1, 3 vs. 2, 3 vs. 3, 5 vs. 5 and full game options.
2. Identify and experiment with the following.
   a. *Attack/offensive options:* gaining possession, creating a + 1 situation = switch, wrap, dump, give and go, in and away, in and out ball, block, screen, pattern recognition of defence
   b. *Defence options:* person on person, zone, press, pattern recognition of attack
   c. *On-the-ball and off-the-ball movements:* awareness – for example, movement execution, pass or shot selection
   d. *Space:* for example, movement pathways, use of space, when to run into space or when to pass
   e. *Quality of movement:* for example, force development, efficiency and outcome
   f. *Relationships:* for example, interaction with opponent and team members, verbal and non-verbal communication

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

3. Review the video captured in relation to the technical and tactical elements identified below. Evaluate your current ability level for each by scoring yourself from 1 to 8 and collate how often each element was used and where you had success with each.

   Technical aspects within all positions of your physical activity of study

   - *Australian Rules football* – leading, marking, bouncing, handballing, kicking, tackling, ball handling, tapping the ball, punching the ball, forward and backward movement based on ball movement
   - *Basketball* – dribbling, passing, running fast breaks after receiving an outlet pass, driving into the key to pass or shoot, outside shooting, free throws, stopping or steering opposition ball-handlers into a trap situation, rebounding, inside shooting, blocking shots, setting screens, boxing out, rebounding, transitioning between offence and defence, tip-offs
   - *Futsal* – passing, shooting, jockeying, tackling, receiving, protecting the ball from defender, throwing, forward and backward movement based on ball movement
   - *Netball* – one-on-one defence, defending shots for goal to limit scoring, rebounding, gaining possession, catching and passing, leading and driving into space, defending and attacking, catching, passing, baulks and fakes, step-in shot, step-back shot, lay-up
   - *Soccer* – forward and backward movement based on ball movement, defensive and offensive play, passing, delaying and blocking shots, jockeying, tackling, throw-ins, dribbling, heading. Trapping strikers – forward and backward movement based on ball movement, defensive and offensive play, passing, shooting, throw-ins, dribbling, heading, tackling, trapping. *Goalkeepers* – positioning in relation to goal and attackers, catching, diving, throwing, shot stopping, ball control, trapping, passing, tackling, goal kicks, punt/drop kicks
   - *Touch football* – forward and backward movement, sidestep and swerve, switching and wrapping, dump-and-split, slow then fast movement, dummy passing, defensive and offensive play, passing, effecting a touch, roll ball, scoop, tap, scoring, positioning on the edges

Option B – Net and court games

Demonstrate and apply

1. Digitally capture performance in the situations listed below. Demonstrate specialised movement sequences through game play of 1 vs. 1, 2 vs. 2, 2 vs. 1, 3 vs. 2, 3 vs. 3, 5 vs. 5 and full game options.
2. Identify and experiment with the following.
   a. *Setting up attack:* force the opponent to the baseline or net – for example, a forehand high or long serve, or forehand or backhand short serve; control a rally and draw the opponent to a specific area on court – for example, drop shot, or to the corners of the court; move the opponent to the back court and create space in the front court – for example, variations of ground strokes, lob, defending against attack; draw the opponent from the baseline to the front court to allow time to return to ready position – for example, use of drop shot; hit the ball from the attacker's front court into the rear court of the opponent – for example, cross-court forehand or backhand passing shot; use front-court setter to implement attack; use different attack; serve or hit options – for example, back-court setter, triple front-court hitters, short serve, topspin or jump serve; force opposition to use a 'free ball' or non-attacking return; pattern recognition of defence.

Continued »

ISBN 978-1-009-31125-0

b. *Defending against attack:* move the opponent to the back court and create space in the front court – for example, a forehand clear, cross-court forehand or backhand; hit the shuttle/ball from the attacker's front court into the rear court of the opponent – for example, net lift.

c. *Creating, defending and exploiting space:* move the opponent to the back court and create space in the front court – for example, cross-court forehand or backhand; hit the ball from the attacker's front court into the opponent's rear court after drawing them to the net – for example, lob; maintain court position through transition from attack to defence – for example, 'off the ball' and 'on the ball' movements; front-court setter and back-court setter strategies to implement attack.

d. *Attacking opposition court and scoring:* win a rally, following an opponent's high shot to the net – for example, backhand or forehand net kill or overhead smash; drive the shuttle/ball into the opponent's court to score and win the rally, or win with the following shot at the net – for example, smash, cross-court volley; maintain court position through transition from attack to defence – for example, 'off the ball' and 'on the ball' movements; front-court setter and back-court setter strategies to implement attack.

e. *On-the-ball and off-the-ball movements:* awareness – for example, movement execution, pass or shot selection.

f. *Space:* for example, movement pathways, use of space.

g. *Quality of movement:* for example, force development, efficiency and outcome.

h. *Relationships:* for example, interaction with opponent and team members, verbal and non-verbal communication.

Analyse and synthesise

3. Review the video captured in relation to the technical and tactical elements identified below. Evaluate your current ability level for each by scoring yourself A to E and collate how often each element was used and where you had success with each.

Technical aspects within all positions of your physical activity of study

- *Badminton:* front court – serve (forehand, backhand, high, short), net lift, drop shots, net kill, transition to defensive (side-to-side) formation; rear court – serve (forehand, backhand, high, short), clear, drop shots, smash, transition to defensive (side-to-side) formation; ready position – use at the centre of play, base position or in doubles defensive (side-to-side) formation; footwork – shuffle step; grip
- *Tennis:* baseline – serve, smash, lob, approach shot, passing shots, forehand, backhand; net – smash, drop shot, lob, volley, forehand, backhand; ready position – use at the centre of play, net position and baseline position; footwork; grip
- *Volleyball:* setter – set (forward, reverse, quick), block, tip, dig, serve (underarm, overarm, topspin or jump), awareness of position; hitter (outside hitter, opposite hitter or back-court hitter) – spike (cross-court, line), block, tip, dig, serve (underarm, overarm, topspin or jump), awareness of position; libero – dig, serve receive, set, awareness of position, substituting; ready position – use at setter, hitter approach and serve or hit receive; footwor.

ISBN 978-1-009-31125-0 Stewart et al.

ACTIVE INVESTIGATION 16.6

Inquiry question: How can we use digital data to optimise tactical and movement strategies in developing intelligent performance?

Recognise and explain

1. Go to https://cambridge.edu.au/redirect/10373 to watch a YouTube clip about digital evidence in relation to Johnathan Thurston's performance.
2. Identify how the use of video analysis may be used to identify strengths and weaknesses.
3. Explain the affordances identified by Andrew Johns in relation to Johnathan Thurston's performance.

Demonstrate and apply

4. Over a number of lessons, capture footage of your performance in your physical activity of study (this could have been captured during previous lessons or activities).

Analyse and synthesise

5. Over a number of lessons, use video editing software to isolate sections of footage of your performance in which you demonstrate movement strategies. This will also provide footage of the associate specialised movement sequences.
6. Use the captured primary data and apply the following characteristics to your performance to give yourself a score out of 6.

Demonstrating and applying	Marks
The student response has the following characteristics:	
• effective demonstration of the specialised movement sequences and two movement strategies from two different principles of play in authentic performance environments • effective application of the body and movement concepts, including quality of movement and one other, to the specialised movement sequences and two movement strategies from two different principles of play (when applicable) in authentic performance environments	5–6
• competent demonstration of isolated specialised movement sequences and a movement strategy in authentic performance environments • competent application of the body and movement concepts, including quality of movement and one other, to some specialised movement sequences and two movement strategies from two different principles of play (when applicable) in authentic performance environments	3–4
• variable or inaccurate demonstration of isolated movement sequences and a movement strategy in authentic performance environments • variable or inaccurate application of a body and movement concept to movement sequences and a movement strategy in authentic performance environments.	1–2
The student response does not match any of the descriptors above.	0

Source: *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

7. Create a voice-over on your digital capture that critiques your performance using the data from tasks 5 and 6 above.
8. Identify a movement strategy that could be improved to optimise your overall performance.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- For intelligent performers to develop, a learner must be exposed to more contemporary training activities that reflect representative practice and involve decision-making and problem-solving.
- The constraints-led approach is a framework for understanding and developing movement skills. It involves identification of interacting constraints to develop a stable and functional movement pattern.
- The constraints-led approach involves manipulating constraints, to allow specific affordances to emerge, so that a learner can practise their self-organisation in representative practice.
- The constraints-led approach assists performance because it:
  - is learner-centred
  - includes representative practice
  - involves simplification
  - offers unique solutions
  - promotes affordances
  - contains variation in practice
  - has no ideal movement pattern.
- Decision-making is an essential skill in order for effective attunement and perception–action coupling and self-organisation to develop.
- The principles of decision-making include reading the play, recognising and responding to information, reacting to implement movement and recovering with appropriate movements.
- To develop effective constraints-led activities, there must be an understanding of the technical proficiency and tactical awareness required by the physical activity.
- To develop effective constraints-led activities, primary data must be collected and an accurate evaluation of current performance must be undertaken.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. A key element of intelligent performance is:

A. refined motor programs that are frequently successful.

B. high cognitive processing.

C. attunement.

D. tactical awareness.

2. A constraints-led approach to learning motor skills is reflective of contemporary teaching and coaching pedagogy because:

A. it highlights the link between the learner and the environment.

B. it allows for problem-solving to occur.

C. it encourages variation in the responses enacted.

D. all of the above.

3. The ability to perceive information from the performance environment and identify the available affordances is:

A. attunement.

B. perception–action coupling.

C. self-organisation.

D. affordance cognition.

4. Which of the following is not a feature of learning activities designed using the constraints-led approach to learning?

A. Learner-centred activities

B. Problem-solving activities

C. Repetitious activities

D. Activities that manipulate constraints

ISBN 978-1-009-31125-0 Stewart et al.

5. Implementing the movement and making modifications and fine adjustments to the motor program during the performance relates to which aspect of the 4 R decision-making principles?
   A. Recover
   B. React
   C. Read
   D. Recognise and respond
6. When designing a constraints-led activity, it is important to consider the:
   A. level of tactical awareness and technical proficiency required in the physical activity.
   B. level of fitness and decision-making required in the physical activity.
   C. number of affordances possible in the physical activity.
   D. correct technical requirements for the skill being targeted.
7. Changing the rules so that players must perform a 'dump and split' move in the first three plays of an attacking set of a touch football match is an example of manipulating which type of constraint?
   A. Task
   B. Team
   C. Environment
   D. Learner
8. When developing small-sided games so that the learner can develop affordances, the focus on manipulating constraints should:
   A. be teacher/coach-centred.
   B. be representative of the authentic environment.
   C. involve deconstruction of tasks.
   D. involve closed repetitive tasks.
9. The use of a game performance assessment instrument (GPAI) allows for:
   A. summation of forces to be reviewed.
   B. only tactical aspects to be evaluated.
   C. an evaluation of many aspects of performance.
   D. decision-making errors to be dismissed.
10. The principles of play involved in invasion games are:
   A. only useful when you are the coach of a team.
   B. setting up attack, defending against attack, creating, defending and exploiting space, attacking opposition space and scoring.
   C. defending the goal third, restarts of play, attacking opposition space, scoring and umpiring.
   D. useful for biomechanical considerations regarding limitations of performance.

SHORT-RESPONSE QUESTIONS

1. List and explain five implications of implementing the constraints-led approach.
2. Identify the three different types of constraints and provide one example of how each could be manipulated in a constraints-led learning activity.
3. For the physical activity currently being studied, provide an example of how a constraint may be manipulated to allow for the emergence of a movement strategy to set up attack.

EXTENDED-RESPONSE QUESTION

Develop a training activity using a constraints-led approach that is designed to enhance a specific movement strategy that is currently hindering your performance in the physical activity of study. In 400 words, describe the activity and justify how it will optimise your performance of the identified movement strategy.

ISBN 978-1-009-31125-0 Stewart et al.

Unit 3

TOPIC 2

Ethics and integrity in physical activity

Topic 2:
Ethics and integrity in physical activity

- **Chapter 17** Ethics, integrity and fair play
- **Chapter 18** Factors that influence ethics and integrity in physical activity
- **Chapter 19** Ethical dilemmas and decision-making

Introduction

Being physically educated is concerned with developing knowledge in the biophysical, sociocultural and psychological domains that underpin physical activity and using this knowledge to maximise enjoyment, engagement and physical performance for yourself and others. The physically educated become advocates for both the social and physical importance of being physically active.

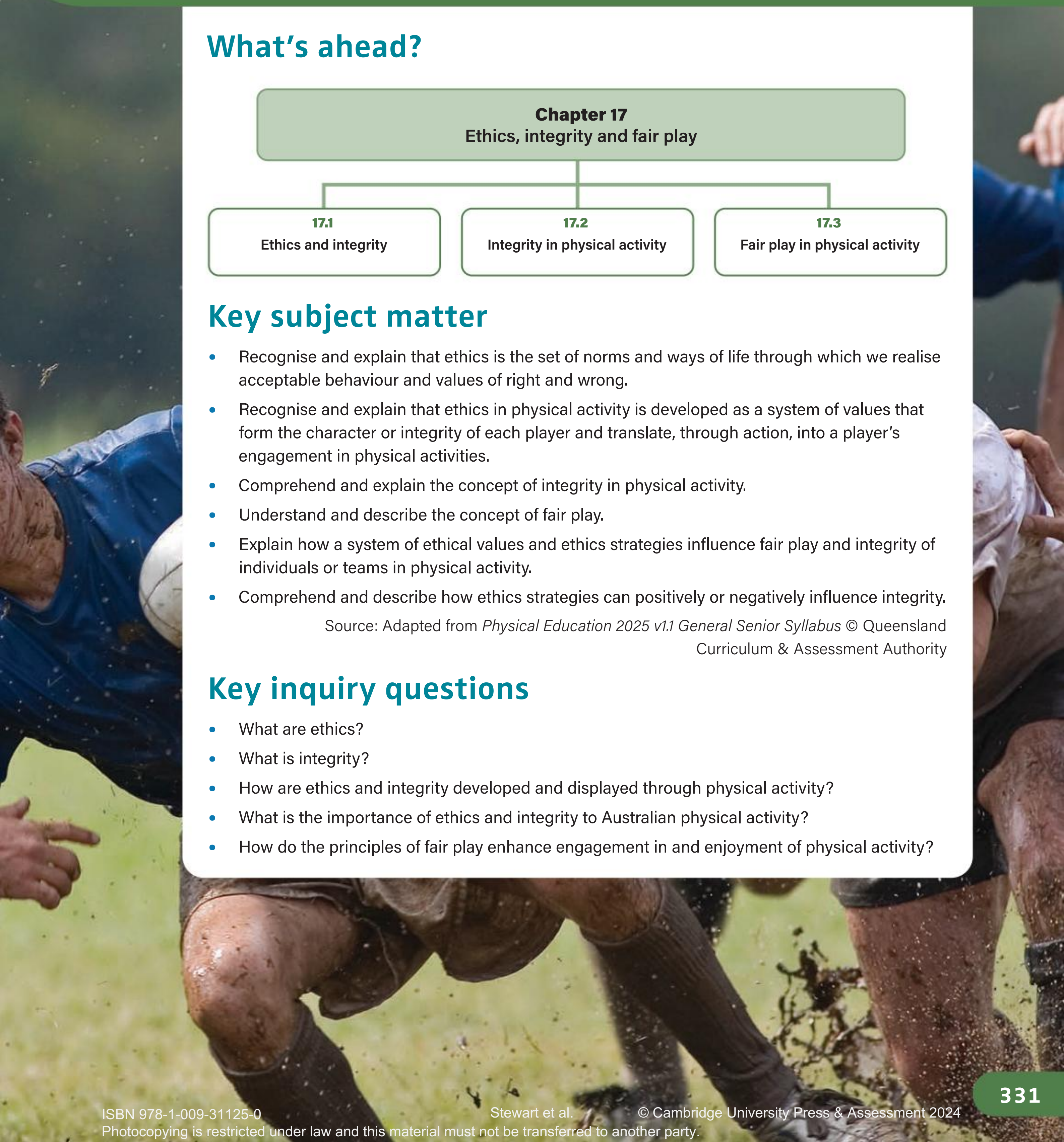
This unit topic explores ethics and integrity as key elements within the sociocultural sub-discipline of physical activity. Through an understanding of ethics and integrity, the physically educated can work to enhance engagement and the enjoyment experienced through physical activity. They can assist in establishing and maintaining equity and fair play within physical activity, and encourage inclusiveness and a respect for diversity. They learn to establish themselves as appropriate sporting role models for others, and as such enhance the place of sport in modern Australian society.

UNIT 3 TOPIC 2
Overview

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 17

Ethics, integrity and fair play



What's ahead?

Chapter 17
Ethics, integrity and fair play

- **17.1** Ethics and integrity
- **17.2** Integrity in physical activity
- **17.3** Fair play in physical activity

Key subject matter

- Recognise and explain that ethics is the set of norms and ways of life through which we realise acceptable behaviour and values of right and wrong.
- Recognise and explain that ethics in physical activity is developed as a system of values that form the character or integrity of each player and translate, through action, into a player's engagement in physical activities.
- Comprehend and explain the concept of integrity in physical activity.
- Understand and describe the concept of fair play.
- Explain how a system of ethical values and ethics strategies influence fair play and integrity of individuals or teams in physical activity.
- Comprehend and describe how ethics strategies can positively or negatively influence integrity.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What are ethics?
- What is integrity?
- How are ethics and integrity developed and displayed through physical activity?
- What is the importance of ethics and integrity to Australian physical activity?
- How do the principles of fair play enhance engagement in and enjoyment of physical activity?

ISBN 978-1-009-31125-0 Stewart et al.

17.1 Ethics and integrity

What are ethics?

Humans have spent a considerable amount of time pondering the meaning of life. Ancient philosophers Plato and Socrates are famous for statements such as 'The unexamined life is not worth living'. In a modern context, this is understood to mean that people should be introspective, reflect on their actions and find meaning in life for themselves. Philosophers may expand this central question to include 'How should I live?', 'How should I act?' and 'What should I do?' In part, these questions can be answered through the exploration and application of **ethics**.

ethics a system of moral principles and values by which actions and proposals may be judged good or bad, or right or wrong

ENGAGE 17.1

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How do ethics play a role in physical activity?

Demonstrate and apply

1. Select a team sport to be the focus of a lesson's activity.
2. Set up uneven teams where one will have an obvious advantage over the other. If numbers allow, have players sitting on the sideline as reserves who are infrequently used.
3. Engage in the activity for a 20-minute half.
4. At half-time, discuss that as this is a team sport, teams win or lose as a group. As a result, the marks for this unit will be awarded to the whole team (everyone on the team will receive the same physical assessment result). For this reason, the current teams will be used throughout the term so that some people are not overly advantaged, and therefore it is 'fair'.
5. Engage in the activity for the second half.

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

6. At the end of the match, reflect on the following with regard to team composition and the 'group assessment'.
   a. How did it affect engagement?
   b. How did it affect confidence and motivation?
   c. How did it affect enjoyment?
   d. Who would be advantaged and disadvantaged by this system?
   e. Is there a more equitable way to organise teams? What might be a better strategy?

ISBN 978-1-009-31125-0 Stewart et al.

Evaluate and justify

7. In a short statement, write how this activity fits with your own notion of what is right and wrong in sport and in education.
8. Discuss, as a class, your understanding of the term 'ethical' and whether this activity has displayed an ethical approach to physical activity.
9. Reflect on how unethical situations in physical activity may affect engagement, confidence, motivation and enjoyment of physical activity.

Ethics are a system of moral principles and values by which actions and proposals may be judged good or bad, or right or wrong. Ethics are closely linked to **morals**, and they may be used interchangeably by a philosopher or sociologist, with no clear distinction between the two. However, in areas such as governance, law, medicine, business and sport, it is important to recognise a difference between ethics and morals.

> **morals** an individual's sense of right or wrong developed through their own unique socialisation process

Ethics are determined by a group and establish the norms for what is right and wrong, good or bad. These 'guidelines' can be unwritten, and are reflected in the actions of the group and enforced by group members when these guidelines are broken. Consider a parent telling their child not to cheat when the family is playing cards. More typically, however, ethics refer to a set code that is proposed, monitored and enforced by a group, profession or community. Think of the ethics set by the medical, business or sporting community. Here, ethics may refer to a well-defined set of standards or guidelines that outline the behavioural norms for members of that group.

Morals, on the other hand, are an individual's personal code for what is right or wrong, good or bad. Through socialisation, individuals develop their own personal values, beliefs and attitudes in this area. When the ethics of a group and the morals of an individual align, then it is easy for an individual to display appropriate actions. For example, if a players' code of conduct for netball states, 'Follow all instructions from officials', and the player believes that 'the umpire's decision is final', then playing by the rules is an easy affair. However, if the player believes the umpire can make mistakes and winning is a priority, they may argue decisions. When there is a conflict between the **ethical standards** and an individual's morals, behaviours deemed inappropriate by the group can result.

> **ethical standards** a set of principles or guidelines that outline expected conduct reflecting underlying morals, such as trust, equality and kindness

What is integrity?

With every action, behaviour and word spoken, people make an ethical decision about whether or not to follow the expectations established by those around them. It is through their actions that people display **integrity**,

> **integrity** the application of generally accepted values and norms in daily practice

FIGURE 17.1 Where there is a conflict between the ethical standards set by the group and an individual's morals, inappropriate behaviours may result.

ISBN 978-1-009-31125-0 Stewart et al.

which is the application of generally accepted values and norms in daily practice. People with high integrity are those who consistently display **ethical behaviours** through their actions.

ethical behaviours the actions that reflect the ethical standards for expected conduct as set by the group

CHECK-IN 17.1

1. Use one sporting and one non-sporting example to explain the difference between ethics and morals.
2. Explain why ethics could be easy to change, whereas morals are much more difficult to influence.

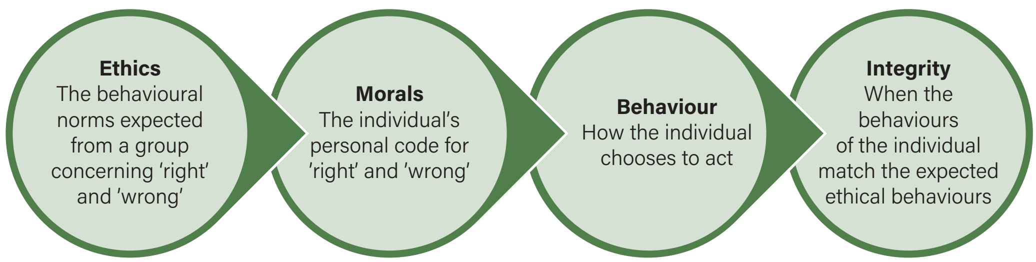


FIGURE 17.2 A person's morals are a key link between the ethical behaviours that are expected by those around them and the behaviour that is actually displayed.

CHECK-IN 17.2

1. Integrity is displayed in a person's actions and reflects their morals. In a think–pair–share activity, devise a list of the top five characteristics a sportsperson must display in order to be considered to have integrity.
2. Integrity can also be applied to a specific sport, club or competition. The integrity of these institutions is vital for maintaining community confidence. Identify five characteristics these institutions would need to display in order to maintain integrity.
3. Select a player from any physical activity – famous or local – who is recognised for their integrity or lack of it. Research their behaviours and be prepared in your next lesson to present your athlete and support your position on their integrity with two examples of their behaviours.

KEY MESSAGE

Ethics allow behaviours to be judged as right or wrong.

KEY MESSAGE

An individual's behaviours reflect their own morals, which may or may not align with the expected ethical behaviours.

KEY MESSAGE

Integrity is demonstrated when behaviours align with the ethical behaviours expected by others.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 17.2

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How does a lack of integrity affect enjoyment of and engagement in physical activity?

Demonstrate and apply

1. Undertake a physical activity for a lesson. Your teacher will choose a team game where all can participate throughout the lesson.
2. During the match, **unethical behaviours** are allowed to be displayed (where this does not compromise safety). For example:
   - Referees or umpires may police the rules 'loosely', favour a particular player or team or make obvious poor decisions.
   - Players may be encouraged to exploit or ignore rules to their advantage or to act in 'un-sportsperson-like' ways (within reason).

> **unethical behaviours** actions that are outside, or against, the ethical standards set by the group for expected conduct

Analyse and synthesise

> KEY COGNITION
> **Analyse**: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

3. Debrief the experience by identifying examples of:
   a. unethical behaviours displayed by the referee or umpire
   b. unethical behaviours displayed by the players.
4. Rate the following on a scale of 1–5:
   a. enjoyment level
   b. engagement of all participants
   c. spirit in which the game was played.
5. Note how difficult it was personally to act in unethical ways – easy or hard.

Evaluate and justify

6. Reflect and respond: evaluate how a lack of integrity affected the general enjoyment and participation of players during this lesson.
7. Justify how a similar lack of integrity would affect enjoyment, participation and the reputation of the sport if it were a regular feature in weekly club competitions.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 17.3

Inquiry question: Do ethical guidelines increase the positive experience of physical activity engagement?

Demonstrate and apply

1. Review the findings from Engage 17.2.
2. As a class, devise a set of guidelines for the same physical activity that outlines standards for sportsperson-like behaviour. Try to set very high expectations – for example:
   - Hand the ball to your opponent at a changeover.
   - Use supportive language to teammates, opponents and officials.
   - You may even include an expected standard for play – for example, you must say one complementary thing each set with the ball or point, or apologise to an opposing player if accidental contact is made, or shake hands with an opponent when they score.
3. Implement these guidelines in a match.

Analyse and synthesise

4. Debrief the experience by rating the following on a scale of 1–5:
   a. enjoyment level
   b. engagement of all participants
   c. spirit in which the game was played.
5. Was it difficult to follow the guidelines?
6. Were un-sportsperson-like behaviours still displayed? If so, what were they?

Evaluate and justify

> KEY COGNITION
> **Evaluate**: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

7. Evaluate how effective the guidelines were in creating a positive playing experience.
8. What guidelines could be adjusted or added to further enhance the playing experience?
9. Does playing with integrity provide a more positive playing experience for players?

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 17.3 Ethical behaviours are an important factor in childhood activity, as they are vital for maintaining a sense of fun.

ENGAGE 17.4

Inquiry question: How do ethical behaviours influence engagement and enjoyment of physical activity?

Recognise and explain

1. As a class, brainstorm a list of activities that you played in junior primary school that were really enjoyable – for example, cat and mouse, duck-duck-goose, hide and seek or tiggy.
2. Discuss why they were enjoyable.

Demonstrate and apply

3. For a lesson, relive your childhood by playing these games.

Analyse and synthesise

4. Towards the end of the lesson, stop and discuss the following.
   a. What was the enjoyment level experienced?
   b. What was the engagement level of the class?
   c. Were any unethical behaviours demonstrated?
   d. Do these activities still provide the same sense of 'fun' as when you were younger?
   e. What characteristics do these activities have that may promote ethics and integrity – for example, fair, honest, a lack of scoring, no set 'winner'?

Evaluate

KEY COGNITION

Appraise: evaluate the worth, significance or status of something; judge or consider a text or piece of work

5. In a short paragraph, appraise how important ethical behaviours are for establishing enjoyment and fun for participants in childhood games.

ISBN 978-1-009-31125-0 Stewart et al.

17.2 Integrity in physical activity

Culturally, physical activity and sport in Australia constitute a significant microcosm of society, and play an important part in the socialisation process of Australians. Physical activity is an important socialising agent in terms of establishing social and moral values such as teamwork, respect for others and rules, **fair play**, equity and honesty. It is through **positive engagement** that participants learn the physical and mental health benefits of being physically active, and experience the enjoyment that regular participation can offer.

There is not only cultural value in maintaining the integrity of physical activity, but for sporting organisations in a competitive marketplace, there is also a significant economic value. Ethical violations decrease the integrity of their product (a player, a club, a sport or sport in general). A decrease in integrity through displaying unethical behaviours makes it more difficult to market a sport, attract sponsorship and increase participation. It is through integrity that the cultural significance and economic worth of physical activity are maintained.

Integrity plays an essential role in maintaining the significance and importance of physical activity for Australians. The concept of integrity – that is, ethically high morals demonstrated through expected sporting behaviours – therefore includes:

- the demonstration of the ethics and values that promote community confidence in physical activity
- fair and honest performances and outcomes, unaffected by illegitimate enhancements or external interests
- positive engagement by athletes, administrators, officials, supporters and other stakeholders in and around physical activities, which enhances the reputation and standing of the contest and perception of physical activity

Source: Physical Education 2025 v1.1 General Senior Syllabus © Queensland Curriculum & Assessment Authority

The extract in Figure 17.4 was taken from *The Essence of Australian Sport: What We Stand For*, produced by the Australian Sports Commission in 2012. It is a reflection of the important role that integrity plays in maintaining the ethical standards of Australian sport.

fair play a set of values and associated behaviours that are designed to retain the hope, pride and integrity that is associated with sporting participation and performance

positive engagement (in physical activity) when an individual experiences enjoyment or gains constructive socialisation experiences through participation in physical activity

FIGURE 17.4 Extract from *The Essence of Australian Sport: What We Stand For*, Australian Sports Commission, 2012

Despite the positives of physical activity, ethical violations detract from the important role of sport in society. To maintain the cultural and financial worth of a physical activity, significant time, money and intellect are invested at all levels of society to develop laws, rules and frameworks to uphold sporting integrity. These strategies are built on a solid foundation of ethics and protect against corruption and inequity. They address the conduct of all people involved in physical activity – players, parents, coaches, officials and administrators.

ISBN 978-1-009-31125-0 Stewart et al.

While ethics strategies work to uphold sporting integrity, there are still many unethical behaviours displayed by those in and around the physical activity and sporting industries. Table 17.1 lists some of the main ethical and integrity issues currently facing Australian sport.

TABLE 17.1 The main ethical and integrity issues currently facing Australian sport

High-level sport	Grassroots sport
• Insufficient resourcing of management by sports governing bodies • The use of illicit and performance-enhancing drugs – doping • Overseas-based criminal threats • Domestic criminal associations • Infiltration of sports by illegitimate businesses, contractors and consultants • Match-fixing • Exploitation of inside information • Wagering vulnerabilities • Financial vulnerabilities • Commercial arrangements • Specific high-risk individuals Source: Adapted from the *Report of the Review of Australia's Sports Integrity Arrangements*, Department of Health, 2018	• Discrimination • Harassment • Verbal abuse and sledging • Going beyond the spirit of the game • Juniors participating against more physically developed opponents • Juniors participating against more skilled opponents • Athletes being pushed too hard by coaches or parents • Negative coaching behaviours and practices • Negative administrative behaviours and practices • Negative officiating behaviours and practices • Commercial arrangements Source: Adapted from *Sports Integrity Matters*, Sport Integrity Australia, 2020

FIGURE 17.5 Ethics strategies work in many ways to maintain and enhance the cultural and economic value of physical activity.

CHECK-IN 17.3

1. As a group, brainstorm a list of 'Australian' beliefs that are reflected in physical activity – for example, 'getting a fair go' or 'battling through to the end.'
2. Select one belief identified and provide an example of how it is demonstrated in general society, and one example specific to physical activity.
3. Outline some unethical behaviours that could be displayed in sport that might undermine this belief for spectators.

ISBN 978-1-009-31125-0 Stewart et al.

Ethics and values that promote community confidence

In its purest form, physical activity provides a fair contest, free from corruption, equitable and inclusive. It provides a context to display honour, persistence and dedication. In addition, sport provides a stage for winners to celebrate with humility and losers to be gracious in defeat. As such, physical activity reflects characteristics valued highly in Australian society. Sport is therefore seen as a source of national pride; it provides a sense of community and develops **nationalism** among the Australian population. Our national identity has a significant sporting aspect, which can be traced back to Australia's emergence as an independent nation on the world stage. In modern Australia, physical activity also has significant worth from both an economic and a health standpoint. As a commodity, physical activity is a billion-dollar industry that relies on its reputation to maintain both its worth and its social standing.

Many factors contribute to the monetary and societal value Australians place on physical activity. When unethical behaviours are demonstrated in any of these areas, the result is a decline in the value of physical activity. Acting with integrity within the field of physical activity retains confidence and grows value.

When ethical behaviours and integrity are shown, community confidence in physical activity is maintained and so too is its value. People are comforted by the fact that sport is continuing to reflect the beliefs and attitudes they 'hold dear'. Conversely, poor behaviours and corruption in physical activity can erode community confidence. Each time unethical behaviours are displayed at any level of participation, it has a devaluing effect on sport. With ongoing ethical violations comes a lack of community trust. Confidence in sport begins to waver and people start to question whether physical activity (or a specific sport) still reflects appropriate social values. Consumers tend to shy away from 'cheap and nasty', and this is the perception when members of the sporting community act in unethical ways.

Ethics guidelines and standards are one way to combat poor behaviours and maintain community confidence in physical activity. Articulating ethical behaviours through policies, programs and codes demonstrates integrity and encourages the broader community to retain confidence in our sporting system. While not all individuals may uphold these standards, there is a process in place to deal with those who tarnish the image of sport through their behaviours. Beyond the individuals involved, organisations that oversee the governance of physical activity at all levels also must follow ethics guidelines to ensure community confidence in physical activity. At a time when there are many troublesome events globally, positive sporting behaviours can provide confidence and faith in human nature.

nationalism devotion and loyalty to your own country and the desire for national advancement

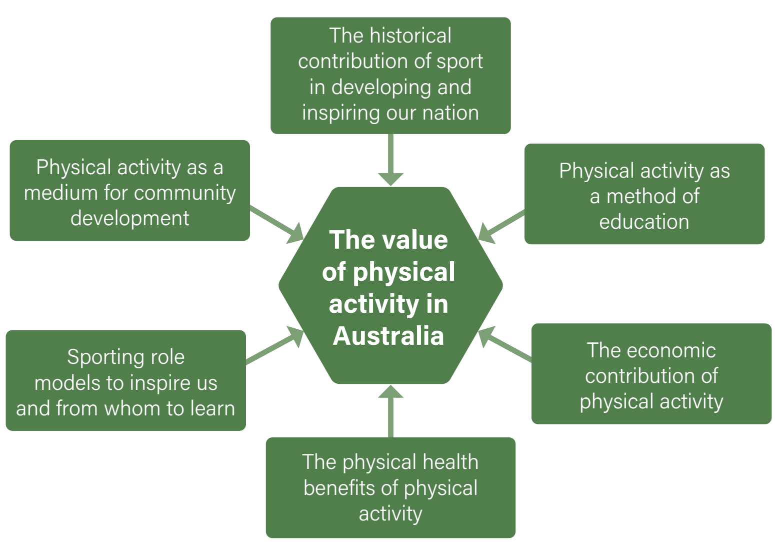


FIGURE 17.6 Many factors contribute to the value Australians place on physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 17.7 Throughout his career, Johnathan Thurston was known for picking up his own kicking tee, cleaning the change rooms while injured and giving his headgear away to fans. Consider the impact of these behaviours on other players and fans.

CHECK-IN 17.4

1. Read the following scenario.

   During an interschool sporting match, a fight breaks out between two players, which is instigated by a player from your school. Four other players from both sides join in the fight.
2. In groups, investigate the ethical frameworks your school has in place to address this situation (school behaviour management plan, sport code of conduct, others). What specific guidelines have been broken?
3. How would this incident affect the integrity of:
   a. the instigating player?
   b. sport within your school?
   c. your school?
4. How would this incident be viewed by the following community members from your school?
   a. Student body
   b. Teachers and administration
   c. Parents and friends of the school
5. Justify whether you believe the possible consequences for the players involved would be sufficient for the harm done to integrity.

CHECK-IN 17.5

1. Find a recent example of a player who has demonstrated high integrity in their chosen field. Outline why their actions showed integrity and infer how this may have boosted confidence in physical activity for those who are aware of the person's actions.
2. Find a recent example of a person/team being unethical in their chosen field. Outline why their actions lacked integrity and infer how this may have been detrimental to confidence in physical activity for those who are aware of the person's actions.

ISBN 978-1-009-31125-0 Stewart et al.

Fair and honest performances and outcomes

The notion of **fairness** is held in high esteem in Australia, which has long presented itself as a land of opportunity where anyone can succeed with a little hard work and ingenuity. Colloquially, we pride ourselves on giving everyone a 'fair go', and many Australians view this value as one of our most important.

'Fairness' is therefore a central feature of Australian physical activity. People can accept that there are winners and losers in a game, provided the contest has been fair from the outset. As either a competitor or a spectator, many are affronted when a contest is seen to be unfair, and this can lead to deep outrage from the community. As a result, in our culture cheating is perceived as taking the easy road to success at the expense of those who have committed to doing the hard work needed to succeed.

fairness where competitors have a relatively equal chance of success as all involved are undertaking the activity in accordance with the rules, ethics or logic

ENGAGE 17.5

DEMONSTRATE APPLY ANALYSE & SYNTHESISE JUSTIFY

Inquiry question: How does illegitimate competition affect the outcome of matches?

Demonstrate and apply

1. Your teacher will provide a reward for the winner of a flexed arm hang competition (one male, one female). See the flexed arm hang test procedure below.

Flexed arm hang	Age (years)	Male (seconds)	Female (seconds)
This test measures upper body strength. Procedure: • Grasp pull-up bar with palms facing away from body. A spotter may assist in helping raise chin above the bar. • Time starts when performer is in position with chin above the bar. • Time stops when the chin hits the bar, drops below the bar or the head tilts back. The body may not swing during the test. • The performer may have one attempt only and their score is the number of seconds they last.	14	≥15	≥8
	15	≥15	≥8
	16	≥15	≥8
	17	≥15	≥8
	>17	≥15	≥8

2. Before recognising the winner, your teacher will apply age-based criteria, so times will be adjusted as follows:

Month born	July	August	September	October	November	December
Time added	+0s	+1s	+2s	+3s	+4s	+5s
Month born	January	February	March	April	May	June
Time added	+6s	+7s	+8s	+9s	+10s	+11s

3. Following this calculation, your teacher will announce the male and female winners based on age-adjusted times.

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

4. Was the outcome of the competition affected by the rules of the competition?

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

5. Was this an ethical way to administer a competition to determine the greatest upper body strength?
6. How did participants feel about the winners? The competition?

Justify

7. Using this experience as evidence, justify how illegitimate competition affects the integrity of sport.

ENGAGE 17.6

Inquiry question: How does illegitimate competition affect the engagement, enjoyment and the value of physical activity?

Demonstrate and apply

1. You will engage in a 100 m sprint race based on gender for the title of fastest male and female in the class. Your teacher may offer a reward for the winner of each division.
2. Before commencing each race, each student will randomly select a number between 1 and 15. The number they select represents their starting position for the race – that is, the student who is allocated the number 6 may take six steps forward from the 100 m start and this becomes their individual starting position. Each student does this until all students have different starting positions for the race.
3. Conduct the race.

Analyse and synthesise

4. Analyse the effect the different starting positions had on the competitors and the outcome of the race. Consider the following.
   a. Was the race a true indication of the fastest person in the class?
   b. Was the race fair?
   c. Was the winner deserving of the reward?
   d. Which participants still put in maximum effort? Which did not?
   e. How did competitors in the race feel about the competition, knowing the circumstances under which it was run?

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

5. Discuss how this activity might relate to the geographical location or socio-economic status of young athletes. What impact does 'individual circumstance' or 'privilege' have on the opportunities to be successful as an athlete?

Evaluate and justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

6. Justify how this competition affected the engagement, enjoyment and value of 100 m sprint racing for competitors.

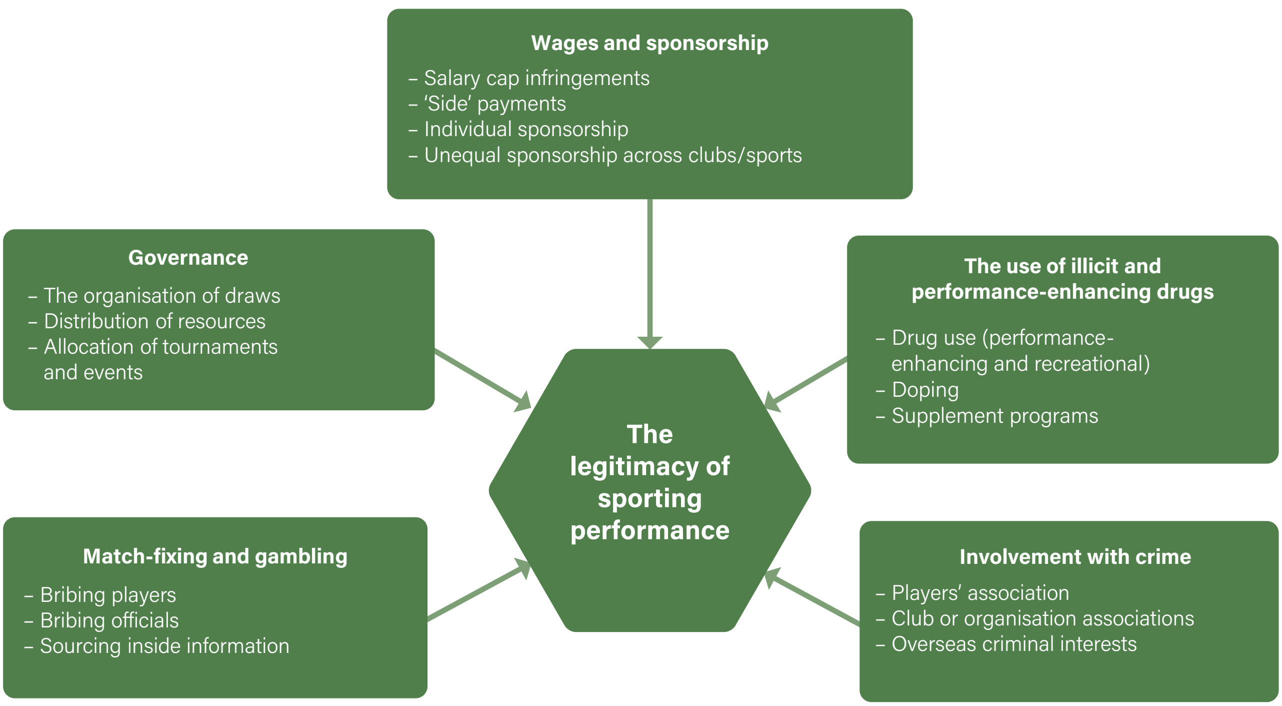


FIGURE 17.8 Some of the many factors surrounding fairness and honesty that affect the legitimacy of sporting results

As cheating is diametrically opposed to the values of many Australians, when sporting performances are affected by this unethical behaviour, confidence in physical activity is reduced. As participants or spectators, most Australians would agree that they want the competition to be fair and honest – that all involved are displaying integrity.

There are many factors surrounding fairness and honesty that affect the legitimacy of sporting results. These negatively affect the integrity of sporting performances, and undermine the value placed on physical activity by Australians.

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 17.9 In 2018, Australian cricket player Cameron Bancroft (left) was accused of ball-tampering using sandpaper in a test match against South Africa. In the fallout, Captain Steve Smith (right) and David Warner were also sanctioned. This incident had a major impact on the players' careers, the reputation of the Australian cricket team, and sport in Australia.

ENGAGE 17.7

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How does illegitimate competition affect the notion of fairness?

Demonstrate and apply

1. Your class will divide into teams to compete in a class round-robin basketball competition lasting one lesson.
2. Engage in matches for a lesson and collect primary data that would indicate a player or team's performance – for example, scores, for and against record.
3. Keeping the teams the same, conduct the same activity in the next lesson. However, before each match have a player from each team play scissors, paper, rock; the losing team must play the whole game (or a set time at the start of the match) with one hand behind their back.
4. Engage in the matches again, collecting the same type of primary data on player performance. At the completion of the match/competition, celebrate the winning team; your teacher may award a prize as an incentive.

Analyse and synthesise

KEY COGNITION

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

5. Debrief the activity.
   a. Was the second competition a legitimate competition?
   b. Which players gave their full effort throughout the second competition?
   c. Which players' efforts were affected by the 'unfair' conditions?
   d. What data or evidence did you collect from both competitions that would support your answers?

Evaluate and justify

6. In a 100-word statement, justify how this activity relates to the taking of performance-enhancing drugs and the notion of 'fair competition.'

ENGAGE 17.8

DEMONSTRATE APPLY ANALYSE & SYNTHESISE JUSTIFY

Inquiry question: How does illegitimate competition affect the integrity of physical activity?

Demonstrate and apply

1. Your class will divide into two teams to compete in a class match.
2. Before the start of the match, the teacher will offer two players on one of the teams a greater reward if they perform 'below their best' to throw the match. Brief them not to be obvious; if they can be identified at the end of the game, they will not get their reward.
3. Engage in the match.

Analyse and synthesise

4. At the completion of the match, celebrate the winners, your teacher will inform you that two players were asked to try to 'throw the match.'
5. As a class, debrief the first part of the activity
   a. Can students identify the two players?
   b. Once identified, discuss what actions the two players took to try to 'throw the match.'
   c. Were they successful in influencing the outcome?
6. As a class, debrief the second part of the activity
   a. How do students feel about the match now, knowing that other players were working against them?
   b. How did the two players feel about their role in the match?

Justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

7. Using examples from this learning experience, justify how the integrity of sporting competition is diminished when athletes intentionally underperform.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 17.9

Inquiry question: How does gambling affect the integrity of sport and players?

Recognise and explain

1. Conduct a class discussion on recent examples of gambling incidents in sport. Your teacher may present an article or internet resource as a stimulus for this conversation. Explore the aspects of who and why, as well as how it affected the integrity of the players involved and the sport in general.
2. As a class, decide on a physical activity for this activity – a team sport like touch football, Australian Rules football, futsal or something similar works best, but this activity can easily be adapted for use in a competition in sports like golf, tennis and badminton.
3. Conduct a class 'sweep' by placing the names of all class members into a 'hat' and having each class member pull out a name. Repeat this process a number of times; each time, students are drawing for a different reason. For example:
   - first point scorer
   - first person to have an impact in attack (e.g. first line break in touch football)
   - first to make a specific error (e.g. a dropped ball)
   - first to make a different specific error (e.g. miss a touch in touch football).

   Students will need to record the players they have drawn for each of the categories included in the activity.
4. Your teacher may offer a prize as an incentive for the student who wins each category of the 'sweep.'
5. Undertake the physical activity, taking note of the players who perform the actions that were the focus of the sweep and the student who drew that player.
6. At the end of the match, the students who won the various sweeps will be awarded their prizes.

Analyse and synthesise

7. Debrief the activity.
   a. Did the sweep affect the effort of players?
   b. Did the sweep influence the decisions and skills implemented during the game?
   c. Did any students try to influence the outcome, either through their own on-field actions or by influencing the actions of others?
   d. Was the integrity of any students compromised by the sweep?
   e. Did the match itself have integrity?

Evaluate and justify

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

8. In 200 words, and using the primary and secondary data gathered during this activity, justify why ethics guidelines must address player gambling if the integrity of sport is to be maintained.

ISBN 978-1-009-31125-0 Stewart et al.

Positive engagement by all stakeholders

It is essential that if physical activity is to remain a valued microcosm of Australian culture, all those involved need to behave ethically and with integrity. This means athletes, administrators, officials, supporters and all other stakeholders in and around physical activity must undertake their involvement in a positive and constructive manner. The primary tools for enhancing integrity and positive engagement in physical activity are the ethical guidelines, policies and codes established to enhance the perception, reputation and standing of physical activity in Australia.

Physical activity and associated industries have a significant number of policies, guidelines and frameworks covering all aspects of governance and participation levels to assist them in enhancing the perception, reputation and standing of physical activity in Australian society. Many of these are required by various levels of government within Australia, or the governing bodies for the specific physical activity. Overarching policies exist, such as the federal government's Australian Sport: The Pathway to Success Framework, the Australian Sport Policy and the Sport 2030 National Sport Plan.

Sporting organisations are required to have guidelines and policies on ethics and integrity, and these are highlighted to all members. These guidelines outline expected and unacceptable behaviours in order to maintain society's desired standards. There are many resources available to clubs and organisations to help establish and maintain the ethics guidelines, and thus maintain positive engagement in physical activity for all stakeholders. These guidelines and policies will be explored further in the following chapter.

17.3 Fair play in physical activity

The vital role played by physical activity in the betterment of society has been established throughout this chapter and in Chapter 10. The health and social influence of physical activity are at their greatest when all people associated display the values of fair play. It is through the values of fair play that physical activity becomes a positive socialising agent for individuals, guiding them to act in ethical ways. Following the values of fair play allows people to act with integrity and, for Australians, uphold the expected behaviours of our society.

Fair play is a complex concept that comprises and embodies a number of fundamental values that are not only integral to sport but relevant to everyday life. The International Fair Play Committee states that:

> “Fair play is not a theory. Fair play is an attitude that manifests itself in behaviour. Whenever we act in the spirit of fair play we contribute to building a peaceful and better world.
>
> Without fairness and trustworthiness the established order of our society is at risk. If we do not play by the rules, we ruin the spirit of the game and it is impossible to play with destroyers of the game.
>
> Fair play, which is an essential and central part of successful involvement, promotion and development in both sport and life, can teach people tolerance and respect for others. It allows them to integrate into society and create a sense of teamwork. Fair play in sport is capable of giving hope, pride and identity, and it is able to unite where nationalities, politics, religions and cultures often divide.
>
> Cooperation in the spirit of fair play delivers even greater results than pure gamesmanship in all walks of life. It plays a key role, the role of a catalyst in today's society as a means of improving quality of life and human well-being.”
>
> Source: International Fair Play Committee

ISBN 978-1-009-31125-0 Stewart et al.

To act with integrity, all those associated with physical activity should comply with these ethical standards, which reflect the international expectations for sport participation.

The International Fair Play Committee works to educate all athletes, from children to adults, and from beginners to the elite. On page 351 is a charter for youth participation in physical activity designed by the International Fair Play Committee.

KEY MESSAGE

Maintaining integrity in sport through ethics strategies is key to ensuring its high value in Australian society.

KEY MESSAGE

Ethics strategies include guidelines, policies, frameworks and codes that outline behavioural standards.

KEY MESSAGE

Ethical violations reflect poor integrity and lower the cultural and economic value of physical activity.

FIGURE 17.10 Policies, guidelines and frameworks for physical activity and associated industries

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 17.11 The fundamental values of fair play

Source: Adapted from the International Fair Play Committee

ISBN 978-1-009-31125-0 Stewart et al.

Fair Play Youth Charter

- Fair play is the only way.
- I shall devote my utmost of my physical, intellectual and moral abilities to both training and competition.
- I shall observe the written and the unwritten rules of my sport.
- I shall treat my opponents in the same manner in which I would like to be treated.
- During the competition, my aim is to defeat my opponents, not to hurt or humiliate them.
- I shall respectfully acknowledge the decisions of the judges.
- I shall bear both victory and defeat with dignity.
- My greatest gratitude is towards my parents, teachers and trainers – without whom I would not be here.
- I am ready to help someone in need even if I put my own victory at risk by doing so.
- I represent my homeland with great humility and humbleness.
- I would like to be a role model for the youth in my country and my sport.

Source: International Fair Play Committee

ENGAGE 17.10

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: To what degree do we demonstrate the values of fair play during physical activity participation?

Demonstrate and apply

1. Develop a method of recording observations to collect primary data on how often the following fair play values are demonstrated, and how they are displayed during participation in physical activity: respect, friendship, team spirit, integrity, solidarity, tolerance, excellence, care, joy.
2. Engage in a variety of different competitive and non-competitive physical activities over two lessons and record observations using the method developed.

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

3. From the primary data you have collected, rate each fair play value on a scale of 1–5, where 1 = not demonstrated and 5 = demonstrated frequently. When making this judgement, it is important to consider when the value was demonstrated, displayed or observed – that is, you may feel you were acting with team spirit the whole time; however, did you actually display any actions to demonstrate this, such as congratulating a teammate when they scored?

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

4. Show your rating in a bar graph, with the values on the x-axis and the 1–5 rating on the y-axis. For example:

Evaluate and justify

5. Select one low-rated value and discuss with others how this value could be displayed during class matches. Formulate a plan for action by listing three different behaviours you will undertake in the next match to demonstrate this fair play value.
6. Implement your plan in the next outside lesson.
7. Reflect: did you demonstrate the fair play value more often and to a greater degree? Did you demonstrate other fair play values more frequently as a result? When focusing on the positive values of physical activity during play, was there a subsequent increase in enjoyment or effort?

CHECK-IN 17.6

1. Explain why fair play is an important value in Australian culture.
2. Describe the link between fair play and enjoyment for participants.
3. Explain how a system of ethical values, such as the fair play values, influences the integrity of individuals and teams.

KEY MESSAGE

Ethics strategies include policies, guidelines, codes and frameworks, which set the standards for all those involved in physical activity.

KEY MESSAGE

Ethics strategies are the primary tools used to enhance ethical standards and integrity in physical activity.

KEY MESSAGE

Through ethics strategies, the perception, reputation and standing of physical activity in Australian society are enhanced.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Ethics are the behavioural norms expected from a group concerning 'right' and 'wrong', while integrity is demonstrated when the behaviours of the individual match the expected ethical behaviours.
- Peers, family, coaches, the school, the community and the media all play a role in establishing expected ethical behaviours.
- Ethical violations occur when individuals display behaviour that does not represent the expected standards of a larger group or organisation.
- An individual demonstrates integrity when they consistently display the ethical standards (expectations) set by the social group or organisation.
- Physical activity and sport must maintain high ethical standards and display integrity if they are to maintain or enhance their social and economic value in Australian culture.
- Ensuring fair play values are present in physical activity builds integrity, retains community confidence and increases the value of sport for the Australian people.
- Ethics strategies include policies, guidelines, codes and frameworks that set behavioural expectations and educate all involved in physical activity for the purpose of raising the level of integrity.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Which of the following identifies a key difference between ethics and integrity?
   A. Ethics are an individual's value system, while integrity consists of behaviours.
   B. Ethics are an external view of what is right and wrong, while integrity is the behaviours that reflect our internal view of this.
   C. Integrity is how we behave in physical activity, while ethics is how we behave in social situations.
   D. Integrity is demonstrated through the values of fair play, while ethics reflect individual morals.
2. Which of the following does not contribute to the value of physical activity in Australia?
   A. Physical activity as a vehicle for self-interest
   B. Physical activity as a medium for community development
   C. Physical activity as a method of education
   D. The historical contribution of sport in developing and inspiring our nation
3. To enhance the perception, reputation and standing of physical activity in Australian society, organisations create and mandate:
   A. ethics strategies.
   B. integrity guidelines.
   C. ethical behaviours and personal values.
   D. behaviours that dictate values to enhance integrity.
4. Which of the following is not a concept associated with integrity in physical activity?
   A. Fair and honest performances and outcomes, unaffected by illegitimate enhancements or external interests
   B. Positive engagement by stakeholders to enhance the reputation and perception of physical activity
   C. The development of individual morals through family socialisation
   D. The promotion of community confidence in physical activity
5. Illegitimate sport performance most accurately reflects which two fair play values?
   A. Fair competition and team spirit
   B. Sport without doping and excellence
   C. Excellence and integrity
   D. Fair competition and equality

SHORT-RESPONSE QUESTIONS

1. Compare and contrast ethics and morals.
2. Evaluate the level of impact that illegitimate competition has on enjoyment for you as a participant.

EXTENDED-RESPONSE QUESTION

Propose and justify two recommendations that would enhance the fair play principles currently displayed in your Physical Education class.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 18

Factors that influence ethics and integrity in physical activity

What's ahead?

Chapter 18
Factors that influence ethics and integrity in physical activity

- **18.1** The role of peers, family, coaches, school and community in developing personal values and ethical behaviours
- **18.2** Globalisation and media coverage as stimuli for ethical values and behaviours
- **18.3** The influence of media coverage on ethical values and behaviours
- **18.4** Creating policies to mandate ethical behaviours

Key subject matter

- Identify the role of peers, family, coaches, school and community in the development of personal values and ethical behaviours in physical activity.
- Explain how a system of ethical values and ethics strategies influence fair play and integrity of individuals or teams in physical activity.
- Comprehend and describe how ethics strategies can positively or negatively influence integrity.
- Access codes of behaviour and conduct, and rules and polies (including risk assessment) in class, school and community contexts to identify how they support ethical behaviour and fair play in physical activity.
- Identify and explain how globalisation and media coverage have influenced ethical values and behaviours.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What role do peers, family, coaches, school and community play in the development of personal values and ethical behaviours in physical activity?
- How do globalisation and media coverage influence ethical values and behaviours?
- What are ethics strategies?
- How can ethics strategies be used to positively influence fair play?
- How can ethics strategies be used to positively influence integrity?
- What codes of behaviour and conduct and rules and policies already exist to support ethical behaviours in class, school and community contexts?

ISBN 978-1-009-31125-0 Stewart et al.

18.1 The role of peers, family, coaches, school and community in developing personal values and ethical behaviours

The process of socialisation describes the way an individual acquires knowledge, language, social skills and values from their surroundings. It is through engaging with various agents of socialisation that individuals learn acceptable social norms. The process of socialisation is comprehensively explained in Chapter 12, where peers, family, coaches, schools and the broader community are all established as essential agents for establishing appropriate values, attitudes and behaviours.

FIGURE 18.1 Coaches are significant agents for enforcing ethical behaviours for the individual in physical activity.

1. They set the ethical standards	2. They demonstrate the ethical standards	3. They enforce the ethical standards
Through the values and behaviours displayed, these groups demonstrate what is acceptable within the physical activity context. These values and behaviours then form the basis for the development of ethical standards. Ethical standards may be created through the formulation of specific policy documents to be followed, or may be communicated informally to individuals from the group. Ethical standards are designed to ensure that individuals act with integrity and understand how to create a positive physical activity experience for all.	Once ethical standards are established, it is the role of peers, family, coaches, schools and the broader community to uphold these standards. It is through observation that individuals establish their own values and behaviours as part of the socialisation process. Therefore, each member of these groups must act as a role model, enacting the ethical standards to demonstrate them to the individual. Without effective role modelling from the larger group, individuals may not display ethical behaviours, as they are not deemed to be important, or they may learn alternative undesirable behaviours if these are being displayed.	When individuals display unethical behaviours or actions that lack integrity, it is the responsibility of these groups to provide consequences. When poor behaviours are left unchecked, it is far more likely that they will recur. Where formal ethical guidelines exist, consequences may be also outlined for infringements of these standards. However, in the case of family or peers, infractions of the unwritten ethical standards may result in a wide variety of consequences governed by parenting style or peer group composition.

FIGURE 18.2 Socialising agents play three key roles in developing ethical behaviours and values surrounding physical activity for the individual.

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 18.1

1. Copy and complete the following table by adding relevant information to the rows for each agent of socialisation.

Agent of socialisation	An example of an ethical standard established from this agent that relates to physical activity	An example of how others display this standard	A possible consequence for breaking this standard
Informal, unwritten ethical standards			
Family	Always put in maximum effort	Siblings always train with high intensity	Spoken to by parent to find cause of low effort and reminder to always try your hardest
Peers			
Formal, written ethical standards			
Coaches	Treat players, officials and all others with respect	Listening when the coach is giving instructions	Loss of playing time or starting position on the team
Schools			
Community			

2. Think of an example of an ethical standard that you observe across all agents of socialisation listed in the table. In 100 words, use various examples from your upbringing to describe how the process of socialisation has taught you this ethical standard.

18.2 Globalisation and media coverage as stimuli for ethical values and behaviours

Globalisation is the process by which the societies, cultures and communities of the world are becoming increasingly interconnected. Historically, different societies were limited in their interactions with others due to geographical location and a lack of technology. However, advancements in transport and communications (such as the internet) now ensure that all people can interact with others across the planet. This modern phenomenon has greatly enhanced economic trade, cultural exchange and the sharing of ideas.

globalisation the process by which the world is becoming increasingly interconnected

Globalisation has affected physical activity in many ways. There are economic benefits as a worldwide marketplace for sport is now a reality. Some activities, such as football (soccer), tennis, motor racing and golf, are popular on the world stage and enjoy lucrative financial benefits as a result. Sports like badminton continue to grow in popularity in specific regions such as Asia, and help to develop a cultural exchange for those areas. While badminton participation remains comparatively low in Australia, its popularity has grown – partly due to globalisation and an increased connectedness to our Asian neighbours.

ISBN 978-1-009-31125-0 Stewart et al.

Other activities that have ventured beyond their own national boundaries have developed both financial rewards and cultural change. Consider the impact of the NBA (America's elite basketball competition) on the world and Australians. Improved technology sees games broadcast in over 200 countries and translated into over 45 different languages, and with the inclusion of streaming platforms its global reach is only limited by technology. Thanks to the internet, anyone is able to access games, and social media allow a global community of fans to follow their favourite player or team. While basketball in Australia has traditionally been valued poorly, through globalisation American basketball is more popular than our own domestic competition, and it is more common to see Australians wearing franchised supporter clothing of NBA teams than Australian NBL teams. As a result of global marketing, the best basketball players in the world desire to be part of the NBA's money and fame.

While globalisation has facilitated interest in and access to a wider variety of physical activities, it has also increased the ethical issues associated with physical activity. Typically, unethical behaviours are the result of three key areas associated with globalisation:

- increased economic benefit
- increased fame and status for organisations, clubs and players
- increased national status on the world stage.

Due to globalisation, there are now much greater rewards in these areas, and therefore greater incentives for those involved with physical activity to act in unethical ways. There are also increased incentives for those outside the sporting field to show an interest for financial gain. This can be beneficial in terms of international sponsors bringing billion-dollar companies into the sporting arena, or detrimental with regard to organised crime and betting syndicates. While the risks involved are high, the benefits can be very lucrative, and therefore unethical behaviours can be tempting for those with lower personal moral standards.

KEY MESSAGE

Globalisation has stimulated cultural exchange and economic growth within all areas of society, including physical activity.

KEY MESSAGE

Globalisation has provided positive benefits to physical activity.

KEY MESSAGE

Globalisation has increased the rewards involved in sport, and as a result there is more incentive to act unethically.

CHECK-IN 18.2

1. As a class, brainstorm a list of unethical incidents in sport that have occurred on the world stage over the last 15 years. Note the incident, the sport and any specific players involved.
2. Spend 30 minutes engaging in some secondary research using the internet to source other examples. Discuss search words that may assist in refining searches for the topics you seek. As new examples are found, add them to the list you have already created.
3. Examine the incidents, and identify three sports that have questionable integrity resulting from these occurrences.
4. Using specific examples as evidence, outline a physical activity that has low worldwide integrity.

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 18.3

1. Assess the overall impact of globalisation on physical activity by creating a list of positives and negatives.
2. Your teacher will divide the class in half for you to engage in an informal debate on the following subject: 'Globalisation has been detrimental to the integrity of sport.' Both sides will have time to prepare their basic arguments and present point and counterpoint in a structured class argument. Alternatively, you may be asked to construct a 300-word persuasive essay either for or against the above contention.

18.3 The influence of media coverage on ethical values and behaviours

In response to the cultural significance placed on sport in Australia, the **media** have always had a vested interest in reporting sporting achievements. From recording Don Bradman's cricketing accomplishments from England in 1930 to the television broadcast of the 1956 Melbourne Olympics to modern State of Origin telecasts and broadcasts of the Olympic and Commonwealth Games, the Australian media have always been advocates for physical activity. Due to ongoing technological advancements, the media are now engaging with Australians in all aspects of life. On a typical day, many Australians engage more with the media – including online – than with family and friends. Consequently, the media have developed into a key agent of socialisation with a significant influence over the values of individuals. The images and messages that the media send to viewers are therefore vital to the way individuals embrace physical activity.

Within contemporary Australian society, the media both reflect and set standards when it comes to ethical behaviours. In the end, media organisations are businesses, and the most successful media outlets are those that attract the largest audience share. Engaging an audience involves the media providing a product that relates to a large proportion of the population. Therefore, the media have financial incentives to publicise topics in ways that reflect the values and expectations of the majority of people. The media will reflect the dominant culture in order to retain their audience. Consider an athlete caught taking performance-enhancing drugs after winning an international event. The media would report on this in a negative way, branding the athlete a cheat and a national disgrace. Here the media are simply reflecting social expectations about fair play, and reinforcing society's expectations on ethical standards.

media the collective term for the main means of mass communication in society; includes broadcasting, publishing and the internet

There would be very little incentive for the media to show the athlete as a victim of the highly stressful and competitive world of elite sport, as this would not reflect the ethical standards society has with regard to cheating.

Due to media saturation in our society, the media can also work to set ethical standards, particularly where there is division in public opinion concerning what is ethical. Consider a player terminating their contract with one club at the end of the season to take up a position at another for great financial gain. Media headlines may ask questions about the player's ability to play out the season or their commitment to their current club. In this sense, the media may be establishing an expectation that players should value loyalty over greater financial security. If this issue is in the media often enough, then public opinion may be influenced, as it 'appears' to be popular opinion. As a result, the governing body of the sport might feel pressure to review the guidelines around player transfers to retain the integrity of their competition.

Whether the media are reflecting or setting ethical expectations, there is no doubt that they serve as our 'social conscience'. This means that the media, through their headlines, stories and images, work to remind society of our values and ethical standards. The media tell us what should be offensive, what should be tolerated and what behaviours should be celebrated. They highlight popular social opinion, and therefore can influence the ethical standards and guidelines that are created in response to society's expectations.

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 18.4

1. At a youth sport level, the media seem to report regularly on the issue of competition guidelines regarding divisions. Discuss whether sports like Rugby League and Rugby Union should have competitions based on age, ability or size.
2. Undertake some research into how the media have covered this issue. From what you find, which method do the media seem to favour? Cite specific articles as evidence to justify your belief about the media's preference.

CHECK-IN 18.5

1. Through research, identify three players or clubs that have displayed unethical behaviours, resulting in a loss of sponsorship. For each, note the player or club, the sponsor and the behaviour that was displayed.
2. Select a player in any sport who you believe has integrity. Make a list of the behaviours they have displayed throughout their career (both on and off the field) that have built this 'ethical capital.'

The media's role in creating sporting role models

Media saturation in the daily lives of many Australians means the performances and behaviours of players – both national and international – are readily accessible. News stories through traditional media forms, as well as the internet and social media, ensure that elite players are under constant scrutiny. On-field performances are critiqued, with behaviours and reactions judged. Off-the-field lifestyles, relationships and social interactions are all a source of news for traditional and social media. It is due to the constant media attention given to athletes that they have become important role models in society. While at times athletes may be unwilling role models, there is no doubt that in the modern sporting era, they are held accountable to the game, the club, the team and themselves.

Athletes who display integrity and promote themselves positively are able to gain financial benefits, such as sponsorship. Clubs that have established a good reputation can also market themselves as being strong, clean, reliable, trustworthy and high-performing, and this increases their value to fans and makes them a sound investment for sponsors. There are certainly performers at all levels of sport who spend their whole career acting ethically, showing integrity and acting as outstanding role models for other members of society. However, players who continually demonstrate unethical behaviours and low integrity are seen as poor role models. They have very little ethical capital, and as a result poor ethical behaviours are not forgiven easily by the public and these athletes are labelled 'bad for the sport'.

FIGURE 18.3 Positive role models in the media are essential for maintaining integrity in sport and the value of physical activity for the Australian people.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 18.1

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How can students be good role models for younger athletes?

Demonstrate and apply

1. Your teacher will organise for your class to join with a younger Physical Education class for two lessons as they undertake their normal outdoor activity. You will not be there to coach, but to be a part of the learning just like the other younger students.
2. Before you engage in these lessons, brainstorm behaviours that would make you a good role model to these students. Consider behaviours under the following headings:
   a. as an athlete b. as a learner c. as a person.
3. Under each heading, plan two behaviours that you will aim to demonstrate throughout your two lessons with the other class.
4. Engage your plan while joining the selected class; you might not only demonstrate your selected behaviour, but also encourage others. For example, if your behaviour as a learner is to listen to instructions, you might ask others talking to be quiet so you can listen.

Analyse and synthesise

5. Reflect on the activity and make notes on how successful your strategies were, and how being a good role model to others made you feel.

Evaluate and justify

KEY COGNITION **Appraise**: evaluate the worth, significance or status of something; judge or consider a text or piece of work

6. From this experience, and knowledge of your own actions, appraise your contribution as a role model for younger students at your school.

18.4 Creating policies to mandate ethical behaviours

Society must continue to value physical activity, as it makes a significant contribution not only to the health of Australian citizens, but also the social and moral development of the Australian people. As physical activity is a multibillion-dollar industry, it is essential that people feel they are getting value for money when it comes to such a significant investment. To ensure the reputation of physical activity within Australian culture, it is vital that the community retains its confidence in sport. With every positive interaction with physical activity, community confidence grows and so does its value to the Australian people. However, with every negative experience or detrimental news story, public confidence is eroded and the value of physical activity declines.

The most effective way to increase positive experiences with physical activity, and to decrease the exposure to negative ones, is through being specific about what is acceptable and expected in the physical activity domain. This is achieved through the creation of **ethics strategies**. An ethics strategy is a method or plan of action devised to bring about ethical behaviours and encourage individuals

ethics strategy a method or plan of action devised to bring about ethical behaviours and encourage individuals to act with integrity; typically involves the creation of ethical standards, guidelines, frameworks or codes

ISBN 978-1-009-31125-0 Stewart et al.

to act with integrity. Typically, a strategy involves the creation, implementation and regulation of ethical standards, guidelines, frameworks or codes.

Ethics strategies are effective because they are explicit when setting expectations, can be mandated to individuals within a group and in many cases are easily policed. As these documents are based on social expectations, they reflect public opinion in setting norms, and are therefore widely supported.

An important aspect of any ethics strategy is that it is regularly scrutinised for its effectiveness. In other words, is the strategy achieving the desired outcome? Is there an increase in the number of individuals displaying the 'correct' ethical behaviours and a decrease in those being unethical?

Strategies also need to be reviewed periodically to ensure that they still reflect social values. The expected ethical behaviours of a community change over time, and policies and guidelines need to reflect these changes. Consider the tolerance given to on-field fights during Rugby League or Australian Rules football matches during the 1980s, compared with today. Current player codes now reflect a society that is less accepting of violence and physical assault. However, ethics strategies are easily changed through a review of wording, or by adding or removing specific sections. With the release of updated policies and guidelines, participants are again able to understand the new expectations set.

Organisations of all types and at all levels take on the responsibility of creating ethics strategies for the good of their physical activity. In some cases, these strategies are mandated by a higher authority to ensure the 'good running' of the school or club. Some of the institutions creating ethical policies related to physical activity are:

- government bodies (federal, state and local)
- government departments (e.g. Australian Sports Commission, Education Queensland, Queensland Curriculum and Assessment Authority)
- international sporting organisations (e.g. FIFA, the International Olympic Committee)
- sporting authorities
- sporting clubs
- schools.

These organisations produce ethics strategies in a wide range of areas relating to physical activity. A comprehensive list of these areas was displayed in Figure 17.10. However, the policies and guidelines that directly affect physical activity at a school level or in local clubs revolve around:

- behavioural standards for players, coaches, officials, parents, spectators and teachers
- diversity, equity and inclusiveness
- safety and risk management
- funding and sponsorship
- sport participation, development and education
- resource development and maintenance
- governance (how the institute is organised, run and makes decisions).

One key resource for all Australians involved in physical activity – particularly at a youth club level – is the Play by the Rules initiative. This website-based initiative provides a wealth of information for further investigation during this unit of work and may provide assistance when undertaking assessment tasks.

Play by the Rules provides information, resources, tools and free online training to increase the capacity and capability of administrators, coaches, officials, players, parents and spectators to assist them in preventing and dealing with discrimination, harassment, child safety, inclusion and integrity issues in sport.

FIGURE 18.4 The Play by the Rules initiative

Source: Play by the Rules website (www.playbytherules.net.au)

ISBN 978-1-009-31125-0 Stewart et al.

First developed by the South Australian Government in 2001, Play by the Rules has developed into a unique collaboration between the Australian Sports Commission, Australian Human Rights Commission and various departments from all states and territories. The investment in this strategy demonstrates the importance of ethical and equitable participation in physical activity for the Australian people.

KEY MESSAGE

Ethical strategies specifically outline the expected behaviours of all stakeholders in physical activity.

KEY MESSAGE

When followed, ethical strategies ensure that integrity is maintained.

KEY MESSAGE

Ethical strategies must continue to meet community expectations if they are to be effective.

CHECK-IN 18.6

1. Describe how ethics strategies can positively influence integrity.
2. Select a physical activity from the current senior Physical Education syllabus. As a small group or individual, locate policy documents that address behaviour and risk-management guidelines for each of the following groups for your selected activity:
   a. your Physical Education class
   b. your school
   c. a community sporting club.
3. Use the documents gathered to copy and complete the table below. You may wish to look back to Figure 17.11 to help you recall the values of fair play.

	What policies or guidelines exist that mandate behaviour or safety requirements?	**Who produced these documents?**	**Were the policies a mandated requirement from a higher authority? If so, whom?**	**Which values of fair play are targeted by the policies?**	**Which values of fair play are not specifically addressed in the policies?**
Class					
School					
Local community sporting club					

4. From analysing the documents gathered, identify two fair play values that are clearly supported through the ethics strategies.
5. From this analysis, identify one fair play value that is currently under-represented, and write a guideline that is designed to set an expectation for this ethical behaviour across all areas.
6. Write a short response, using examples from your research, that identifies how ethics strategies support ethical behaviour and fair play in physical activity.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- As agents of socialisation, peers, family, coaches, school and communities play a significant role in developing personal values and ethical behaviours.
- Socialising agents set, demonstrate and enforce ethical behaviours for the individual.
- Globalisation has brought both financial and cultural advantages to physical activity worldwide.
- The media are a significant agent of socialisation with regard to physical activity, and both reflect and establish ethical standards for society and the individuals within it.
- Positive role models in the media help to develop and maintain physical activity as a valued and important cultural activity.
- Poor role models devalue physical activity as a commodity and reduce the confidence society places in physical activity.
- Ethics strategies include policies, guidelines, codes and frameworks that set behavioural expectations and educate all involved in physical activity.
- Ethics strategies are essential in raising the level of integrity in physical activity, as well as the equity, access, engagement and enjoyment experienced by individuals.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. For peers, family, coaches, schools and communities, ethical standards can be both:
   A. enforced/enacted and unenforced/tolerated.
   B. legislated and policed.
   C. unspoken and tolerated.
   D. informal/unwritten and formal/written.
2. Globalisation:
   A. is a process where cultures are becoming more similar due to modern interconnected societies.
   B. describes the way in which activities, such as sport, are bringing nations closer together.
   C. is the process of communicating through worldwide mediums, such as the internet.
   D. is the process by which the world is becoming increasingly interconnected.
3. Which of the following is not an outcome of the way the media portray physical activity?
   A. The amount of sponsorship available for players and clubs
   B. The confidence that individuals have that they can be successful in physical activity
   C. The setting and maintaining of public expectations for ethical behaviours
   D. The increased interest in sport as an opportunity to make money illegally
4. Increased economic benefit, increased fame and status for organisations, clubs and players, and increased national status on the world stage are all outcomes of what phenomenon?
   A. Fair play
   B. Globalisation
   C. The integrity policy
   D. The social media revolution
5. Policies and guidelines that most directly affect physical activity at a school and local level address:
   A. behavioural standards.
   B. diversity, equity and inclusiveness.
   C. safety and risk management.
   D. all of the above.

SHORT-RESPONSE QUESTIONS

1. Using an example from Australian sport, explain how the media's portrayal of players can create a negative role model and how this might affect the standing of sport in general for Australians.
2. Explain why club guidelines on behavioural standards for all stakeholders are important to local community-based sport.

EXTENDED-RESPONSE QUESTION

In a 300-word response, justify how one of the following factors influences ethics and integrity for individuals undertaking physical activity.

- Friends and teammates
- The media
- School guidelines for inclusion in Physical Education

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 19

Ethical dilemmas and decision-making

What's ahead?

Chapter 19
Ethical dilemmas and decision-making

- **19.1** What are ethical dilemmas?
- **19.2** Ethical decision-making
- **19.3** Enhance integrity and positive engagement through ethics strategies in response to ethical dilemmas in physical activity

Key subject matter

- Identify ethical dilemmas (gender inclusion or exclusion, ability, enhancements in technology and equipment, corruption) through involvement in physical activity contexts.
- Recognise and explain the ethical decision-making framework for exploring ethical dilemmas.
- Apply the ethical decision-making framework to investigate the factors that influence integrity in class, school and community physical activity contexts.
- Gather primary data about the relationship between ethical dilemmas, the influence of concepts and principles about ethics and integrity, and engagement in physical activity.
- Use secondary data to analyse how the development of ethics strategies can influence engagement in physical activity.
- Analyse primary data and secondary data to ascertain relationships between the ethical dilemma, ethics strategy, concepts and principles and engagement in the class, school and community physical activity contexts.

ISBN 978-1-009-31125-0 Stewart et al.

- Analyse and synthesise primary data and secondary data about ethical dilemmas in class, school and community contexts to identify individuals and groups who have an important stake in the outcome and strategies that have been used in response to similar problems or situations.
- Devise ethics strategies that provide a course of action in response to the ethical dilemmas that identify the audience, context and outcome to be achieved.
- Justify the development of the ethics strategies using evidence from primary data and secondary data.
- Propose or implement the ethics strategies to gather primary data about the potential outcome and limitations about decisions.
- Reflect on primary data and secondary data to evaluate the effectiveness of the ethics strategies to enhance integrity and optimise engagement for all stakeholders in the class, school and community physical activity contexts.
- Make decisions to maintain or modify the ethics strategies to optimise integrity and engagement in the class, school and community physical activity contexts.
- Justify maintenance or modification of the ethics strategies using evidence from primary data and secondary data.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What are ethical dilemmas?
- What is ethical decision-making?
- Why is ethical decision-making required in a modern physical activity context?
- How can an ethical decision-making framework help limit ethical issues and increase integrity?

ISBN 978-1-009-31125-0

19.1 What are ethical dilemmas?

Ethical dilemmas are situations that extend across different areas of morality. A number of options must therefore be considered to resolve the situation; in many cases, none of the solutions are totally ethically acceptable or preferable. Ethical dilemmas exist in all areas of daily life. An easy example might be sharing your homework with a friend who has not completed it. Do you provide your work to copy, knowing the other person has not put in the effort and would not be learning from the experience? Or do you support a friend by assisting them in their time of need? Which solution is more beneficial for your friend and you?

Another example, which relates more to physical activity, may be a local council that must decide between funding for two community projects. One group is petitioning for $10 000 to upgrade the local athletics track used by 2000 community members, while another group requires the $10 000 to start a new archery club as there are currently no facilities for a projected 200 people. What is the council's decision and why? The solution to an ethical dilemma may not satisfy all affected, or solve the issue for everyone; however, an effective solution to an ethical dilemma is one that is equitable and justifiable, and in the case of physical activity, one that reflects the values of fair play.

FIGURE 19.1 Ethical dilemmas in Physical Education can be grouped into four priority areas of study that affect equity or access within physical activity.

ethical dilemmas situations that extend across different areas of morality, and therefore available options to resolve the situation may not be totally ethically acceptable or preferable to all stakeholders involved

As ethical dilemmas occur in all aspects of life, this can be a very broad subject to discuss and analyse. The Physical Education General Senior Syllabus (Queensland) defines ethical dilemmas in physical activity as:

> "gender inclusion or exclusion, ability, enhancements in technology and equipment, corruption"
>
> Source: Physical Education 2025 v1.1 General Senior Syllabus © Queensland Curriculum & Assessment Authority

CHECK-IN 19.1

1. Have each student in your class write about an ethical dilemma that is experienced in your Physical Education class when undertaking physical lessons. Consider each of the following four areas:
   a. gender inclusion or exclusion in physical activity
   b. the impact of ability levels on engagement and enjoyment in physical activity
   c. the equitable distribution of technology and equipment enhancements for physical activity
   d. the influence of corruption over fair play in physical activity.
2. Quickly review each person's suggested ethical dilemma and decide on one from each category.
3. Divide the class into four groups and allocate one of the selected dilemmas to each group.
4. As a group, consider the issue and make a recommendation to improve or eliminate the dilemma in future lessons.

ISBN 978-1-009-31125-0 Stewart et al.

Gender inclusion or exclusion

For many physical activities that traditionally are stereotyped as gender-neutral, there are competitions that are male, female and mixed. This allows personal preference for an individual to engage with the activity in a way that is comfortable for them. Examples include touch football, volleyball, tennis, badminton and Oztag. Other physical activities, such as Australian Rules Football, Rugby League, Rugby Union, cricket and netball, often encounter ethical dilemmas with mixed divisions. This is due to the physicality of the activity, where a sense of fairness and the possibility of injury are weighed against being inclusive. These activities must also work against cultural stereotypes, which see them as male or female activities. Gender guidelines are also challenged when overlaying a modern perspective of gender, sexuality and discrimination on guidelines and sports trying to implement appropriate policies that cater for gender diversity. Due to the biological differences between the sexes – such as speed, muscular strength and power – activities such as swimming, triathlon and track and field events continue to have separate male and female divisions to retain a sense of fairness and equality. However, these guidelines and structures are more frequently being challenged to reflect a change on society's understanding of gender.

Ethical dilemmas surrounding gender inclusion can often result when catering for individual needs or due to a lack of other participants. Some people prefer to engage only with the same gender in physical activity – it provides a sense of fairness in an environment that enables confidence and may be free of judgement. Consider the existence of women-only gyms or fitness training sessions. Others prefer the challenge or the social aspect of a mixed environment. In some situations, gender inclusion issues result due to a simple lack of participants: there may not be enough players to establish a male or female competition, and therefore the participant must either play with the opposite sex or not play at all. All sports aim to be inclusive of all genders; however, on a case-by-case basis, each individual situation may provide a different ethical dilemma.

ENGAGE 19.1

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How do ethical guidelines based on gender create an ethical dilemma in individual physical activities?

Demonstrate and apply

Note: For single-sex classes, or for an alternative, this activity may be undertaken using bibs to allocate male and female gender roles. When you reach the evaluate and justify section, you may draw on other anecdotal primary data that you have experienced outside of the current Physical Education environment.

1. In an individual sport, conduct a one-lesson mixed competition. Consider archery, golf, lawn bowls, badminton, tennis, or a track and field event.
2. As a class, create a simple method to collect the following data for all participants post-competition: engagement, enjoyment, confidence.
3. Use the following scale for each.

Very low	Low	Normal	High	Very high
1	2	3	4	5

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

4. Use a simple tally table to collate the data for the class, such as the example below, noting the responses for each gender.

	Very low		Low		Normal		High		Very high	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Engagement										
Enjoyment										
Confidence										

5. Run the competition and collect data.

6. In another lesson, run two separate competitions in the same activity – one male and one female.

7. Run the competition and collect the same data set.

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

8. Analyse the data sets as a class, looking for trends – for example, did females generally engage more in the mixed competition?

9. Seek additional information:
   a. that may be impacting the data – for example, where there was very low engagement, was this a result of the competition or simply a lack of interest or ability in the selected activity?
   b. that may assist in understanding – for example, which students preferred the mixed competition and which preferred the segregated environment? Why was this the case?

Evaluate and justify

10. Using the primary data collected to justify your response, outline some of the ethical issues faced when individual physical activities create competitions based on gender.

Note: This activity could be run across two or three different physical activities to collect a variety of data.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 19.2

DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: How do ethical guidelines that are inclusive of genders create an ethical dilemma in team activities?

Demonstrate and apply

Note: For single-sex classes, or for an alternative, this activity may be undertaken using bibs to allocate male and female gender roles. When you reach the evaluate and justify section, you may draw on other anecdotal primary data that you have experienced outside of the current Physical Education environment.

1. As a class, select a team physical activity and play a structured mixed match for a set time (e.g. 25 minutes). Ensure that there is an equal number of males and females on the field for each team at any point; this is important for data collection. Modify where teams usually consist of an odd number (e.g. basketball). Activities might include basketball, futsal, touch football, hockey, soccer, Oztag or any other suitable invasion game.
2. During the match, use a simple tally sheet to record the number of times someone from each gender touches the ball. If possible, consider recording the touches for each individual player and then collating gender data later.
3. Engage in the match.
4. Many mixed-team sports (or Physical Education classes) contend with the integration of male and female players. While female players are represented on the field, they may not be fully included in the play. They may find themselves at the extremities of the field, or cut out of the action. Investigate rules or practices that team sports use to better integrate males and females on the field – for example, maximum–minimum representation on the field at all times, different scoring systems for males and females, or females must touch the ball before scoring.
5. For the physical activity selected, implement rules that are more inclusive of female players – for example: double points if a female scores; a female must touch the ball in every play; before a point is scored, a female player must touch the ball.
6. Implement the game under the same team structure as earlier and record female and male involvement using the same data-collection method.

Analyse and synthesise

7. Review the data sets as a class, looking for trends. For example:
   a. Did females generally engage more when the rules required them to do so?
   b. What percentage increase or decrease was there in male and female involvement?
   c. Did females score more when rules were implemented?
8. Seek additional anecdotal evidence. For example:
   a. Did players adjust their strategies to be more inclusive of females?
   b. Did females feel more involved in the match?
   c. Did females feel like this engagement strategy was helpful or condescending?
   d. How did males feel when they were required to be inclusive?
   e. Which match did males and females enjoy more?

Continued »

ISBN 978-1-009-31125-0

Evaluate and justify

9. Using primary data to justify your argument, write a 200-word persuasive response either for or against the following statement: 'All Physical Education classes involved in mixed activities should permanently mandate rules that promote gender engagement.'

CHECK-IN 19.2

1. Gender inclusion in or exclusion from physical activity is one area of study where ethical dilemmas occur. In a think–pair–share activity, think of some ethical dilemmas that may occur under this heading for each category below:

Local-level sport	
Elite-level sport	
Youth sport	
In team activities	
In individual activities	

2. The Play by the Rules website offers some great advice for people faced with a wide variety of ethical dilemmas. Access the site and work your way through the 'Girls Playing in Boys Teams' interactive scenario to learn more about this specific issue.

The impact of ability levels on engagement and enjoyment

ENGAGE 19.3

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: How can ability levels be used in an inclusive way?

Recognise and explain

1. As a class, select an individual physical activity – for example, archery, badminton, tennis, triathlon, or a track or field event.
2. Investigate the handicap system employed in golf. How does it work? How does it create equity for players of different ability levels during competition?
3. Engage in some game play for the individual physical activity selected to assess ability level.
4. As a class, develop a handicap system for the selected physical activity and allocate handicaps to each student based on previous performances.

ISBN 978-1-009-31125-0 Stewart et al.

Demonstrate and apply

5. Apply your handicap system in a tournament environment to find a class champion in the selected activity.

Analyse and synthesise

6. Post-competition, collect class data on engagement, enjoyment and confidence using a similar method to that described in Engage 19.2.
7. Analyse the data and establish what trends were found.

Evaluate and justify

8. In a short statement, evaluate whether a handicap system in individual physical activities is an effective strategy to increase inclusiveness for participants.

ENGAGE 19.4

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: Do ability groupings encourage participation in team physical activity?

Demonstrate and apply

1. As a class, select a team sport.
2. Collect primary data by engaging in a series of matches, with team selection for each match based on different criteria:
   a. random teams – mixed ability
   b. high ability vs. high ability and low ability vs. low ability
   c. age-based – born first half of year vs. born second half of year
   d. student-selected – friendship groups
   e. teacher-selected – 'even' teams.
3. Following each match, collect class data on engagement, enjoyment and confidence using a similar method to that described in Engage 19.2.

Analyse and synthesise

4. Review the data to ascertain the 'best system' of allocating teams for each data set.

Evaluate and justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

5. Decide which system for team make-up was most effective overall and justify your selection.
6. Outline the relationship found between ability level grouping and participation in your Physical Education class.

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 19.3

1. The impact of ability levels on engagement and participation in physical activity is one area of study where ethical dilemmas occur. In a think–pair–share activity, think of some ethical dilemmas that may occur under this heading for each category below:

Local-level sport	
Elite-level sport	
Youth sport	
In team activities	
In individual activities	

2. Select one of the ethical dilemmas that interests you, undertake some research and identify any policy documents or guidelines that might be available in your selected situation.

The equitable distribution of technology and equipment enhancements

Technology has been used in physical activity for as long as competitive sport has been a part of society. Consider the Roman gladiators, where the advantage of better weaponry or armour over an opponent may have been the difference between life or death. In a modern context, at the elite level, individuals, teams, clubs and countries all employ a myriad of people to research, analyse or develop a wide range of elements that may provide a competitive edge over an opponent. Even at the local level, some players will have access to better equipment than others.

The ethical issue that arises from technology and equipment concerns access to these resources. Where technology and equipment provide an advantage beyond what is acceptable to other competitors and spectators, the competition may be seen to be unfair – even if such technology may be within the rules. This might be particularly true if players, clubs or countries do not have the means or resources to utilise the same technological advances. Consider clubs, organisations or countries that do not have the necessary resources to fund the development of physical activity technology or the financial resources to supply it. Or even a young local golfer or tennis player who is unable to afford the best clubs or racquet.

Where there is a lack of fair access to technology and equipment, many fair play principles can be affected, such as fair competition, equality, joy and excellence. As a result, the unequitable distribution of technology and equipment to competitors can lead to competitions with diminished integrity and a lack of enjoyment.

FIGURE 19.2 What ethical dilemmas may occur in elite-level sport, such as international Rugby Sevens at the Commonwealth Games?

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 19.5

RECOGNISE & EXPLAIN
DEMONSTRATE
APPLY
ANALYSE & SYNTHESISE
EVALUATE
JUSTIFY

Inquiry question: To what level can an equitable distribution of resources and technology affect the fair play values of 'fair competition' and 'equality'?

Recognise and explain

1. As a class, brainstorm physical activities where technology and equipment have caused ethical issues in the past. Consider sports such as swimming, golf, cricket, tennis, cycling or motor car racing (F1).
2. As you create your class list, discuss the issues as they arise. You may undertake some secondary internet research as the discussion develops to find exact examples and how this influenced the sport. For example, was there a resulting rule change to ensure that the competition remained fair?

Demonstrate and apply

3. As a class, select an individual sport from tennis, badminton, golf or archery.
4. Engage in five competitive matches of this activity (for golf, this could mean using match play rules over three holes). Try to play against people of similar ability. Record the score in each match.
5. Now play the same opponents again; however, before each match play scissors, paper, rock, with the loser to use the following equipment:
   a. badminton: plastic racquet or one with broken strings
   b. tennis: mini-sized racket, wooden racquet or one with broken strings
   c. golf: fewer clubs or older-style clubs
   d. archery: arrows with torn fletching or tape around the shaft.

   For accurate data, try to approach the match with the same determination to win – don't give up just because of the equipment being used. Record scores for each match again.

Analyse and synthesise

6. Analyse your scores, looking to see how much the change in equipment changed the results.
7. As a class, discuss anecdotal evidence – were you encouraged by the situation or demotivated by poor equipment? Were you challenged or did you want to give up?

Evaluate and justify

8. As a class, discuss how a lack of equipment and resources can affect the fair play values of fair competition and equality.

KEY COGNITION

Consider: think deliberately or carefully about something, typically before making a decision; take something into account when making a judgement; view attentively or scrutinise; reflect on

9. Consider how this experience relates to athletes from wealthy or poor nations preparing for the Olympic Games.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 19.6

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: To what level can an equitable distribution of resources and technology affect the fair play values of 'fair competition' and 'equality'?

Demonstrate and apply

1. As a class, select two relatively evenly matched teams and engage in an invasion team activity for 20 minutes. Note the score.
2. If possible, equip one team with heart rate monitors for another 20-minute match. Members of this team are not allowed to have their heart rates above 140 bpm at any stage.
3. Alternatively, if heart rate monitors are not available, assign one team to participate at maximum 80 per cent intensity. Your teacher may referee/umpire, and if they decide a player is engaging beyond 80 per cent, then an automatic handover, point or free throw/pass might be awarded to the opposing team.

Analyse and synthesise

4. Reflect on the overall scores and see how this alteration affected the performance and outcome.

Evaluate and justify

KEY COGNITION

Consider: think deliberately or carefully about something, typically before making a decision; take something into account when making a judgement; view attentively or scrutinise; reflect on

5. Consider how this activity reflects the inequality experienced when some teams do not have access to appropriate training programs, training equipment or suitably skilled coaching staff. How does this affect the fair play values of fair competition and equality?

CHECK-IN 19.4

1. The equitable distribution of technology and equipment enhancements in physical activity is one area of study where ethical dilemmas occur. In a think–pair–share activity, think of some ethical dilemmas that may occur under this heading for each category below:

Local-level sport	
Elite-level sport	
Youth sport	
In team activities	
In individual activities	

2. Select one of the ethical dilemmas that interests you, undertake some research and identify any policy documents or guidelines that might be available in your selected situation.

ISBN 978-1-009-31125-0 Stewart et al.

The influence of corruption over fair play

One of the main underlying values and beliefs in physical activity is that the best player or team on the day will win – that this win is deserved, and is a result of the commitment and hard work put in during the lead-up to the event, and where both competitors were striving to perform at their best. Many of the inherently socially desirable values and behaviours gained through sport participation are based on this assumption about sporting performance – that it is fair.

One of the biggest affronts to the integrity of sport and physical activity is when there are issues of cheating as it undermines the high standards and values that we hold sport and our sporting role models against. When there is any issue of corruption in sport, even the suspicion that the competition is not fair, then integrity and enjoyment suffer.

ENGAGE 19.7

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How can corruption affect the integrity of competition?

Demonstrate and apply

1. As a class, select an individual sport, such as badminton, tennis, archery, or a track and field event, and identify the top four students to be part of a competition. Identify how this competition will run within the next lesson and publish a draw if required.
2. You will need some pretend money for this activity. The winner is to receive \$1000 for winning the competition. The remainder of the class will break into four groups, where your teacher will *secretly* allocate each group a player in the competition and give them \$10 000.
3. Each group is to use its allocated money to influence the result of the competition and get its player to win. The groups may use some class time to discuss how this might be achieved. The competition players' goal is to receive as much money as possible for their participation, but they cannot openly throw matches.
4. Conduct the competition in the next lesson, so groups have a chance to approach players privately.

Analyse and synthesise

5. Analyse the effect of corruption on the tournament in two stages.
6. Discuss the following:
   a. Which player ended up with the most money (including the \$1000 prize for winning and any bribes received)?
   b. Which groups had what players?
   c. What did groups do to influence the players involved? What was offered and what was taken?
   d. Did players change their performance or try their best?
   e. How were matches influenced – what actions did players take to affect the results?
7. Reflect on the following:
   a. Was there integrity in this competition?
   b. What unethical behaviours were demonstrated?
   c. What fair play values were undermined?
   d. Was the integrity of players maintained? Why or why not?

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Evaluate and justify

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

8. Use the table below to evaluate the degree to which each fair play value was affected by the corruption of this tournament.

Value	1 Very little	2	3	4	5 Significant
Fair competition					
Respect					
Friendship					
Team spirit					
Equality					
Integrity					
Joy					
Care					
Excellence					
Tolerance					
Solidarity					
Sport without doping					

ENGAGE 19.8

Inquiry question: Can one player influence a team result?

Demonstrate and apply

1. As a class, you will perform a team activity. However, one player from each team will be assigned the task of influencing the outcome. They must not alert other players that this is happening.
2. Engage in the match.

Analyse and synthesise

3. Debrief the activity by informing all there was a 'mole' on each team, and have students try to identify the player.
4. Discuss the actions displayed by each mole in trying to influence the outcome of the match.

Evaluate and justify

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

5. Evaluate whether one player can have a significant impact on the outcome of a team game.
6. In an appropriate format, outline the risks and rewards for an elite player who might be faced with this situation.

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 19.5

1. The influence of corruption over fair play in physical activity is one area of study where ethical dilemmas occur. In a think–pair–share activity, think of some ethical dilemmas that may occur under this heading for each category below:

Local-level sport	
Elite-level sport	

2. Explain why legitimate gambling operators have a vested interest in ensuring fair competition and equality.

19.2 Ethical decision-making

In life, individuals are faced with ethical decisions every day. Do they act in accordance with the established societal expectations? Do they follow the set ethical guidelines? Do they act with integrity? Or do they choose behaviours that are unethical? The decision about how to act in these circumstances is greatly influenced by the individual's own moral values. Some individuals have high ethical standards and high moral values, and for these people no level of reward can sway them towards unethical behaviours. However, for others, rewards such as winning, success, financial gain or fame are big temptations that may result in unethical behaviours. These ethical decisions may be the result of weighing risk and reward for the individual.

Ethical decision-making in senior Physical Education, however, is more focused specifically on the decision-making process of institutions in relation to the governance of physical activity. This ethical decision-making is in relation to the creation or reviewing of ethics strategies, or regarding the implementation of these strategies. Here, institutions such as clubs, governing authorities and schools, as well as government, must make ethical decisions to enhance the equity, access or fair play for participants in physical activity.

As these decisions affect a wide range of participants, it is important that the decision-making process is clear and transparent, as these organisations will be held accountable for their choices. When devising ethics strategies, such as policies, guidelines or codes, many institutions must demonstrate that they have followed the procedures and guidelines of higher governing bodies that have mandated a course of action. They must also demonstrate to the community that the strategies they devise are equitable. While any strategies will generally advantage some while disadvantaging others, it is an important aspect of accountability that a strategy can be justified to the community. This is why undertaking a formal, documented decision-making process is essential.

One example of this ethical decision-making process is how a club develops a code of behaviour for its players, officials, parents and spectators. The club itself needs to follow the guidelines set by the government regarding issues like equity, discrimination and inclusive practices. The club may also need to adhere to guidelines or templates handed down from the governing authority for its specific sport. The club may look to examples already established by other clubs, as well as canvassing its own members during the creation process to ensure that the code of behaviour reflects the values of members. While the resulting code may not please all individual club members, the ethical decision-making process undertaken should ensure that all see the value of adhering to the guidelines established.

Once ethics strategies are developed, they must be implemented effectively if they are to be successful. Again, having an **ethical decision-making framework** to document how a decision is reached is

ethical decision-making (in Physical Education) decision-making that provides integrity and accountability in relation to the governance of physical activity

ethical decision-making framework a specific decision-making process that ensures integrity and accountability in the resolutions made for the governance of physical activity, especially when determining the actions required in response to ethical dilemmas

ISBN 978-1-009-31125-0

essential to ensure that those affected feel the decision was reached after consideration of all possibilities. Ethical decisions need to reflect community expectations to:

- be free of bias
- be transparent
- be equitable and just
- explore all possibilities before making a final decision
- give consideration to possible consequences
- reflect community expectations.

Ethical decision-making while implementing a strategy can be demonstrated when enacting funding guidelines. Here a cricket club may have to make a decision about how to spend an amount of money. Does the club spend $2000 to repair the irrigation system for its fields, or does it spend the money on purchasing additional protective equipment for its junior teams? The ethical dilemma may be a result of conflicting priorities – the improved cricket fields would benefit all members, whereas the protective equipment only benefits some, but is a matter of child safety. Whatever the outcome, the cricket club will need to ensure that its members understand how an equitable and ethical decision was reached.

Decisions that are deemed ethical are those that reflect equitable practices. However, it is important to note that 'equity' can take on many meanings when it is part of any decision-making process. For example:

- Equity as *equality* – will the decision benefit every individual equally (or as many people as possible)?
- Equity as *need* – will the decision address an issue where some are disadvantaged?
- Equity as *inclusivity* – will the decision increase participation or engagement?
- Equity as *demand* – will the decision meet the requirements of those most frequently involved?
- Equity as *market equity* – will the decision produce a financial benefit?
- Equity as *efficiency* – will the decision be good value for money?

Each of these different 'interpretations' of equity must be considered during a decision-making process in order to provide a sufficient outcome to an ethical dilemma. However, these differing definitions of equity frequently contradict each other, and each may lead to a different ethical solution – hence ethical dilemmas are seldom easy to solve.

An ethical decision-making framework

An ethical decision-making framework provides structure to the decision-making process. It demonstrates transparency and ensures that decisions are informed and justifiable. When implemented correctly, a decision-making framework produces outcomes that are equitable.

The ethical decision-making framework presented in the Physical Education General Senior Syllabus (Queensland), and adapted in Figure 19.3, is just one model that demonstrates how ethical decisions can be made. There are many other similar processes that can be implemented to produce ethical results. Many institutions and organisations have their own established processes and guidelines in place to demonstrate how ethical decisions are made. The Play by the Rules website also provides advice on ethical decision-making that provides assistance for the remainder of this topic.

KEY MESSAGE

Ethical dilemmas occur both when tempted by unethical behaviours and when engaging with ethical strategies.

KEY MESSAGE

Organisations must demonstrate accountability and transparency regarding the decisions they make.

KEY MESSAGE

Undertaking a formal decision-making process demonstrates accountability and transparency.

ISBN 978-1-009-31125-0 Stewart et al.

The ethical decision-making framework: a five-stage process

STAGE 1

Identify the ethical dilemma
Clearly articulate the problem or situation and identify the tension that exists between the organisation's or player's values.
- Find information about:
  - the relevant facts of the problem or situation
  - all individuals and groups associated with the situation, what they want from the situation and the stake they have in the outcome.

STAGE 2

Identify possible solutions and/or behaviours
- Are there examples of similar dilemmas previously being addressed?
- Where previous examples exist, how successful were the strategies implemented *(i.e. extent to which behaviour changed or the dilemma solved, amount of people reached or helped, was the outcome a permanent change or band-aid solution, was it cost-effective)*?
- How effectively will the identified solutions transfer to your context? *Consider: How much will it need to be adapted? Will any adaptations affect the success of the strategy?*
- Are there any other possible solutions that have not previously been attempted? Consider:
  - totally new thinking; or
  - correcting the flaws in other strategies – where did they go wrong?
- Formulate a list of potential strategies.

STAGE 3

Evaluate alternatives
- Use criteria to evaluate potential strategies, which might include:
  - level of good produced *(which strategy will produce the most good and do the least harm)*
  - respect for rights *(which strategy will best respect the rights of all who have a stake)*
  - level of equality produced *(which strategy will treat people equally or proportionately)*
  - how many people will benefit *(which strategy will best serve the community as a whole)*
  - level of behavioural change *(which strategy will lead players to act with integrity, or reflect the values of fair play).*

STAGE 4

Devise a course of action
- Select a strategy based on evaluation.
- Refine or modify the selected strategy, if required, to better suit the context. *This may include how the strategy can best be delivered to the intended player/s, target group or organisation.*
- Implement the strategy.

STAGE 5

Reflect on the effectiveness of the strategy
- Determine the effectiveness of the strategy by:
  - gauging the degree to which the strategy has affected the dilemma (*to what degree has the problem been solved*) – what has changed, what has not?
  - gauging the longevity and sustainability of the changes displayed.
- Has there been a permanent change or will it revert?
- How long can the strategy continue? Does it need to continue?
  - dentifying any unforeseen consequences (both positive and negative) on all stakeholders?
- Determine whether the strategy should continue.
- Determine whether modifications to the strategy are required.

FIGURE 19.3 Ethical dilemmas in Queensland Senior Physical Education can be grouped into four priority areas of study that affect equity or access within physical activity. An ethical decision-making framework can be employed to address issues in all these priority areas.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 19.9

RECOGNISE & EXPLAIN DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How can I increase engagement in our current physical activity among junior students?

Recognise and explain

1. Individually or in small teams, develop a strategy to increase engagement for lower year levels in a physical activity that is assessed in your Senior Physical Education subject. The goal is to increase access for younger students so they will be more experienced when they reach Senior Physical Education.
2. Your strategy must be ethical, increase engagement and be realistic.

Demonstrate and apply

3. Use the ethical decision-making framework to guide the development of your ethics strategy for increased engagement, and document each stage as you progress right to the point of implementation. In researching potential strategies during stage 2 of the process, you might consider accessing the Clearinghouse for Sport website. This organisation provides a large amount of Australian-based physical activity research and guidelines for the development and justification of ethics strategies.

Evaluate and justify

4. Once you have devised your strategy, pair with another group or individual and take it in turns to explain your strategy and the ethical decision-making process you followed.

KEY COGNITION

Appraise: evaluate the worth, significance or status of something; judge or consider a text or piece of work

5. Provide a 100-word appraisal to your partner/group outlining the strengths and weaknesses of the strategy they proposed.

19.3 Enhancing integrity and positive engagement using strategies in response to ethical dilemmas

Ethical dilemmas occur as a result of many unique factors specific to the individuals and groups involved. Consequently, the ethics strategies developed to overcome these dilemmas must be tailored to the circumstances of the specific context. What works in one situation to enhance integrity and engagement may not always be as successful in a different context. As you investigate ethics strategies to address class, school and community ethical dilemmas through this chapter, it may be relevant to refer to Tables 19.1 and 19.2 as a reference to assist in guiding your research, strategies and evaluations.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 19.1 Integrity in ethical dilemmas

Integrity refers to the demonstration of morals and values through personal behaviours, which align with the ethics expected by the surrounding social or cultural group. In physical activity, behaviours that demonstrate integrity are those that promote community confidence in sports, including: • fair and honest performances and outcomes, unaffected by illegitimate enhancements or external interests • positive conduct by athletes, administrators, officials, supporters and other stakeholders, on and off the sporting arena, which enhances the reputation and standing of the sporting contest and of sport overall.
Key demographics to investigate include: • gender • age • ability level (including abled and disabled participants) • socio-economic status, and the related access to technology, equipment, resources and facilities • stakeholders – which individuals or groups have a vested interest in the situation.
Key questions to consider when contemplating ethics strategies to enhance integrity include: • What ethical (or unethical) behaviours are affecting integrity in the situation? • Which principles of fair play are not being demonstrated in reality, or in the policies, guidelines or routine practices of the stakeholders? • What does each stakeholder want from the situation? • What are the real motivators influencing the integrity of individuals or groups? • What can be done to enhance the integrity of all stakeholders involved in the situation? • How can the physical activity (or the policies, guidelines or routine practices surrounding the physical activity) be modified to enhance integrity? • What concessions might be required by different stakeholders to reach a more satisfactory outcome for all stakeholders?
Key areas to investigate include: • current policy documents – scrutinise for areas that might affect integrity (ethical behaviours being displayed) • the routine practices of institutions.

TABLE 19.2 Engagement in ethical dilemmas

Engagement refers to both becoming involved in physical activity and maintaining that involvement. In a physical activity context, ethical dilemmas associated with engagement can investigate two areas: • social, cultural or environmental factors that limit the opportunities for engagement experienced by an individual • personal factors that prevent an individual from engaging in physical activity.
Key social factors to consider when investigating engagement strategies include: • the role of family through value placed on activity, financial considerations, their involvement, available time and competing priorities • the role of peers through their interests, engagement levels and support • the behaviours and attitudes of teachers and coaches.

ISBN 978-1-009-31125-0
Stewart et al.

TABLE 19.2 *(continued)*

Key cultural factors to consider when investigating engagement strategies include: • gender expectations and stereotyping • cultural expectations for the amount and type of engagement • the associated institutes – the policies, strategies and codes of government, sporting authorities, clubs and schools. Key documents might address: • diversity, inclusion or discrimination • funding and sponsorship • resource allocation and maintenance • codes of behaviour • competition structure • development strategies for improving performance and engagement • the distribution of and access to physical, human or financial resources • the role of promotion or media coverage.
Key environmental factors to consider when investigating engagement strategies include: • the availability and quality of facilities.
Key individual factors to consider when investigating why people choose to disengage with physical activity include: • the level of enjoyment experienced (feelings of fun or success, their contribution being valued, a sense of inclusion) • their level of confidence (perceived level of ability, possibility to improve and the chances of success) • their level of motivation: Why would I participate? What are the benefits? • their personal values and attitudes towards engagement in physical activities or specific activities • the level of autonomy experienced (do they have control over what they do and how they participate) • the interest in the specific activity • other priorities in life • available time • available finances. These factors will be heavily influenced by the principles of fair play experienced by the individual – fair competition, respect, friendship, team spirit, equality, integrity, joy, care, excellence, tolerance, solidarity and sport without doping.
When investigating ethical issues related to engagement, consider all aspects of engagement. This includes the opportunity to: • participate (access to physical activity, and the players, officials and management to undertake games) • develop skills and improve (access to quality teachers, coaches and resources) • be successful – reach higher representative levels, make a career, receive earnings or prestige (access to quality competitions, media, rewards, sponsorship) • enjoy participation (what aspects of the activity may be positively or negatively affecting the enjoyment experienced by participants).

ISBN 978-1-009-31125-0 Stewart et al.

Key questions to consider when contemplating ethics strategies to enhance engagement include:

- Which demographic groups currently participate in the physical activity?
- Which demographic groups are currently being marginalised or excluded?
- What are the real barriers restricting engagement to individuals or groups?
- Are any barriers to engagement found in current policies, guidelines or routine practices?
- What situations may be decreasing positive engagement for the physical activity?
- What can be done to remove or limit the effect of these barriers for individuals or groups?
- How can fair play be enhanced to optimise positive engagement?

Ethical dilemmas in a class context: Integrity

ACTIVE INVESTIGATION 19.1

RECOGNISE & EXPLAIN | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: Can physical activity lessons be inclusive of the ability level of all class members?

Recognise and explain

1. As a class, collect primary data by tracking individual performance for all class members in a selected physical activity for a number of lessons.
2. Using an appropriate game performance assessment instrument, assess the level of individual skills and make an overall evaluation of the ability level for each class member.
3. Make notes on how your teacher accounts for different ability levels in their teaching practice (games and activities).
4. Divide the class into three groups: higher ability, typical ability and lower ability. Have each group reflect on how the skill development needs of their allocated ability level are currently being met, and how they could be improved.

Analyse and synthesise

KEY COGNITION

Analyse: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

5. Analyse the primary data collected by reviewing strengths and weaknesses in individual skills and the range of overall ability levels within the class. Analysis may include presenting data in tables or graphs to identify trends.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

6. In small groups, design a one-lesson strategy (lesson plan) that employs inclusive practices to enhance the skills of all ability levels within your class for your selected physical activity of study. Your group must document the use of the five-stage ethical decision-making framework to devise this ethics strategy. While using the framework, ensure that your group undertakes secondary research to synthesise contemporary and inclusive training activities to develop the desired skills. In devising your strategy, consider:
   a. the different skills that require improvement (addressing everyone's needs)
   b. how students are organised (individual, ability groups, mixed-ability groups, whole class)
   c. the amount and range of activities included (addressing student needs, interest levels and enjoyment)
   d. skill-development activities or game play
   e. autonomy (student choice versus allocated activities)
   f. safety and resources (what can safely be undertaken and monitored).
7. Over a series of lessons, implement the strategies devised by each group.
8. At the completion of each group's lesson, survey class members to identify how inclusive the lesson was in meeting their developmental needs. Possible survey questions may include:
   a. To what degree did the lesson meet your overall needs?
   b. Did the lesson target the skills on which you needed to focus?
   c. Do you feel like you experienced improvement by the end of the lesson?
   d. Did the lesson cater for your ability level more than a typical Physical Education class?
   e. Did you feel part of the class group?
   f. Which aspect of the lesson was most inclusive?
9. You should also develop a rating scale for survey responses (e.g. not really, somewhat, pretty well, extremely well).
10. As a group, collate your post-lesson primary data and analyse the results.

Evaluate and justify

11. In a 200-word evaluative statement, use two pieces of evidence to highlight the effectiveness of your strategy in being inclusive to all ability levels in the class. Make one recommendation that would further enhance your overall strategy.

ISBN 978-1-009-31125-0 Stewart et al.

Ethical dilemmas in a class context: Engagement

ACTIVE INVESTIGATION 19.2

RECOGNISE & EXPLAIN DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: Does implementing the fair play values in Physical Education classes increase student engagement?

Recognise and explain

1. Refresh your understanding of the values of fair play outlined earlier in the chapter – respect, friendship, team spirit, integrity, solidarity, tolerance, excellence, care and joy.

Demonstrate and apply

2. As a class, collect primary data on the extent to which each of these values is displayed in your Physical Education class during your outside lessons. Some data may have been gathered as part of Engage 17.10 (on pages 351–2); if not, make observations over a series of physical lessons.

Analyse and synthesise

3. Analyse your primary data by developing a rating scale and applying it to each fair play value. Also rate the overall enjoyment students experienced in outside physical activity lessons. Identify the five values that are most poorly displayed in your Physical Education class.
4. As a class, divide into five groups with each group allocated one of the identified fair play values.
5. Document your use of the five-stage ethical decision-making framework to devise a code of conduct for players in your class addressing the fair play value your group is assigned. Your code of conduct is to outline three key areas:
   a. a value statement (a short two- to four-sentence statement that explains the value for your class)
   b. the code (four dot points that set the expectations for your class)
   c. the behaviours (four dot points that provide examples of how to demonstrate the value during the physical activity being studied).

   In devising your code, ensure that you consult the class concerning the standard of behaviour that should be aspired to.
6. Collate the codes created from each group to form one code of conduct that addresses the five fair play values selected and promote your code and expected behaviours to all class members.

Demonstrate and apply

7. Over a series of lessons, implement the code of conduct and emphasise the importance of displaying the exemplar behaviours as often as possible during this period.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

Analyse: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

8. At the end of the implementation period, collect primary data on the success of the code in improving the fair play values addressed. Consider the following:
   a. Was there an increase in the awareness of the fair play values among students?
   b. Was there an increase in the behaviours that displayed the specific fair play value?
   c. Were there players or behaviours that went against the code displayed?
   d. Overall, was there increased enjoyment among students when participating?
   e. Overall, was greater integrity demonstrated by students when participating?
   f. Overall, did your classmates engage more enthusiastically than normal as a result of an increased emphasis on fair play during lessons?
9. Collate your post-implementation data in an appropriate format.

Evaluate and justify

10. In a 200-word statement using the primary data collected, respond to the inquiry question at the beginning of this activity.

Ethical dilemmas in a school context: Integrity

ACTIVE INVESTIGATION 19.3

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What ethical dilemmas must be overcome to optimise integrity in a school-based competition?

Demonstrate and apply

Your class will be creating and implementing a school-wide competition for a selected physical activity.

1. Your class will be divided into five groups. Your group will be allocated one of the following areas of responsibility:
   a. competition promotion
   b. team structure and draw
   c. competition time and resources
   d. risk management
   e. rewards and incentives.

ISBN 978-1-009-31125-0 Stewart et al.

2. Each group is to use the five-stage ethical decision-making framework to devise an ethics strategy that maximises integrity in their allocated area by promoting the fair play principles of friendship, team spirit, respect and joy. Consider:
   a. competition promotion (the images and words used to be inclusive of all year levels, genders, ability levels as well as how promotion will best reach all students)
   b. team structure and draw (How can teams make up guidelines to create fair competition? How will the type of draw maximise participation? Will any rule or scoring adjustments create a fairer, more inclusive competition?)
   c. competition time and resources (When will the competition be held to maximise the opportunity for all school members to participate? What resources will limit the competition – for example, number of playing areas, available referees/umpires?)
   d. risk management (What guidelines need to be followed and how does this impact on competition structure? What documents need to be completed or people consulted?)
   e. rewards and incentives (What prizes or prestige can be awarded as incentives? How will this be funded? What funds are available? Who receives the rewards?).
3. As a class, collate the work from each group, then promote and run the competition.

Analyse and synthesise

4. Following the competition, each group is to collect primary data from both participants and non-participants. Consider the following:
   a. *Participants:* Did your group's allocated area for organisation create a fair, enjoyable and engaging competition? Would participants play again in a similar competition? Would they consider playing outside of school?
   b. *Non-participants:* What prevented them from playing in the competition? Is there anything about the competition that could be changed to get them playing?

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

5. As a class, analyse and discuss the primary data collected.

Evaluate and justify

6. Using the PMI table below, reflect on the primary data collected and categorise points that affected the equity experienced by participants and non-participants.
7. From the PMI, identify the three biggest hurdles to creating a competition that displayed integrity.

Plus	Minus	Interesting
Factors that enhanced integrity	Barriers that hindered integrity	Any points of note about the competition organisation or implementation

8. In your groups, recommend one aspect of maintenance and one modification for potential future implementations of the ethics strategy to promote integrity.

ISBN 978-1-009-31125-0 Stewart et al.

Ethical dilemmas in a school context: Engagement

ACTIVE INVESTIGATION 19.4

Inquiry question: Can targeted ethics strategies reduce the barriers to engagement experienced by specific age groups?

Recognise and explain

1. *Collect primary data – stage 1:* As a class, identify a year level at your school that currently has poor access to the physical activity being studied or a specific activity chosen by your class. If your school is a P–12 campus, this may include primary year levels. To identify the year level, you may review the Physical Education curriculum offerings and school sports programs, as well as surveying students concerning their involvement outside of school.
2. *Collect primary data – stage 2:* For the identified year level, survey students regarding reasons for non-participation. Your survey should incorporate questions covering a range of individual, social, cultural and environmental factors that may be creating barriers to participation for this target group (refer to Table 19.2 to assist in survey construction).

Analyse and synthesise

3. As a class, document your use of the five-stage ethical decision-making framework to devise a two-lesson come-and-try program for a specific class in the year level identified. Your two-lesson program is to develop enjoyment, skill level and confidence for the selected physical activity. Your program may also attempt to address any other barriers identified during the analysis of primary data. For example, if the audience finds the activity boring, then your strategy may need to adapt the rules of the game to make it more appealing and exciting for the players. Ensure that you research appropriate secondary sources to provide a wide variety of engaging activities for the players.
4. The class may be broken into small groups and allocated different sections of the program to develop. Organise to implement your two-lesson come-and-try program for a class in the identified year level. Before commencing, survey the targeted students with regard to their level of:
   a. enjoyment
   b. skill
   c. confidence

   Also survey the likelihood of them participating in the selected physical activity outside the school.

Demonstrate and apply

5. Implement the program and collect post-program data on the same questions. Where students still identify that they are not likely to play outside of school, consider asking why.

> KEY COGNITION
> **Analyse**: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

6. Collate your pre- and post-implementation data in an appropriate format and analyse.

ISBN 978-1-009-31125-0 Stewart et al.

Evaluate and justify

7. Make an assessment of your program's ability to overcome barriers for the specific demographic by selecting one aspect of enjoyment, skill development or confidence, and evaluate how successful the program you implemented was in increasing levels in that area. Ensure that you identify positives and negatives from the program that influenced its effectiveness in the selected area.

Ethical dilemmas in a community context: Integrity

ACTIVE INVESTIGATION 19.5

RECOGNISE & EXPLAIN | DEMONSTRATE | APPLY | ANALYSE & SYNTHESISE | EVALUATE | JUSTIFY

Inquiry question: Is it ethical to overcome poor participation by using strategies that reinforce gender stereotyping?

Recognise and explain

Note: For single-sex classes, or for an alternative, this activity may be undertaken using bibs to allocate male and female gender roles. When you reach the evaluate and justify section, you may draw on other anecdotal primary data that you have experienced outside of the current Physical Education environment.

1. As a class, divide into two groups: males and females.
2. Each group is to use research and the analysis of secondary data to select a physical activity from the current version of the senior Physical Education syllabus that currently shows increased participation rates for the opposite gender. *If this cannot be done due to class size or undertaking a specific physical activity, then a stereotypically 'gender-neutral' physical activity can be utilised.*
3. Over one or two lessons in the performance environment, each gender group is to experiment with manipulating the playing conditions and rules to adapt the activity for their gender. Use the table below to help guide ideas for these changes.

Characteristics of 'female' sport	Characteristics of 'male' sport
Non-contact	Speed
Distance maintained between participants	Strength
Limited running space	Endurance
Set positional areas	Agility
No running with the ball	Physical contact, tackling and violence
Strict dress requirement	Risk-taking
	Open field

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Demonstrate and apply

4. Once your group has finalised its adaptations, implement them in a competitive match for your group. If possible, collect additional data by implementing the game with other Physical Education classes, year levels or groups outside of school – for example, at a club training session for another sport.

Analyse and synthesise

5. After the match, collect primary data relating to enjoyment and engagement.
6. From the data collected and your own experiences, complete the following SWOT analysis, specifically looking at rule changes that use gender-based stereotypes as a method of increasing engagement.

SWOT analysis

A SWOT analysis is used to evaluate the strengths, weaknesses, opportunities and threats related to an issue. Once you have done a SWOT analysis, you are better placed to make informed decisions or form an opinion.

Rule adaptation based on gender stereotypes	
Strengths	**Weaknesses**
• • •	• • •
Opportunities	**Threats**
• • •	• • •

Evaluate and justify

7. Reflect on your analysis and examine the five-stage ethical decision-making framework. Make a decision either for or against the statement, 'Using gender stereotypes is an ethics strategy to overcome an imbalance of participation rates.'

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

8. Justify your stance on this topic in a 400-word persuasive response that uses both primary and secondary data as evidence.

ISBN 978-1-009-31125-0 Stewart et al.

Ethical dilemmas in a community context: Engagement

ACTIVE INVESTIGATION 19.6

Inquiry question: How can ethics strategies enhance engagement for community clubs?

Recognise and explain

1. As a class, select a physical activity from the current version of the senior Physical Education syllabus. Conduct primary and secondary research into the participation rates and current barriers to engagement that may exist. This would include surveying a variety of community members from different demographics to establish barriers to participation. Surveys should include questions exploring personal, social, cultural and environmental factors (refer to Table 19.2 to assist in survey construction).
2. In one lesson, have a representative from a local club or sporting organisation visit your class and speak about the issues they face at a local level in administering a fair, equitable and inclusive competition, and the barriers that they perceive affect engagement. Use your primary and secondary data to ask clarifying questions of your guest speaker.

Analyse and synthesise

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

3. Using the five-stage ethical decision-making framework, synthesise the information you have collected to design a strategy for the guest speaker's organisation to increase engagement.

Evaluate and justify

4. Present your strategy in an appropriate format that clearly outlines the:
   a. target audience – who the strategy is aimed at
   b. context – the current situation at the club or organisation, and the details of the engagement strategy
   c. outcome – how the strategy will overcome identified barriers to participation for the target audience, provide more opportunities for engagement and create a more inclusive organisation.

   An appropriate format may include a video, PowerPoint presentation, brochure or poster that is designed to highlight the importance of undertaking your recommended strategy.
5. If possible, present your strategy to the guest speaker. Alternatively, present it to your teacher, who may select some to pass on to the relevant club or organisation. Ideally, your class would work with the organisation to implement this strategy at a local level.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Ethical dilemmas are situations that extend across different areas of morality; therefore, a number of options must be considered to resolve the situation – in many cases, none of the solutions is totally ethically acceptable or preferable.
- There are four main areas of investigation in senior Physical Education in relation to ethics and integrity: gender inclusion or exclusion; ability; enhancements in technology and equipment; corruption.
- Gender inclusion or exclusion concerns the ethical issues that affect integrity and engagement stemming from modern definitions of gender, inclusion and discriminatory practices and gender stereotypes.
- Ethical issues related to ability investigate how the learning and developmental needs of different ability levels can be accounted for through class, school and community contexts to ensure that engagement for all levels is enabled and the integrity of the organisation is maintained.
- Ethical issues regarding the distribution of technological and equipment enhancements investigate how all participants can access these resources to maintain an equitable and fair opportunity to competition on a level playing field.
- Ethical issues relating to corruption explore how competition and engagement free of cheating and external influences can be maintained, with the fair play principles of fair competition, equality and excellence being promoted.
- To solve ethical dilemmas, organisations should implement an ethical decision-making process to ensure that the solution they reach is equitable, accountable and transparent.
- Ethics strategies, developed through the ethical decision-making framework, can be applied in class, school and community contexts for the enhancement of physical activity integrity and engagement.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Ethical dilemmas extend across different areas of morality, making them difficult to completely solve because:

A. they typically involve different stakeholders, each with different and competing needs to be addressed.

B. there is never enough money to please all stakeholders.

C. organisations cannot develop inclusion guidelines that account for the individual needs of all stakeholders.

D. each individual and team has unique requirements that cannot be solved through policies and guidelines.

2. Which of the following is not a priority area of ethical dilemmas for physical activity identified in the senior Physical Education syllabus?

A. Corruption

B. Enhancements in technology and equipment

C. Enjoyment

D. Gender inclusion or exclusion

3. When physical activity fails to display fair play values, there is a decrease in:

A. enjoyment and engagement.

B. equity and transparency.

C. ethical standards.

D. social expectations.

ISBN 978-1-009-31125-0 Stewart et al.

4. Identify the correct sequence of the ethical decision-making framework.
   A. 1. Reflect on the effectiveness of the strategy
      2. Identify the ethical dilemma
      3. Evaluate alternatives
      4. Identify possible solutions and/or behaviours
      5. Provide a course of action.
   B. 1. Identify the ethical dilemma;
      2. Identify possible solutions and/or behaviours
      3. Evaluate alternatives
      4. Provide a course of action
      5. Reflect on the effectiveness of the strategy.
   C. 1. Identify the ethical dilemma
      2. Identify possible solutions and/or behaviours
      3. Provide a course of action
      4. Evaluate alternatives
      5. Reflect on the effectiveness of the strategy.
   D. 1. Evaluate alternatives
      2. Identify the ethical dilemma
      3. Identify possible solutions and/or behaviours
      4. Provide a course of action
      5. Reflect on the effectiveness of the strategy.

5. Which of the following are the three contexts through which ethics and integrity in senior Physical Education are investigated?
   A. Class, school and community
   B. Personal, social and community
   C. Family, peer and coaches
   D. Social, institutional and cultural

SHORT-RESPONSE QUESTIONS

1. Using examples, explain how equity can be defined in different ways when evaluating solutions to ethical dilemmas.

2. Justify a recommendation to increase the inclusiveness of different ability levels in your Physical Education class.

EXTENDED-RESPONSE QUESTION

Clearly outline the causes of three barriers to engagement for a specific sport in your local area. For each barrier, devise a recommendation that will increase engagement and justify how integrity for the specific sport will increase as a result.

ISBN 978-1-009-31125-0

Unit 4

Energy, fitness and training in physical activity

Unit 4:
Energy, fitness and training in physical activity

Topic 1:
Energy, fitness and training integrated in physical activity

Chapter 20 | Chapter 21 | Chapter 22

Unit description

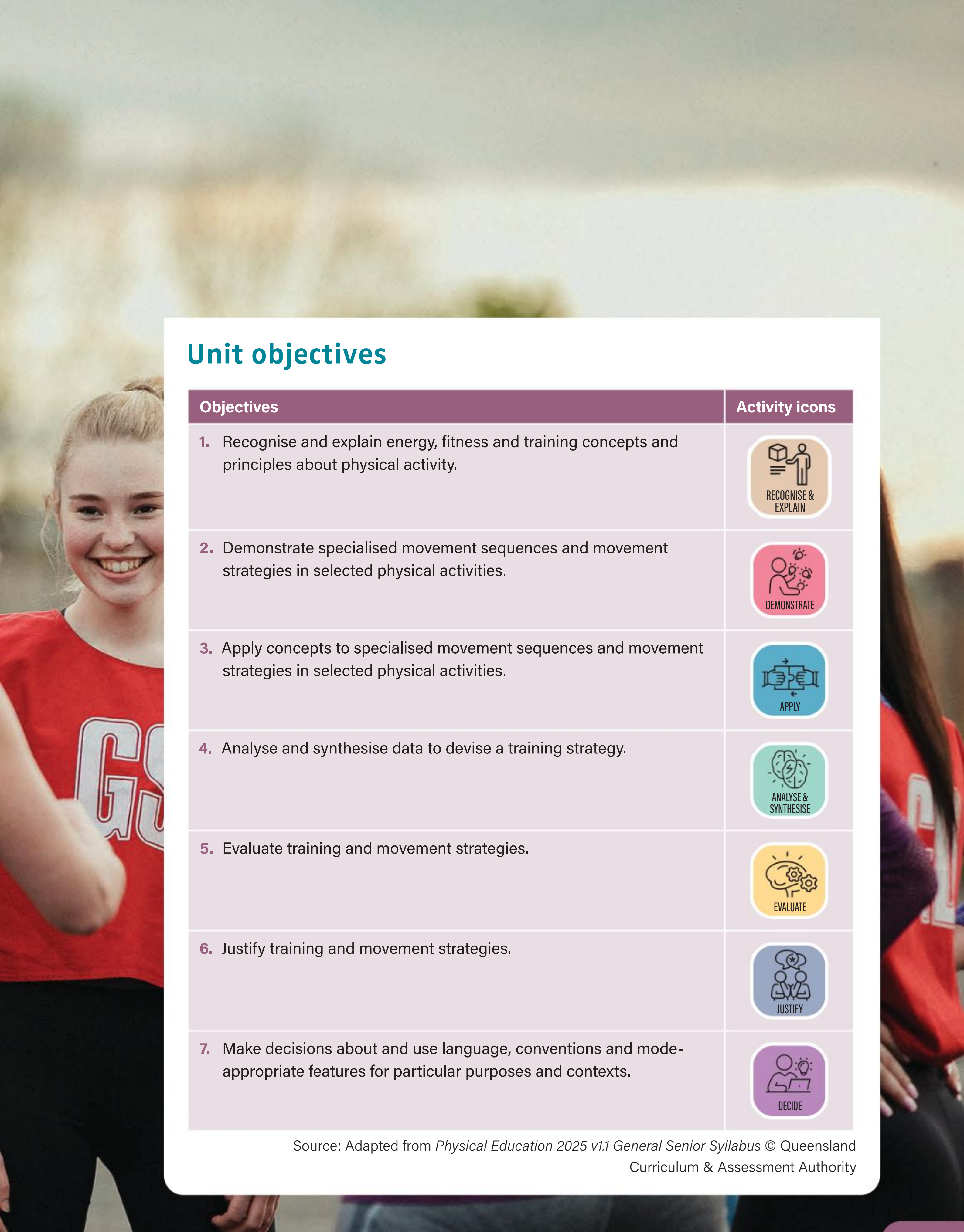
In Unit 4, students engage with concepts, principles and strategies about energy, fitness, training and physical activity.

Students recognise and explain the concepts and principles about energy, fitness and training through purposeful and authentic learning in selected physical activities. In selected physical activities, students investigate body and movement concepts and demonstrate specialised movement sequences and movement strategies.

Students apply concepts and principles to specialised movement sequences and movement strategies in authentic performance environments to gather data about their personal application of energy, fitness and training concepts. Students analyse and synthesise relationships between the energy and fitness demands of physical activity and their personal performance. Students then devise a training strategy to optimise performance for an identified movement strategy in a selected physical activity.

Students evaluate the effectiveness of the training strategy and movement strategies and justify using primary and secondary data.

ISBN 978-1-009-31125-0 Stewart et al.



Unit objectives

Objectives	Activity icons
1. Recognise and explain energy, fitness and training concepts and principles about physical activity.	RECOGNISE & EXPLAIN
2. Demonstrate specialised movement sequences and movement strategies in selected physical activities.	DEMONSTRATE
3. Apply concepts to specialised movement sequences and movement strategies in selected physical activities.	APPLY
4. Analyse and synthesise data to devise a training strategy.	ANALYSE & SYNTHESISE
5. Evaluate training and movement strategies.	EVALUATE
6. Justify training and movement strategies.	JUSTIFY
7. Make decisions about and use language, conventions and mode-appropriate features for particular purposes and contexts.	DECIDE

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

ISBN 978-1-009-31125-0 Stewart et al.

UNIT 4

TOPIC 1

Energy, fitness and training integrated in physical activity

Topic 1:
Energy, fitness and training integrated in physical activity

- **Chapter 20** Energy for physical activity
- **Chapter 21** Analysing the demands of physical activity
- **Chapter 22** Effective training to enhance physical fitness for physical activity

Introduction

Being physically educated is concerned with developing knowledge in the biophysical, sociocultural and psychological domains that underpin physical activity and utilising this knowledge to maximise enjoyment, engagement and physical performance for yourself and others. The physically educated become advocates for both the social and physical importance of being physically active.

This chapter explores energy production, components of fitness, and training principles and methodology as key elements within the biophysical sub-discipline of physical activity. Through an understanding of energy pathways, fitness components and training principles, the physically educated can determine how best to prepare athletes for the physical demands of varied physical activities. They can analyse the physical fitness and energy demands of various physical activities and, in turn, design training programs that allow athletes to develop the physical attributes demanded by their sport with maximum effectiveness and efficiency. They learn to evaluate the appropriateness of training strategies for the individual needs of athletes and make justified training recommendations for improving physical performances.

UNIT 4 TOPIC 1
Overview

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 20

Energy for physical activity

What's ahead?

Chapter 20
Energy for physical activity

- **20.1** Energy for activity
- **20.2** Cellular energy from adenosine triphosphate (ATP)
- **20.3** Energy systems
- **20.4** Oxygen delivery, consumption and recovery
- **20.5** Lactate threshold and training

Key subject matter

- Recognise and explain that energy for physical activity is provided by adenosine triphosphate (ATP).
- Recognise and explain energy requirements for physical activity.
- Recognise and explain which energy systems are used in a range of physical activity contexts. Energy systems include ATP-PC, lactic acid and aerobic.
- Recognise and explain physiological responses to training.
- Identify and explore the energy requirements for specialised movement sequences and movement strategies in physical activity.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What are the two major learning approaches to motor learning?
- What are the key features of the cognitive approach?
- What are the key features of a dynamic systems approach to motor learning?
- What is self-organisation and how does it drive motor learning?
- How can we develop affordance recognition and perception–action coupling to optimise performance?

ISBN 978-1-009-31125-0 Stewart et al.

20.1 Energy for activity

An understanding of how the body provides energy for physical performance will greatly enhance attempts to improve physical performances. Training programs can be planned accurately to suit the energy requirements of individual athletes in their chosen activity. This section provides an overview of how energy is provided for muscular contraction and other bodily functions.

Energy

Energy is defined as the capacity to do work. It can take many forms, such as chemical energy (energy released from the breakdown of chemical compounds), kinetic energy (energy used in producing movement) and potential energy (energy that is stored). Energy to produce bodily movement is provided by the energy stored in food. This energy is released as the digestive system and body cells break down the chemical compounds in foods that contain energy (energy nutrients). Body cells use this chemical energy to perform essential bodily functions. For example, muscle cells convert the chemical energy released from the breakdown of the energy nutrients in food into kinetic energy (movement) and heat.

Fuel for energy

Energy for physical activity and other bodily functions is provided by the chemical energy in food. Through the digestive process, the energy-providing nutrients (carbohydrates, fats and proteins) can be broken down to provide our energy requirements. The energy from the breakdown of these nutrients cannot, however, be used directly for muscular contractions and other body functions; rather, it is used by body cells to produce a high-energy compound, **adenosine triphosphate (ATP)**. The energy requirement of each body cell is provided by breaking down ATP, releasing usable energy. The energy provided by carbohydrates, fats and protein allows body cells to produce more ATP. Muscle cells can only store enough ATP for one or two seconds of high-intensity work before the supply must be replenished. The rate at which ATP can be produced determines how much energy is available. The way in which ATP is produced in the muscle cell at varying levels of exercise intensity is the focus of this section.

adenosine triphosphate (ATP) a molecule in living cells that provides energy for many processes, including muscle contraction and nerve impulse propagation

FIGURE 20.1 Energy for movement is supplied from the energy nutrients contained in food.

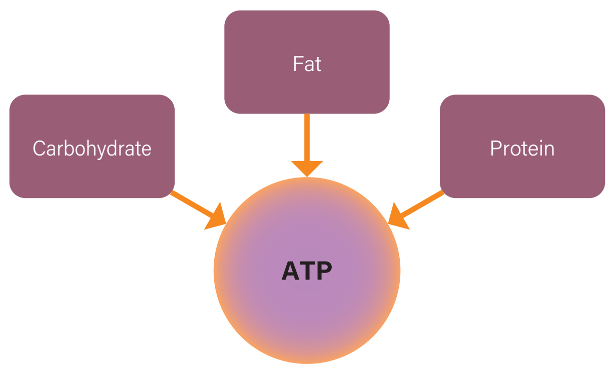


FIGURE 20.2 An overview of the energy sources from food that lead to the production of ATP

20.2 Cellular energy from adenosine triphosphate (ATP)

All the energy for muscular contraction comes from the breakdown of ATP. The ATP molecule consists of an adenosine group and three phosphate groups with the third one joined by a high-energy chemical bond. This large molecule is represented in Figure 20.3.

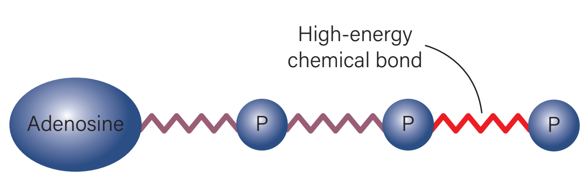


FIGURE 20.3 The structure of adenosine triphosphate (ATP), where 'P' stands for a phosphate group.

ISBN 978-1-009-31125-0 Stewart et al.

ATP (adenosine triphosphate) → ADP (adenosine diphosphate) + P (phosphate) + energy

In order to supply energy, ATP is broken down by splitting the third of the phosphate groups from the molecule. This releases the energy in the high-energy chemical bond to be used for muscular contraction and other functions of body cells (see Figure 20.4). This breakdown can be represented by the chemical equation:

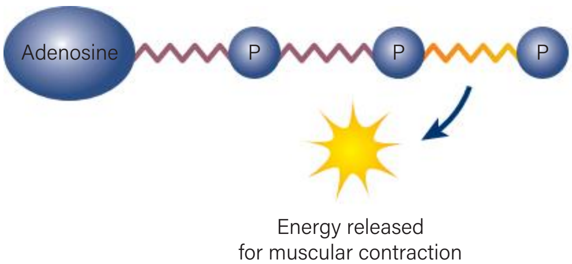


FIGURE 20.4 Diagram of the structure of ATP showing the high-energy bond breaking to release energy

Muscle cells only contain enough ATP for one to two seconds of high-intensity activity. The energy from food (carbohydrates, fats and to a lesser degree proteins) is used to make more ATP by rejoining the free phosphate group (in the form of an ion) to the **adenosine diphosphate (ADP)** molecule. The production of ATP can be represented by the reverse of the chemical equation above:

ADP (adenosine diphosphate) + P (phosphate) + energy (from food) → ATP (adenosine triphosphate)

> **adenosine diphosphate (ADP)** a molecule that carries energy from food, being changed to ATP in the process, and which is regenerated when the high-energy bond in ATP breaks to release useful energy

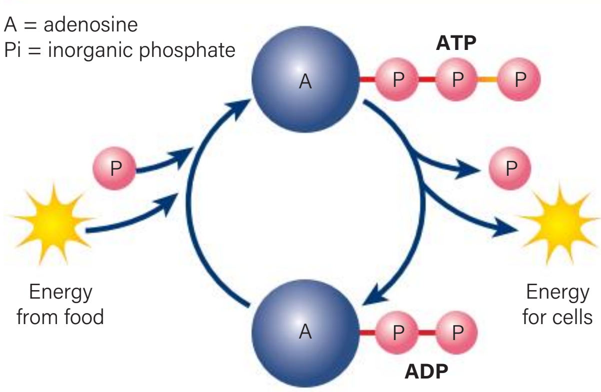


FIGURE 20.5 A flow diagram summarising the overall ADP/ATP cycle which transfers energy from food to cells in a form that can be used. Note that the process involves breaking then reforming the high energy bond in ATP, and it relies on the availability of phosphate groups, which are recycled.

This process of breaking and remaking ATP turns the energy from the food we eat into energy that can be used for muscular contractions. While this process, represented by Figure 20.5, is an overall summary, the details reveal that the body uses three different methods, or **energy systems**, to achieve it. These methods have some important implications for physical activity and maximising performance. The contribution to remaking ATP from each of the three energy systems depends on how much energy is required (activity intensity) and how long the activity will last (activity duration). For instance, slinging a discus requires high amounts of energy for a short period of time, whereas jogging 5 km requires lower amounts of energy over a much longer period.

Energy systems: an overview

Energy to produce ATP is provided by three energy systems, introduced here and discussed in more detail in Section 20.3. In muscle cells, these systems work in combination depending on the intensity and duration of physical activity.

The first energy system, the **ATP–PC energy system**, provides energy to produce ATP by transferring energy and a phosphate group from another high-energy compound, phosphocreatine (PC), to ADP to make ATP. This remakes ATP at a very fast rate, and therefore is used during high-intensity activities. Muscle cells can only store enough PC for approximately 10 seconds of intense activity before the supply is exhausted. Muscular supplies of PC are replenished very quickly, however. An almost total replenishment of PC supplies will occur during two minutes of rest or less-intense activity.

The second energy system, the **lactic acid energy system**, uses energy from glucose to produce ATP.

> **energy systems** collectively the name for the three ways our body produces ATP, and then breaks down the ATP itself, to release energy for muscle movement
>
> **ATP–PC energy system** produces ATP through the breakdown of phosphocreatine for high-intensity movement of very short duration
>
> **lactic acid energy system** produces ATP 'without the need for oxygen, from glucose, which comes from the breakdown of glycogen; this system is used when energy demands are higher than the usable oxygen supplied; it results in the formation of lactic acid

ISBN 978-1-009-31125-0

The glucose comes from the digestion of food and it is stored as **glycogen**. Most glucose used by muscles comes from the breakdown of glycogen. in the muscles. The lactic acid energy system produces energy at a moderate to high rate, and is therefore used during moderate- to high-intensity activities. The end product of the chemical reactions of glucose in this system is called lactate. After periods of moderate- to high-intensity activity, lactate levels rise in the muscle cells. The accumulation of lactate coincides with muscle fatigue, slowing the rate and strength of muscular contraction. The amount of time for which you can continue to produce energy using this system depends on your level of fitness and training, but is generally about 60 seconds at moderate- to high-intensity activity. Lactate is transported to the liver and when sufficient oxygen is available it is converted back to glucose.

The third energy system, the **aerobic energy system**, uses energy from glucose (usually from breakdown of glycogen) and fats in combination with the oxygen we breathe to produce ATP. This system can continue to produce energy indefinitely, provided activity levels are low to moderate; this includes sub-maximal longer duration exercise and most of the energy required for normal resting movement. Levels of fitness and training also determine how much energy can be produced by this system.

The three systems generally are categorised into two groups, according to whether or not oxygen is required in the production of ATP. The ATP–PC system and the lactic acid system do not require oxygen to produce energy and are categorised as **anaerobic** (without oxygen). The aerobic system, however, depends on oxygen supplies to produce ATP.

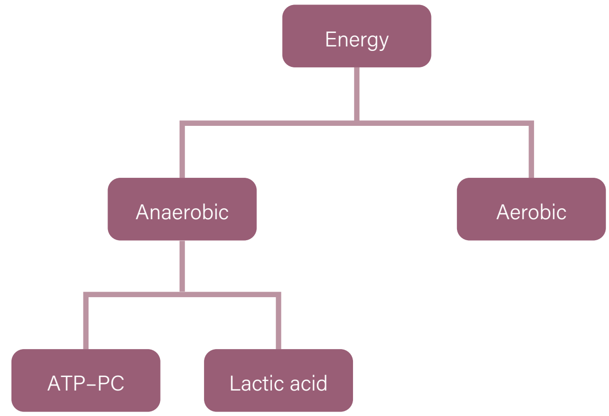


FIGURE 20.6 Overview of the three energy systems that fuel the remaking of ATP

glycogen a substance in the liver and muscles that stores glucose as an energy supply and is important in controlling glucose levels in the blood; when used as an energy source it is converted to glucose first

aerobic energy system produces ATP for low- to medium-intensity activity through the breakdown of glucose (or fat) in the presence of oxygen; the oxygen allows for additional energy to be released by breaking down glucose and fats all the way down to carbon dioxide and water, as opposed to the lactic acid that accumulates when oxygen is not present

anaerobic literally means 'without oxygen', but can also refer to stages of energy production where there is insufficient oxygen available to work totally aerobically; in relation to exercise, it relates to high-intensity activity where the body cannot reach a steady state that is supplying adequate oxygen for the energy demands

KEY MESSAGE

Energy for muscle contraction comes from ATP breakdown in the cells.

KEY MESSAGE

Energy to remake the ATP molecule comes originally from the breakdown of nutrients in food.

KEY MESSAGE

Three energy systems provide energy to remake ATP: the ATP–PC system, the lactic acid system and the aerobic system.

Muscle types and energy production

Muscle fibres are cells which are arranged into groups called motor units. Each motor unit contains a number of muscle fibres, and each motor unit is controlled by one neuron (nerve cell). Using microscopic examination, it is possible to identify two different types of muscle fibre: slow-twitch fibres and fast-twitch fibres. It is differences in the way these fibres are arranged into motor units that determine which type of fibre they are.

ISBN 978-1-009-31125-0 Stewart et al.

Fast-twitch fibres are arranged into motor units where one neuron controls between 300 and 800 muscle fibres. Slow-twitch fibres are controlled by one neuron in motor units of 10 to 100 muscle fibres.

Fast-twitch and slow-twitch muscle fibres vary significantly in the amount of force they can produce, the time over which they can continue to work and the energy system they utilise to produce ATP.

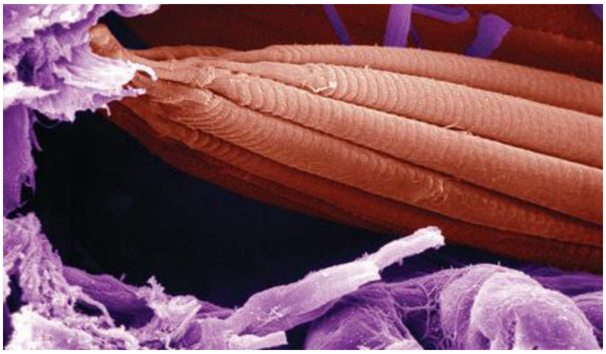


FIGURE 20.7 Microscopic view of muscle fibres

Slow-twitch fibres

Slow-twitch fibres are arranged into motor units that can contain 10 to 100 fibres controlled by the one neuron. Slow-twitch fibres, as the name suggests, are slow to contract but are able to sustain activity for extended periods. These fibres use predominantly aerobic energy sources in order to produce ATP and therefore are capable of resisting fatigue. Slow-twitch fibres are associated with longer endurance type activities.

Fast-twitch fibres

Fast-twitch fibres are arranged into motor units that contain large numbers (300–800) of fibres. Fast-twitch fibres produce much more force than slow-twitch fibres, so are best suited to activities that require speed and the rapid production of force. In track and field athletics, for instance, the sprints, throws and jumps would utilise predominantly fast-twitch fibres. Fast-twitch fibres use mainly anaerobic energy sources in order to rapidly produce the required ATP.

Research into the differences between muscle fibre types (through examination of samples taken via biopsy) has found that fast-twitch fibres cannot be converted into slow-twitch fibres; however, some fast-twitch fibres can take on some of the characteristics of slow-twitch fibres when exposed to endurance training. This has led to a further classification of fast-twitch fibres into fast-twitch ‘a’ and fast-twitch ‘b’. Fast-twitch ‘a’ fibres are able to take on some slow-twitch characteristics and are considered partially aerobic. Fast-twitch ‘b’ fibres are totally anaerobic. This implies that world-class marathon runners, no matter how much sprint training they have done, would generally not improve greatly in speed. However, sprinters are able to improve their aerobic endurance significantly with training, which is evidenced by the number of good sprinters who have trained to become capable distance runners.

TABLE 20.1 Comparison of muscle fibre types

Characteristics	Slow-twitch	Fast-twitch ‘a’	Fast-twitch ‘b’
Speed of contraction	Slow	Fast	Fast
Size of motor unit	Small	Large	Large
Force produced	Low	High	High
Activity type	Aerobic endurance	Aerobic endurance and power/speed	Power/speed
ATP production	Aerobic	Aerobic and anaerobic	Anaerobic
Glycogen stores	Low	High	High
Capillaries	Many	Moderate	Few
Neuron size	Small	Large	Large
Speed of nerve impulse	Slow	Fast	Fast
% in average leg muscle	45	38	16
% in leg muscles of a distance runner	80	14	5
% in leg muscles of a sprinter	23	48	28

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 20.1

1. In groups, discuss how the dietary requirements of an elite athlete may vary from those of an average person.
2. In which sports would athletes benefit from a high fast-twitch fibre count?
3. In which sports would athletes benefit from a high slow-twitch fibre count?
4. Compare the energy requirements of a 200 m sprinter and an Australian Rules player, with reference to the intensity and duration of energy demands, the associated ATP requirements, and how these would be met by their body's energy systems.

Muscle fibre recruitment

As a muscle begins to contract, slow-twitch fibres initially are recruited to provide the muscular force required by the activity. If the force required by the activity remains low, then slow-twitch fibres will continue to provide the muscular force. However, if the activity requires greater levels of muscular force to be exerted, then fast-twitch fibres are recruited. During activities requiring large amounts of muscular force, all muscle fibre types are utilised.

These muscle fibre recruitment patterns change during longer-duration endurance activities. As this type of activity continues, fast-twitch muscle fibres become increasingly involved in providing muscular force. Because fast-twitch fibres use predominantly anaerobic energy sources, lactate will begin to accumulate and performance will deteriorate. In fact, when fast-twitch fibres begin to be recruited during endurance activities, it usually marks a decline in the level of performance.

Coaches must carefully consider the implications of how muscle fibres are recruited when planning training programs. For instance, low-intensity training will only serve to produce improvements in slow-twitch fibres. Only by varying the intensity and duration of training activities will the training effect on all muscle fibre types be maximised.

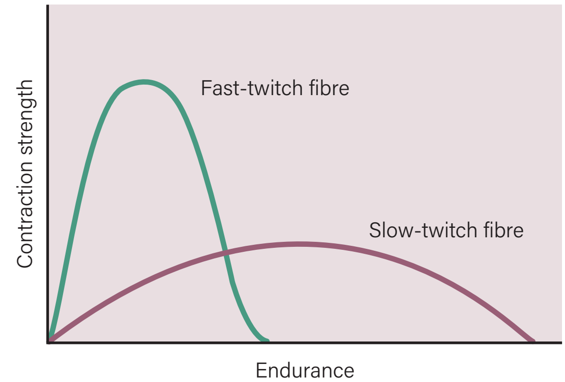


FIGURE 20.8 The relative contributions of muscle fibre types to muscle contraction strength and endurance

20.3 Energy systems

As discussed in the previous section, energy for physical activity is provided by the breaking of the high-energy bond in adenosine triphosphate (ATP). Muscle cells only store enough ATP for one to two seconds of high-intensity activity. The following chemical equations represent the breakdown and production of ATP in muscle cells:

ATP → ADP + P + Energy (for muscle contraction)

ADP + P + Energy (from energy nutrients) → ATP

Three different energy systems are used to convert the energy from food in order to produce more ATP. This section discusses each of the three energy systems separately, but it should be noted that the three systems do not work in isolation, but rather in varying combinations, depending on how quickly energy is required and the amount of time for which physical activity is continued.

The ATP–PC system

The *ATP–PC system* provides energy anaerobically (without requiring oxygen) to produce ATP, by breaking down a high-energy chemical substance called phosphocreatine (PC). The ATP–PC system can produce high amounts of energy for immediate use by the muscles, but supplies of PC stored in muscle cells last only for about 10 seconds of high-intensity activity. The ATP–PC system is therefore used for activities of short duration that require large amounts of energy – such as throwing a javelin or sprinting to a pass in soccer. In comparison, the aerobic system cannot supply energy at this high rate, as it is limited by the time it takes for the body to supply muscle cells with oxygen.

ISBN 978-1-009-31125-0 Stewart et al.

Phosphocreatine is broken down into creatine and phosphate. The energy released from this breakdown is used to produce ATP. This process is represented by the chemical equation:

$$\underset{\text{(phosphocreatine)}}{\text{PC}} \rightarrow \underset{\text{(phosphate)}}{\text{P}} + \underset{\text{(creatine)}}{\text{C}} + \underset{\text{(to produce ATP)}}{\text{Energy}}$$

The ATP–PC system is also referred to as the *phosphate system* because it uses energy from phosphate compounds, and as the *alactate system*, because no lactate is produced.

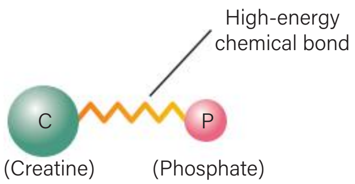


FIGURE 20.9 The structure of phosphocreatine

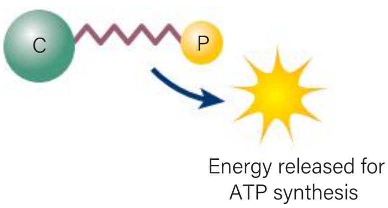


FIGURE 20.10 Diagram of the high-energy bond in phosphocreatine breaking to release energy

Once muscular supplies of PC are exhausted, muscles cannot continue to work at high intensities without a period of rest. It takes approximately two minutes at complete rest for muscular supplies of PC to be almost completely replenished. PC stores can also be recovered during periods of low-intensity work, but the recovery time will be a little longer. This is why you are able to sprint during a game of hockey, and after a period of lower-intensity work, you can sprint again. Training programs for athletes involving high-intensity exercises, such as sprints, are completed as intervals, where periods of high-intensity work are followed by two to three minutes of rest. The recovery time allows supplies of PC to be replenished ready for another repetition of high-intensity work.

Although the ATP–PC system is anaerobic, muscular stores of PC are replenished during rest periods using aerobic energy. This is why your heart rate and breathing rate still rise even after a short sprint requiring only alactic energy (energy from the ATP–PC system), as oxygen is required to provide aerobic energy. The role of oxygen in producing aerobic energy, and in recovery, is discussed later in this chapter.

The lactic acid system

The *lactic acid system* also supplies energy to produce ATP anaerobically, but uses glucose from glycogen rather than PC as an energy source. If an activity continues at a high intensity after the supply of PC is exhausted, the lactic acid system becomes the major source of energy for the production of ATP.

If oxygen is available, the glucose can be used to supply energy by converting it to water and carbon dioxide (the aerobic system), but if energy demands are high, the body cannot supply enough oxygen to the working muscles to meet the demand. The lactic acid system can produce energy by converting glucose into lactate without the need for oxygen. This process can be represented in simple form by the chemical equation:

$$\text{Glucose} \rightarrow \text{Lactate} + \text{Energy (to produce ATP)}$$

The lactic acid system is also referred to as anaerobic glycolysis (as glucose is broken down without using oxygen), and sometimes as the lactate system.

At low to moderate levels of activity, lactate can be removed from the working muscle at the same rate at which it is produced. This system can last between 30 seconds and three minutes, depending on the intensity of the activity. The less intense the activity, the longer the period for which the lactic acid system will supply energy, because it will be producing lactate at a slower rate at the lower-intensity levels. However, during high-intensity activities, lactate cannot be removed as quickly as it is being produced.

FIGURE 20.11 100 m sprinters use primarily alactate energy (from the ATP–PC system).

ISBN 978-1-009-31125-0 Stewart et al.

The point at which lactate begins accumulating in muscle cells coincides with the onset of muscle fatigue, and it becomes impossible to continue at the same intensity of activity without slowing down or resting. This level of intensity of exercise is known as the **lactate threshold** and is discussed in greater detail later in this chapter. This fatigue is characterised by a burning sensation in the working muscles. High-intensity activity can only continue for approximately 60–75 seconds before lactate accumulation occurs, signalling the onset of muscular fatigue. The lactic acid system therefore would be the predominant energy source in a 400 m running race or a 100 m swimming race. Team sports that involve periods of high-intensity activity with intermittent rest periods, such as soccer, rugby, netball and touch football, rely heavily on energy produced by the lactic acid system.

lactate threshold the point at which lactate begins accumulating in muscle cells, as the demand for ATP requires the energy systems produce lactate faster than the cells can remove it

Before high-intensity activity can recommence, the working muscles must undergo a recovery process whereby energy stores, blood oxygen levels and hormone balances are restored and accumulated lactate is removed from the working muscle during and after periods of moderate to intense activity.

The lactate is metabolised back into glucose in the liver using ATP supplied by the aerobic system, so the process depends on oxygen. Like the ATP–PC system (which also recovers using the aerobic system), working in the lactic acid system will cause heart and breathing rates to remain elevated for some time, even after activity has stopped. During this time, the extra oxygen is being used to replenish energy stores in muscle cells and the liver to metabolise accumulated lactate. The muscle cells of well-trained athletes become more efficient at replenishing energy stores and removing lactate, and therefore are able to continue using this energy system for longer periods. The role of oxygen in producing aerobic energy, and in recovery, is discussed later in this chapter.

FIGURE 20.12 Periods of sustained defence in Rugby Sevens uses energy from the lactic acid system.

ENGAGE 20.1

DEMONSTRATE APPLY RECOGNISE & EXPLAIN

Inquiry question: How do working muscles react to extended periods of intense activity?

Demonstrate and apply

Together as a class, stand up with one arm extended vertically and the other by your side.

1. On a starting signal, flex your fingers on both hands to meet your thumb and immediately extend your fingers back to the starting position. Repeat this movement as fast as you can manage for 60 seconds. Try to maintain a 'sprint' pace for the entire minute.

Recognise and explain

KEY COGNITION

Describe: give an account (written or spoken) of a situation, event, pattern or process, or of the characteristics or features of something

2. Describe the feeling in your forearms during the final 15 seconds of activity.

ISBN 978-1-009-31125-0 Stewart et al.

3. Which energy system would have made the greatest contribution to producing the energy for this activity?
4. What would have been occurring in the working muscles as fatigue began?
5. How did muscular fatigue affect your ability to continue this activity?
6. Was there a difference in muscular fatigue between the arm held vertically and the one by your side?
7. How can this difference be explained?

The aerobic system

The *aerobic system* supplies energy to produce ATP at rest and during lower- to moderate-intensity activity. Glucose from glycogen, or in the bloodstream, and/or fat (in the form of free fatty acids) are combined with oxygen to produce energy and the by-products, water and carbon dioxide. This process is represented by the chemical equation:

Glucose or Fat → H_2O + CO_2 + Energy (to produce ATP)

Provided there is adequate oxygen supplied to muscle cells, this process can continue to produce energy indefinitely. However, factors such as muscle soreness, the need for rest, mental fatigue and diminishing levels of glycogen and fat reserves limit continued activity, even at low intensity. The aerobic system is the preferred energy source for activities that require lower intensity over extended periods, such as distance running. Fat is the preferred energy source at rest or during low-intensity activities. Glycogen becomes the preferred fuel source when exercise intensity approaches 60 per cent of maximum heart rate (220 – age).

The aerobic system is also referred to as *aerobic glycolysis* (as glucose is broken down using oxygen) and sometimes as the *oxidative system*.

If an activity that is predominantly aerobic, such as a 10 km road race, requires the runner to go faster to gain a tactical advantage (surge) or run up a steep hill, the body may not be able to supply all the oxygen required to produce aerobic energy. The extra energy required (which cannot be produced by the aerobic system due to insufficient oxygen supplies) will be produced anaerobically by the lactic acid system. If the intensity of the race remains high, lactate levels will begin to rise, signalling the onset of muscle fatigue, and eventually the runner will have to slow down. At the beginning of the race, glycogen is used primarily as a fuel source, but as the race progresses and glycogen supplies are exhausted, fats become the major fuel. This relationship is illustrated in Figure 20.14. When fats become the major fuel source, oxygen demand increases and the athlete will become fatigued more quickly.

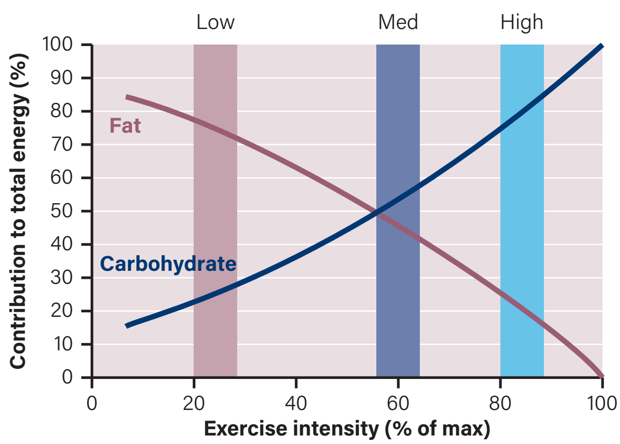


FIGURE 20.13 The relative use of carbohydrate and fat as a fuel source as determined by exercise intensity

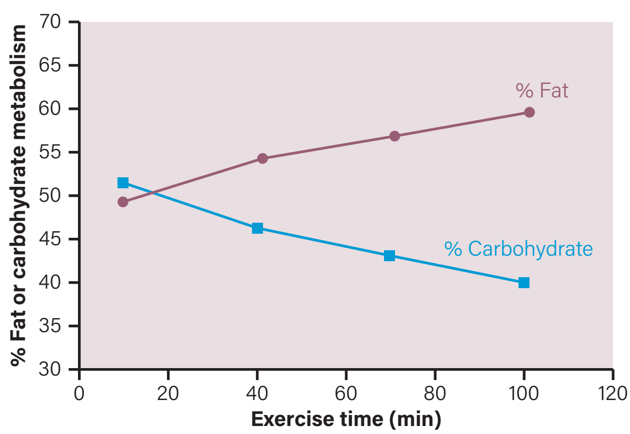


FIGURE 20.14 The relative use of carbohydrate and fat during prolonged exercise

ISBN 978-1-009-31125-0 Stewart et al.

Proteins are only utilised as a fuel source after extended periods of activity, and when supplies of glycogen and fat are exhausted.

The level of intensity at which the aerobic system cannot supply energy fast enough to replenish the phosphocreatine level and remove lactate fast enough, and therefore lactate accumulation begins, is called the *lactate threshold* or, alternatively, the anaerobic threshold. This threshold varies between individuals, depending on their body's ability to gather and use oxygen. The more oxygen that the body is capable of gathering and using, the higher the intensity of exercise possible without beginning to accumulate lactate in the working muscles. An individual's anaerobic threshold can be raised by training. These issues of oxygen supply and training are discussed in detail in the following sections of this chapter.

CHECK-IN 20.2

1. Many theories exist about the causes of muscle fatigue during exercise, but the exact cause is yet to be fully understood. We understand that muscle fatigue corresponds with an accumulation of lactate in the muscles and blood, but this does not seem to be the cause of the fatigue. Conduct an internet search to explore current ideas about the causes of muscle fatigue while exercising at levels about the lactate threshold.
2. What previously held ideas about the causes of muscle fatigue have been disproven by more recent studies?

TABLE 20.2 Summary of the features of the three energy systems

Characteristic	ATP-PC	Lactic acid	Aerobic
Alternative names	Alactate system Phosphate system	Lactate system Anaerobic glycolysis	Oxygen system Aerobic glycolysis Oxidative system
Oxygen use	Anaerobic	Anaerobic	Aerobic
Rate of ATP production	Very rapid	Rapid	Slow
ATP production	Very limited (by stores of PC) Up to 10 seconds of high-intensity activity	Limited (when lactate accumulation occurs) Up to 75 seconds at maximum effort	Unlimited until fuel sources are depleted
Fuel source	phosphocreatine	Glycogen, converted to glucose	Glycogen converted to glucose, fats and possibly proteins
Recovery process	PC stores replenished	Resupply of fuel sources Lactate metabolised	Resupply of fuel sources
Recovery rate	2–3 minutes at rest or lower-intensity activity	2–5 minutes rest to use system again 30–120 minutes rest for complete recovery	Up to 24 hours to recover fuel stores after bouts of sustained exercise
Use	High-intensity, short-duration activities up to 10 seconds	Intense activity of between 10 and 75 seconds duration	Lower-intensity, long-duration activities or rest

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 20.2

DEMONSTRATE APPLY RECOGNISE & EXPLAIN ANALYSE & SYNTHESISE

Inquiry question: How quickly can your body supply energy to produce ATP and how long can these supplies last?

Demonstrate and apply

1. Two students will be chosen to be the subjects for this activity. A running course of 400 m is required, with markers placed every 20 m along it using a measuring tape. A starter with a starting signal is also required.
2. The subjects are to run 400 m, beginning at a sprint pace and trying to maintain that pace for the entire distance.
3. 20 students will each be given a stopwatch and sent to one of the markers on the course.
4. Each student positioned at a marker records the time from the beginning of the run until the subject reaches their marker.
5. Calculate the time taken for each interval and the average velocity over that interval.
6. Create a results table similar to the example below to record your data.

	Recorded time		Interval	Time for interval		Speed	
	(time from the start of the run to reach the marker of this interval)			(time taken for this interval only – for each recorded time except the first, subtract the recorded time in the previous row)		(speed equals distance (20 m) divided by the time taken for the interval)	
	Subject 1	Subject 2		Subject 1	Subject 2	Subject 1	Subject 2
			0–20 m				
			20–40 m				
↓	↓	↓	↓	↓	↓	↓	↓
			380–400 m				

Recognise and explain

7. Plot a graph of running speed over the 400 m run showing both subjects. Note that for a line graph, speed data points must be plotted in the middle of each interval, i.e at 10 m, 30 m, 50 m and so on. (You may decide to use a spreadsheet to record results, perform calculations and create the graph.)
8. Describe the speed of the subjects over the 400 m run.
9. At what distance did each subject begin to slow down?
10. Using your knowledge of energy systems, why was it impossible for the subjects to maintain top speed for 400 m?

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

11. Explain the trends in the graph using your knowledge of the contribution of the three energy systems.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

12. Comment on the differences between the two subjects using your knowledge of the energy systems.
13. What would the graph look like if a motorcycle were used for the same task? How is the supply of fuel and oxygen different from that of the human body?
14. Keep this graph for discussion purposes in later sections of this chapter.

Energy systems interplay

While it is possible to describe an activity as being predominantly anaerobic or predominantly aerobic, energy for physical activity is usually supplied by a combination of the three energy systems working simultaneously. Figure 20.15 shows the relationship between exercise time and the contribution of the three energy systems. The graph represents the percentage contribution of each system, assuming that the exercise is at the highest possible intensity for the time specified.

In an activity such as track and field, events are usually specific in their energy demands. For instance, the 100 m sprint requires very high amounts of energy for a short amount of time, and therefore uses predominantly the ATP–PC system to provide energy. The jumping and throwing events also utilise almost 100 per cent ATP–PC system energy. Running 400 m uses predominantly anaerobic energy sources, particularly from the lactic acid system, and the 1500 m event uses approximately 50 per cent aerobic and 50 per cent anaerobic energy sources.

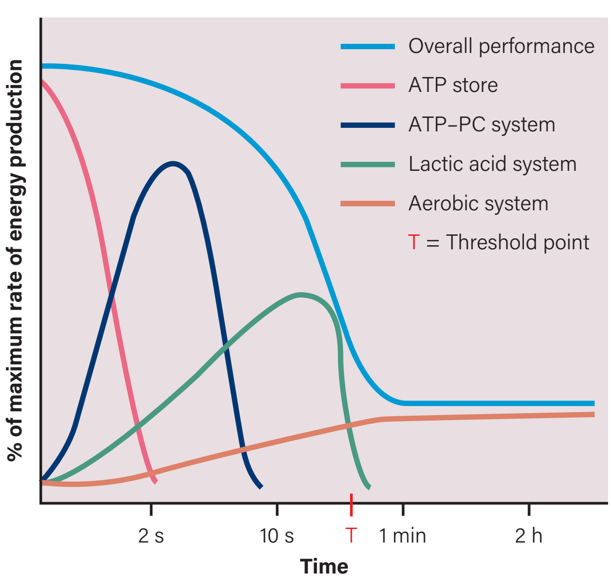


FIGURE 20.15 Contribution of the three energy systems to producing energy during exercise; note that the time axis is not regularly spaced, but compressed for later times

As the duration of an event increases, so does the percentage of aerobic energy that is used. Individual races above 400 m (which is considered a sprint race) may vary in their energy requirements due to the race tactics employed and the pace of the race in general. For example, during the race the aerobic energy system will supply most of the energy, and the ATP-PC then the lactate energy systems provide most of the energy for a sprint finish.

FIGURE 20.16 1500 m running requires training for both aerobic and anaerobic energy systems.

In activities such as team sports, the contribution of each energy system is more difficult to determine, as one game can vary significantly in intensity from the next. Most team sports require a contribution from all three energy systems at various stages of play. Individuals playing different positional roles on the same team may also have different energy requirements. For instance, the energy requirements of a soccer goalkeeper and a mid-fielder would differ significantly.

In a game of hockey, all three energy systems would contribute to produce ATP at various stages of the game, depending on the intensity of activity required at the time. Imagine you have begun the game as a defender. During periods of opposition attack, you require higher amounts of energy, which are supplied anaerobically. Every time you have to sprint to the ball or provide a clearing hit, your ATP–PC system provides

ISBN 978-1-009-31125-0 Stewart et al.

the high amounts of energy required. As this system is limited to short durations, a short period of lower-intensity activity must follow in order for the aerobic system to replenish PC supplies. If the opposition attack is sustained for much of the game, and your workload is quite intense, a large proportion of your energy will be supplied by the lactic acid system.

When lactate begins to accumulate in muscle cells, the amount of time for which you can maintain this pace is limited and you will show signs of fatigue. At this stage, your coach may make replacements or rotate different players into the defending positions. During the brief periods where your team is attacking, your heart rate and breathing rate remain high, as your body is working aerobically to replenish energy stores of PC and glycogen, and metabolise lactate.

As you can see from this discussion, athletes and coaches have to consider the implications of the energy requirements of their sport. An analysis of the energy requirements of an activity will help coaches plan many aspects of training and competition, such as the:

- timing of substitutions during a game, particularly in sports where players can be 'subbed' on and off
- rest periods required between training sessions, competitions and even training activities
- tactics used in competition
- choice of training activities so the energy system combination used in training is specific to the energy requirements of the sport
- most appropriate diet leading into competition.

ENGAGE 20.3

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: Can heart rate data be used to draw conclusions regarding energy system contributions?

Demonstrate and apply

In this activity, your class will engage in two different physical activities in order to compare heart rate data.

1. Select touch football, futsal, football or basketball as the first sport to play and either tennis or badminton as the second sport.
2. Individuals record their heart rate before participating in each activity and then after a period of 10 minutes of play. *If available, use heart rate monitors to record heart rates continuously throughout the activity to allow for a more detailed analysis.*
3. Collate the class heart rate data and calculate class average heart rates for each activity (before play and after 10 minutes of play). Make sure participants are fully recovered after participating in the first activity.

Analyse and synthesise

4. Are there any significant differences in the class average heart rate data between the two activities?
5. With regard to exercise intensity and periods of recovery, what conclusions can you draw about the energy system contribution of both activities?
6. What factors may affect the reliability of this investigation and the conclusions that you have made?

KEY COGNITION

Discuss: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

7. In light of your experience in this activity, discuss Table 20.3 on the following page in terms of the factors that may influence the stated energy system contributions.

ISBN 978-1-009-31125-0 Stewart et al.

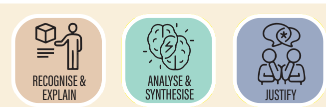
TABLE 20.3 Energy system percentage contribution in a variety of sports

Sport	ATP-PC/Lactic acid	Lactic acid/aerobic	Aerobic
Basketball	60%	20%	20%
Fencing	90%	10%	
Field events	90%	10%	
Golf swing	95%	5%	
Gymnastics	80%	15%	5%
Hockey	50%	20%	10%
Distance running	10%	20%	70%
Rowing	20%	30%	50%
Skiing	33%	33%	33%
Soccer	50%	20%	30%
Sprints	90%	10%	
1500 m freestyle	10%	20%	70%
Tennis	70%	20%	10%
Volleyball	80%	5%	15%

CHECK-IN 20.3

1. In groups, compile a list of 15 sports that are not included in Table 20.3. Discuss the relative contribution of each of the three energy systems to the replenishment of ATP. Consider representing your percentage contributions as a pie graph and compare your graph with those of other groups for further discussion.
2. Add another six sports to the list that could be considered almost exclusively anaerobic or exclusively aerobic.

ENGAGE 20.4



Inquiry question: What are the energy requirements of the physical activity that has been the focus of your study this term?

Recognise and explain

1. Consider the demands of the physical activity that has been the focus of your recent study by describing the:
   a. intensity of physical activity required
   b. duration of activity at various levels of activity
   c. changes in the level of activity
   d. recovery time available
   e. substitution rules (as applicable)
   f. varying roles in the activity, such as specialist positions.

ISBN 978-1-009-31125-0 Stewart et al.

2. Create a table to summarise your discussion.

Analyse and synthesise

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

3. Create an energy contribution bar graph that would represent the percentage energy contributions of the three energy systems for the physical activity that has been the focus of your study this term.

Justify

4. In 200 words, justify your analysis by referring to the demands and playing conditions of the activity outlined in your summary table.

20.4 Oxygen delivery, consumption and recovery

The contribution of each of the three energy systems in terms of producing ATP depends on the amount of oxygen that can be supplied to working muscles during periods of exercise and recovery from exercise. As discussed in the previous section, the anaerobic systems rely on oxygen in order to recover, so the faster oxygen can be supplied, the faster these systems can recover. The aerobic system relies directly on the supply of oxygen in order to produce ATP. As the intensity of an activity increases, the body must supply more oxygen in order to keep producing ATP aerobically. If this oxygen demand cannot be met, a proportion of ATP begins to be produced anaerobically, and lactate begins to accumulate. It follows that if the body becomes better at gathering and utilising oxygen, it will be able to exercise at higher intensity without beginning to fatigue and slow down.

This section discusses how oxygen is transported and utilised for physical activity. An understanding of how oxygen is delivered to and utilised by working muscles will allow coaches and athletes to plan accurate and efficient training programs.

Oxygen consumption

The amount of oxygen needed by muscle cells during physical activity is determined by the effectiveness of the athlete's body in utilising oxygen (their level of aerobic capacity) and the requirements for oxygen determined by the intensity of the physical activity. Measurements of oxygen consumption are very important for determining the energy requirements and capacities suitable for different physical activities. At rest, our bodies consume around 0.25 litres of oxygen per minute. During heavy exercise, young women use about 2.3 litres of oxygen per minute and young men 3.4 litres per minute. The reasons for the gender difference are discussed later. Note that air at sea level is 21% oxygen, so 2.3 and 3.4 litres of oxygen correspond to 11.0 and 16.2 litres of air respectively.

FIGURE 20.17 Typical oxygen uptake test

Oxygen uptake is the amount of oxygen consumed by the muscle and other cells of the body. Oxygen uptake can be measured using gas analysis equipment to compare the volume of oxygen and carbon dioxide (in litres per minute) breathed in with that breathed out.

ISBN 978-1-009-31125-0 Stewart et al.

The maximum amount of oxygen that can be consumed by the body, or maximal oxygen uptake, is known as **VO_2 max**. This maximum level of oxygen uptake is reached after about five to 10 minutes of exhaustive physical activity. Other terms that are used to refer to VO_2 max include maximum oxygen consumption, maximal oxygen intake, maximal aerobic power and maximum aerobic capacity.

VO_2 max the maximum rate of oxygen consumption attainable during physical exertion, commonly measured in millilitres of oxygen per kilogram of body weight per minute (ml/kg/min), or litres of oxygen per minute where body mass is not considered

In athletes, testing for VO_2 max is often conducted in a clinical setting during exhaustive exercise – that is, where the intensity of the physical activity is pushed to the maximum tolerable. An athlete's VO_2 max is therefore a measure of how well the body can transport and utilise the available oxygen. However, this type of testing can be dangerous if applied to untrained individuals. Tests that estimate a person's VO_2 max using sub-maximal exercise have been devised that are suitable for non-elite athletes (such as the 'beep test'). Various fitness tests are discussed later in this chapter.

Undertaking appropriate training can cause the body to adapt so it is able to gather and use more oxygen. Figure 20.19 illustrates VO_2 max levels in elite male and female athletes compared with average male and female levels for several age groups.

FIGURE 20.18 Cross-country skiers have one of the highest VO_2 max readings of any athlete.

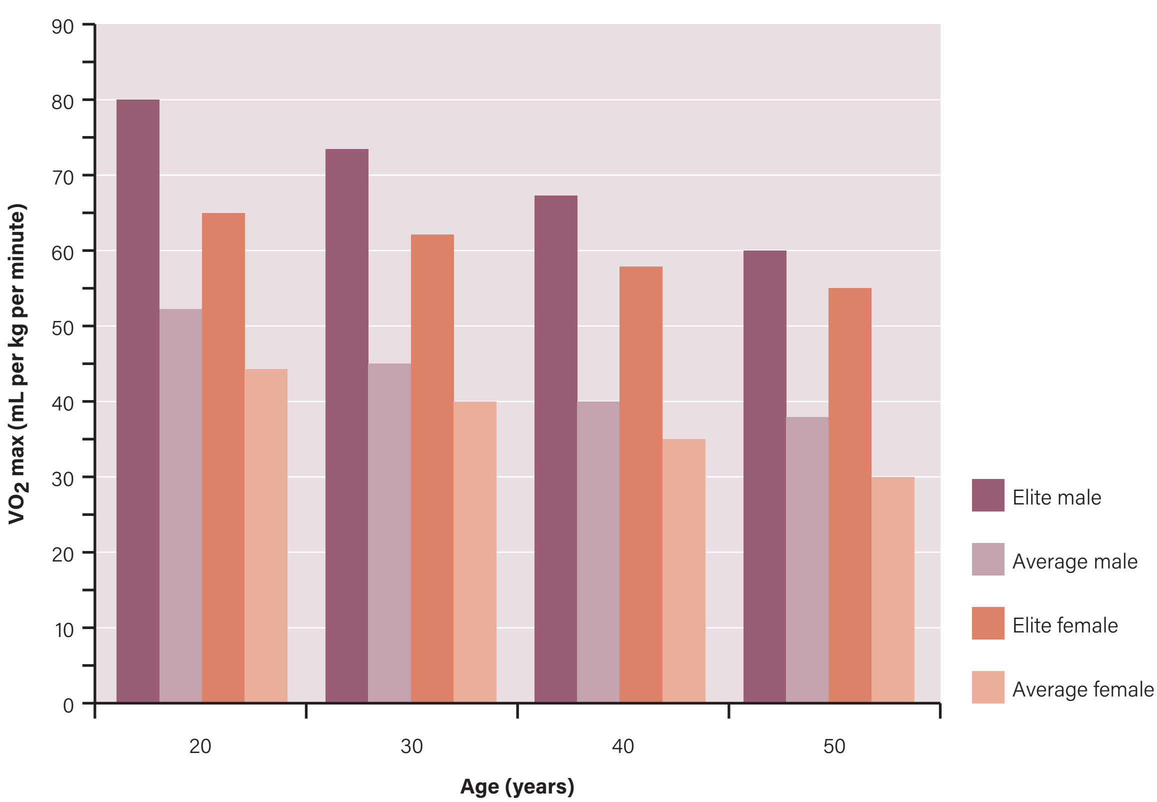


FIGURE 20.19 VO_2 max of elite and average males and females for different ages

ISBN 978-1-009-31125-0 Stewart et al.

Factors influencing oxygen uptake

A number of physiological factors influence an individual's oxygen uptake, and therefore their VO_2 max (see Table 20.4). Many of these factors are genetically determined, but can be marginally improved with training. Endurance training, however, has a more significant effect on raising the lactate threshold, which is discussed in more detail in the following section.

It should be noted that at maximum exercise, the elite athlete is capable of working at a higher intensity than the average athlete.

Oxygen deficit and EPOC

At rest, the body's need for oxygen is low and it can easily be supplied with energy to produce ATP aerobically. However, once physical activity is commenced, more oxygen is required in order to meet the increased energy demands. Because it takes the body time to respond to gather and transport more

stroke volume the volume of blood expelled from the left ventricle of the heart per beat of the heart

cardiac output the volume of blood expelled from the heart in one minute

TABLE 20.4 Factors that influence an individual's oxygen uptake

Factor	Explanation
Lung ventilation	If the rate and depth of breathing are enough to supply the cells of the body with adequate oxygen and clear them of carbon dioxide, then breathing remains constant. If oxygen in the blood falls or carbon dioxide rises, the rate and depth of breathing automatically increase until the situation is balanced. During exercise, increased breathing and depth of breathing enable larger amounts of oxygen to be available for the blood to take up and deliver to the working muscles. At rest, the body can take in 6–8 litres of air (recall that air is 21% oxygen at sea level, so divide by 21% to get the volume of oxygen) a minute at a rate of 15 breaths per minute. During exhaustive exercise, this can rise to more than 100 litres per minute and 40–50 breaths per minute.
Heart rate	At rest, heart rates range from 50–85 beats per minute. During exercise, the heart rate increases proportionally to the level of intensity, up to the maximum heart rate. An estimation of the maximum heart rate of an individual is given as 220 minus their age.
Stroke volume	The volume of blood expelled from the left ventricle of the heart per beat of the heart is called the **stroke volume**. Maximum stroke volume is reached at moderate levels of exercise. At rest, an untrained person's heart pumps out about 70 mL of blood per beat, and during exercise, around 125 mL. An endurance-trained person's heart pumps out around 90 mL of blood per beat at rest, and around 200 mL during exercise.
Cardiac output	The volume of blood expelled from the heart in one minute is known as the **cardiac output**, which is calculated by multiplying stroke volume (volume of blood per beat) by heart rate (number of beats per minute). At rest, this can amount to 4.6 litres per minute and during exercise, up to 40 litres per minute.
Blood flow	Blood flow to the muscles is increased dramatically during exercise. Not only does the increased cardiac output contribute to the increase, but blood is also directed away from non-working areas of the body to the active muscles.
Body size	VO_2 max is more relevantly expressed, when comparing individuals, as millilitres per kilogram of body weight per minute (mL/kg/min). All tissues of the body use oxygen, so a larger individual uses more oxygen at rest and during periods of exercise than a smaller individual. Comparisons of VO_2 max using measurements based on body weight take this factor into consideration (VO_2/min/kg).

ISBN 978-1-009-31125-0 Stewart et al.

oxygen to the working muscles, there is a time at the beginning of periods of activity when our body cannot deliver enough oxygen to meet the requirements of the exercise aerobically. During this time, the body is working in **oxygen deficit**. In this stage of oxygen deficit, the ATP–PC and lactic acid energy systems resupply the additional requirements for ATP.

If the intensity of the activity is sub-maximal – that is, the body can supply enough oxygen so the aerobic energy system is capable of producing almost all the ATP required – a steady state is reached. During this stage, a balance between oxygen use and oxygen supply is achieved (see Figure 20.20).

On completion of sub-maximal activity, the body needs to recover the oxygen deficit. Because energy in the initial stages of activity required the use of the anaerobic energy systems (ATP–PC and lactic acid), oxygen is required to restore the body to a resting state. The extra oxygen required during recovery is known as **excess post-exercise oxygen consumption (EPOC)**. This oxygen is used to replenish fuel stores (such as levels of PC) and affects other processes required to restore the body to the resting state, such as restoring muscle and blood oxygen stores, restoring hormone balances and the conversion of lactate into usable energy. Once recovery is complete and the body returns to a resting state, the balance between oxygen need and oxygen supply is restored.

An oxygen deficit also occurs when the intensity of activity is raised to a point where the body cannot supply enough oxygen in order to meet energy demands aerobically (working above the lactate threshold).

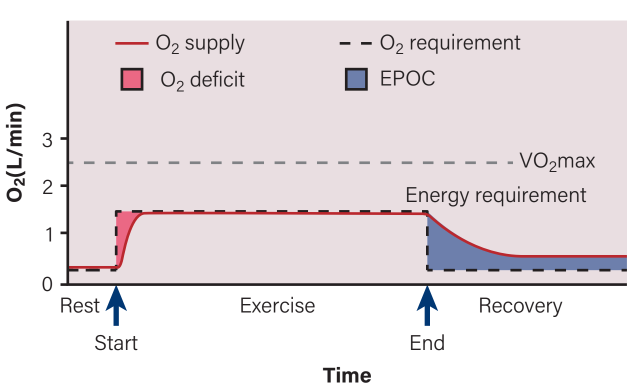


FIGURE 20.20 Oxygen supply and requirement against time for submaximal exercise, including resting beforehand and recovery afterwards. Also shown are the periods of O_2 deficit at the start of exercise, the steady state during exercise when supply meets requirement, and EPOC during recovery, when oxygen is used to replenish fuel stores and return the body to its resting state.

oxygen deficit the difference between the oxygen required for a given rate of work and the oxygen actually consumed at that time; an oxygen deficit occurs whenever the demand for energy production exceeds the oxygen available to produce the required ATP to meet that energy requirement

excess post-exercise oxygen consumption (EPOC) the additional oxygen required by the body during recovery to facilitate a number of processes that return the body to its resting state

During this higher intensity of activity, the oxygen demands of an exercise exceed the body's ability to supply oxygen, so steady state does not occur and some (or most) of the energy is being produced anaerobically. Figure 20.21 illustrates oxygen requirements at maximal exercise where oxygen demand exceeds supply. The oxygen deficit at this intensity of activity is greater than the deficit during sub-maximal activity, as is EPOC; a longer recovery time is therefore needed.

Oxygen during recovery

During post-exercise recovery, oxygen is still required by the body to return it to its pre-exercise state (excess post-exercise oxygen consumption – EPOC). Upon completion of a 5 km jog, breathing and heart rates do not immediately return to resting levels. The length of time taken to recover is partly determined by the intensity of the physical activity undertaken and the body's response to utilising oxygen during the recovery stage. The greater the exercise intensity, the greater EPOC will be.

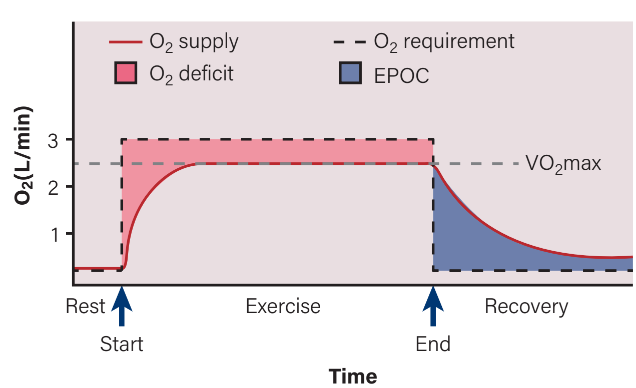


FIGURE 20.21 Oxygen supply and requirement against time for maximal exercise, including resting beforehand and recovery afterwards. Also shown are the periods of O_2 deficit from the start of exercise, continuing during exercise, and the deficit is larger than for submaximal exercise. Now supply does not meet requirements, and so EPOC has to be longer and greater during recovery, when oxygen is used to replenish fuel stores and return the body to its resting state.

ISBN 978-1-009-31125-0 Stewart et al.

During recovery, EPOC assists in replenishing **cellular** energy stores, metabolising lactate and returning muscles to their pre-exercise state. The recovery of the ATP–PC system through replenishing PC supplies occurs in the initial stage of EPOC. Within 30 seconds of rest or less-intense activity, 50 per cent of PC stores are replenished with an almost complete recovery after two minutes.

The recovery of the lactic acid system to full capacity occurs more slowly in the later stages of EPOC (see Figure 20.22). The greater the exercise effort, the more time will be required for full recovery of the lactic acid system. Recovery times of the lactic acid system can be reduced when a light jog or cool down is performed. A 50 per cent recovery of the lactic acid system occurs within the first 15 minutes of recovery but it can take up to 60 minutes (and beyond for greater levels of intensity) for complete recovery.

cellular relating to the cells in the body

Gaining an understanding of how our body utilises oxygen assists the development of appropriate training. The next section discusses training zones and thresholds that specifically address the development of aerobic and anaerobic energy systems.

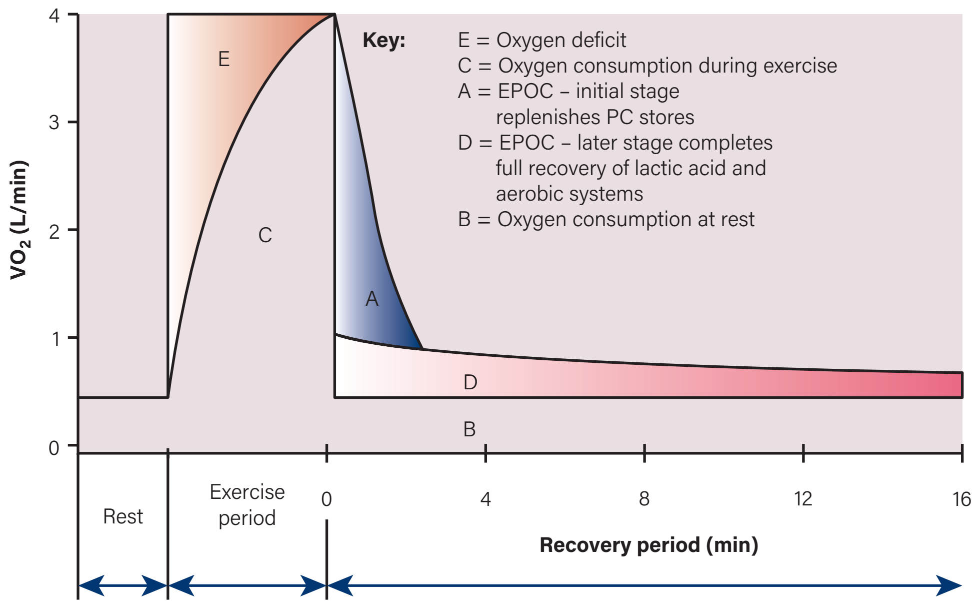


FIGURE 20.22 Stages of EPOC in post-exercise recovery of the lactic acid system.

CHECK-IN 20.4

1. Re-examine the graph you created of the 400 m run at sprint pace in Engage 20.2.
2. At what distance into the 400 m run is it likely that each of the subjects reached their lactate threshold?
3. At what time into the run did this occur?
4. What energy system was the predominant supplier of energy at this point?
5. Is this graph consistent with the known limitations of this energy system?
6. What can be concluded from this graph about the demand for oxygen during this activity?
7. Suggest a training activity that, if completed regularly, could allow the subjects to complete the 400 m sprint in a faster time.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 20.5

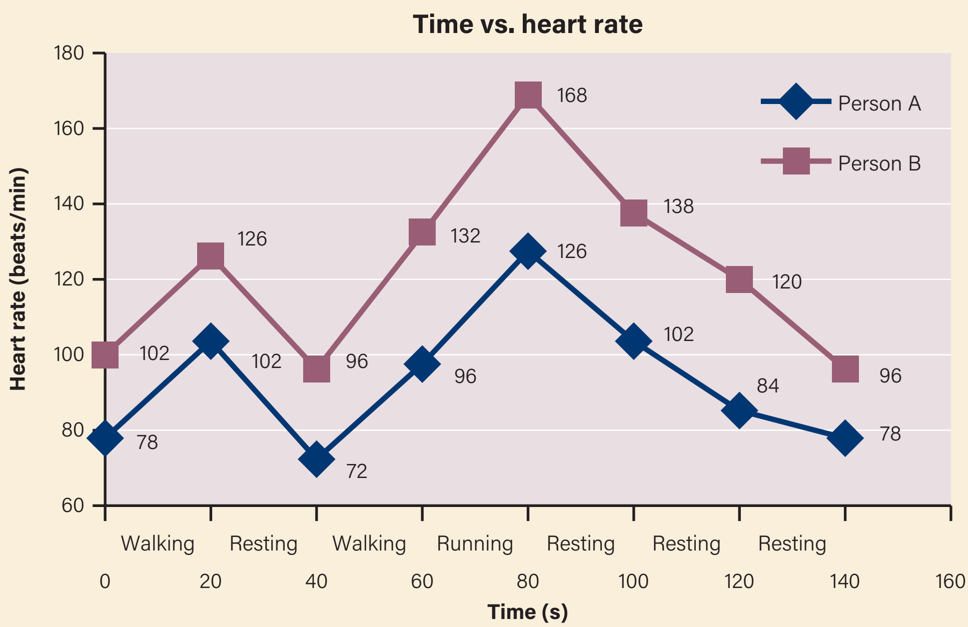
RECOGNISE & EXPLAIN

ANALYSE & SYNTHESISE

Inquiry question: What is the relationship between heart rate response, oxygen demand, exercise intensity and aerobic fitness?

Recognise and explain

1. Two people of the same weight, age and gender are both participating in the same exercise activity at the same intensity. It could be argued that the oxygen demand should be similar for both subjects. Examine the following graph of the heart rate responses of person A and person B.



Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

After analysis of the heart rate data, consider the following discussion questions.

2. Describe the key differences in the heart rate responses of the two subjects to the same exercise intensity.
3. Considering oxygen deficit and EPOC, explain why the recovery of both subjects occurred faster after the first period of walking (0–20 seconds) than after the walking–running set (40–80 seconds).
4. What can be implied about the relative ability of each of the subjects to gather and use oxygen?
5. What physiological factors may be contributing to these differences?
6. Which subject would you predict has a higher VO_2 max? Why?

ISBN 978-1-009-31125-0 Stewart et al.

20.5 Lactate threshold and training

As the intensity of exercise increases, so does the demand for oxygen as the working muscles attempt to maintain a steady state. As discussed in previous sections of this chapter, **steady state** is where all the oxygen demands of the working muscles can be met, and therefore almost all energy (ATP) is being produced by the aerobic system. When the intensity of exercise reaches a level where the body cannot supply all the oxygen required, a proportion of the energy will be produced anaerobically, causing lactate to accumulate. If the intensity of activity remains at this level, muscular fatigue will occur, forcing the athlete to slow down or rest. The level of physical activity where lactate begins to accumulate – that is, where energy can no longer be provided almost totally by the aerobic system – is called the *lactate threshold*. This is also referred to as the anaerobic threshold or the onset of blood lactate accumulation (OBLA). At this level of exercise, blood lactate levels rise sharply, ventilation rates increase, pain levels rise and muscular fatigue sets in.

steady state where the oxygen demands of the working muscles are being met by the body's oxygen uptake

The lactate threshold is influenced by the body's ability to gather and utilise oxygen, and therefore varies between individuals. If an individual's body is capable of gathering and using more oxygen during exercise, it will be able to remain at a steady state at higher levels of activity. Although many factors that determine the ability to gather and utilise oxygen are genetically determined, training can cause physical adaptations that allow the body to become more efficient at gathering and utilising oxygen, therefore raising the lactate threshold. While a person's VO_2 max is largely genetically determined and only improves marginally with training, training can have a more significant effect on raising the lactate threshold.

Lactate threshold

An individual's lactate threshold can be measured by taking blood samples at various stages of exercise intensity and analysing the samples for lactate. When the level of lactate in the blood rises sharply, it indicates the athlete is working at an intensity exceeding their lactate threshold. This corresponds with a sharp rise in the rate of ventilation – that is, the amount of air breathed in and out per minute. Without the necessary laboratory equipment, the lactate threshold can be estimated using percentage of maximum heart rate or by noting the point at which the rate of breathing can no longer be controlled.

FIGURE 20.23 Elite endurance athletes have high lactate thresholds, and can therefore exercise at higher intensities without accumulation of blood lactate.

The average athlete will begin working above their lactate threshold when exercising between 50 and 60 per cent of their VO_2 max. At this point, heart rate is approximately 160–170 bpm. An elite athlete who has been training for an endurance event, such as a marathon, may be able to exercise at up to 80–90 per cent of their VO_2 max before reaching their lactate threshold. This is possible because training has caused a number of physical adaptations in their body that allow more oxygen to be gathered and used efficiently, restricting the production

ISBN 978-1-009-31125-0 Stewart et al.

of lactate and replenishing energy supplies more efficiently. The physical adaptations caused by training for various activities are discussed in detail later in this section.

Lactate threshold and physical activity

Endurance activities require the athlete to work at, or at times slightly above, their lactate threshold. If they continue to work above this threshold, lactate begins to accumulate and they slow down or need to rest. An endurance athlete with a comparatively higher lactate threshold can work at a higher intensity without accumulating lactate and the onset of fatigue. A high lactate threshold is also a significant advantage in many sports that require a sustained effort over time, but there are many physical activities where the athlete's lactate threshold is of little consequence to their performance.

In activities such as 100 m sprint or weightlifting, energy is supplied predominantly by the ATP–PC system and athletes do not need to remain working long enough to require energy produced by the lactic acid system. The rules of some sports, such as touch football, allow players to work at near-maximal levels for relatively short periods and then substitute with another player, providing a significant recovery period. Yet athletes in these types of activities can benefit from maintaining a high lactate threshold despite being predominantly anaerobic. A high lactate threshold will allow them to train and play for longer periods at higher intensity before the onset of muscle fatigue. Early season training in many sports focuses on building an 'aerobic base', raising the lactate threshold of athletes in order to enhance future training gains and on-field performances.

Training thresholds

The objective of any training program is to cause physical adaptations to the body that will enhance a person's training effectiveness, raise sport-specific fitness levels and ultimately improve their performance. In order to produce this training effect, the training program must cause the athlete to work at a level of intensity significantly above the resting state. In the resting state or at low exercise intensities, no training effect occurs as the working muscles and

FIGURE 20.24 Smart watches are a useful training tool that let athletes exercise within targeted training zones.

oxygen delivery systems can easily cope with the demand for energy.

The **aerobic training threshold** refers to a level of exercise intensity that is sufficient to cause a training effect. Using heart rate as an indicator of exercise intensity, the aerobic training threshold is approximately 70 per cent of a person's maximum heart rate (but may be higher for a person who trains regularly). Remember that a person's maximum heart rate is considered to be 220 minus their age. If two people are both working at a level of intensity at 70 per cent of maximum heart rate, their bodies are working equally as hard to provide the oxygen required. However, to get to 70 per cent of maximum heart rate, the first person may be an elite athlete running 5 km at a moderate intensity, whereas the second may be an untrained person walking up a set of stairs. When a person is working above their aerobic training threshold, but below their lactate threshold, they are said to be working in the **aerobic training zone**. Exercising in the aerobic training zone is done at an intensity below the lactate threshold and therefore can be maintained for extended periods without the accumulation of lactate signalled by fatigue. As exercise intensity approaches the lactate threshold, the demand for oxygen is increased and the training effect will be greater, provided activity is sustained for a

aerobic training threshold the level of intensity sufficient to cause a training effect

aerobic training zone the intensity at which your body is using its aerobic metabolism system to produce energy from fat and glycogen

ISBN 978-1-009-31125-0 Stewart et al.

significant length of time. Training intensities above the lactate threshold are in the **anaerobic training zone**.

> **anaerobic training zone** the heart rate above which you gain anaerobic fitness; you cross your anaerobic threshold at 80 per cent of your maximum heart rate

Coaches and athletes may vary the intensity of training to produce the desired training effect that is specific to the particular activity or playing position. Training at or below the lactate threshold (the aerobic training zone) will markedly increase aerobic endurance (raising the lactate threshold and allowing higher intensity of exercise without accumulating lactate). Training in the aerobic training zone will improve or maintain levels of aerobic endurance. Exercising above the lactate threshold will improve anaerobic endurance (improving the efficiency and recovery of the lactic acid system and allowing greater endurance while working above the anaerobic threshold). Exercise at an intensity greater than rest but below the aerobic training threshold will not greatly improve aerobic endurance, but may be useful for maintaining a desired weight and remaining healthy. Training methods and principles used to improve performance in various physical activities are discussed in the following sections of this chapter.

TABLE 20.5 A guide to percentage of maximum heart rate for various ages in various exercise zones

Beats per minute	Exercise zones									
	Age (years)									
	20	25	30	35	40	45	50	55	65	70
100%	200	195	190	185	180	175	170	165	155	150
	VO_2 max (maximum effort)									
90%	180	176	171	167	162	158	153	149	140	135
	Anaerobic (hard-core training)									
80%	160	156	152	148	144	140	136	132	124	120
	Aerobic (cardio training/endurance)									
70%	140	137	133	130	126	123	119	116	109	105
	Weight control (fitness/fat burn)									
60%	120	117	114	111	108	105	102	99	93	90
	Moderate activity (maintenance/warm-up)									
50%	100	98	95	93	90	88	85	83	78	75

CHECK-IN 20.5

1. Why can percentage of maximum heart rate be used as an indicator of exercise intensity?
2. What determines the point at which an individual moves from exercising in the aerobic training zone to exercising in the anaerobic training zone?
3. Does this point between these two training zones always remain the same or can it change? Why is this the case?
4. To produce a training effect (improvements in aerobic capacity), exercise intensity needs to be in the aerobic training zone or above. What are possible reasons for exercising in the 50–70 per cent of maximum heart rate zone?

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 20.6

RECOGNISE & EXPLAIN ANALYSE & SYNTHESISE

Inquiry question: How can percentage of maximum heart rate be used to determine training zones specific to the requirements of various physical activities, and individual needs and capacities?

Recognise and explain

1. It is possible to calculate heart rates that can be used as a guide to your training thresholds (see Table 20.5 on the previous page). These calculations are, of course, approximations, as values will vary between individuals due to differences in fitness and previous training. Copy the table, then calculate and record the values.

Heart rates	Calculations	Values
Maximum heart rate	220 – Age (bpm)	
Aerobic training zone	Low value = Max. heart rate × 0.7 (bpm)	
	High value = Max. heart rate × 0.8 (bpm)	
Lactate threshold	Max. heart rate × 0.8 (bpm)	
Anaerobic training zone	Low value = Max. heart rate × 0.8 (bpm)	
	High value = Max. heart rate × 0.9 (bpm)	
Maximal training zone	Low value = Max. heart rate × 0.9 (bpm)	
	High value = Max. heart rate × 1.0 (bpm)	

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

2. You are to collect personal heart rate data while performing in the physical activity on which your class is currently focused in this unit. This heart rate data can be used to determine individual and team fitness requirements as well as provide an insight into the energy demands of the activity. Gathering usable heart rate data while performing is ideally done using heart rate monitors. Alternatively, heart rate data can be collected manually by stopping the activity every two to three minutes to take a 10-second count of the carotid pulse. To check your pulse at the carotid artery, place your index and middle fingers on your neck to the side of your windpipe. When you feel your pulse, look at your watch and count the number of beats in 10 seconds. These readings over the duration of the activity can be recorded by a partner.
3. Collect/record your heart rate data for the duration of the active phase of the activity and during the first five minutes of rest after stopping activity.
4. Produce a personal heart rate response graph for the duration of the activity session (heart rate vs. time). This could involve printing a graph from heart rate monitor data or plotting data collected manually into a spreadsheet or on graph paper.

ISBN 978-1-009-31125-0 Stewart et al.

5. Calculate your average heart rate during the active phase of the activity (not including the recovery phase) and note your maximum heart rate. Average heart rate can be calculated by dividing the sum of all heart rate readings by the number of readings taken during the active phase. If you are using heart rate monitors, this average is usually available using the associated software application.
6. Calculate a class average for both average heart rate and maximum heart rate during the active phase of the activity.
7. Consider the following discussion questions.
   a. In which training zone does this activity operate?
   b. Did the level of intensity vary over the duration of the activity? Why?
   c. Which energy system would have had the greatest contribution to producing the energy for this activity?
   d. What implications does this have for training activities and playing tactics?
   e. Recommend a training activity that would contribute to developing the specific energy requirements of this activity.

Responses and adaptations to exercise and training

From the outset of increased activity, the body's systems almost immediately respond to the increased demands placed upon it. This results in a wide variety of systems increasing in activity, all of which have been presented previously in the chapter. These immediate effects on the body are known as **acute physiological responses**. While acute responses happen as a result of increased activity, they return to a steady state once the increase in activity has ceased. With regular periodic demands of increased activity, such as through participation in a training program, the systems of the body develop and adapt in order to meet these ongoing requirements. These long-term changes to the functioning of body systems are known as **chronic physiological adaptations**.

Chronic adaptations are the purpose of fitness training, with the goal to enhance the body's ability to cope with the energy and fitness needs of the athlete. It is important to consider that any chronic adaptations to the body as a result of participating in a well-planned training program must be maintained. After even a relatively short period of inactivity, fitness gains will begin to revert to pre-training levels.

acute physiological responses the body's responses when an increase in activity requires additional energy; these responses return to a steady state following the activity

chronic physiological adaptations the long-term changes to the systems of the body that result from regular ongoing increased energy and exercise requirements

FIGURE 20.25 Training brings about both short-term acute physiological responses and chronic physiological adaptations in the body.

ISBN 978-1-009-31125-0

TABLE 20.6 Acute physiological responses and chronic physiological adaptations resulting from exercise and training

	Acute physiological responses	Chronic physiological adaptations
Cardiovascular	• Increased cardiac output – the amount of blood pumped by the left ventricle increases with increased oxygen demand. • Blood flow is increased to working muscles and reduced to other body organs. • Blood pressure and heart rate increase.	• Increased VO_2 max. • Increased stroke volume, therefore cardiac output increased. • Heart rate lower at rest and during sub-maximal exercise. • Increased blood volume. • Increased rate of oxygen transport.
Skeletal muscle	• Increased oxygen exchange. • Increase in lactate production. • Increase in size with increased blood flow. • Increased muscle temperature and pliability.	• Muscle **hypertrophy** – muscle fibres increase in number, diameter and volume, particularly with resistance training. • Fast-twitch fibres develop higher oxygen capacity. • Cross-sectional area of slow-twitch fibres increases slightly with aerobic work. • Cross-sectional area of tendons and ligaments increases and insertion points become stronger. • More efficient oxygen exchange. • Increased size and number of mitochondria (where ATP is remade) in muscle cells. • Increased lactate tolerance
Respiratory	• Increased breathing rate. • Increased breath volume. • Increased oxygen uptake and carbon dioxide removal.	• Increased **lung capacity**. • Increased blood flow to the lungs. • More efficient oxygen exchange. • Increased alveolar-capillary surface area.

hypertrophy an increase in muscle mass usually associated with an increase in muscle size and strength as a result of resistance training

lung capacity the volume of air in the lungs upon the maximum effort of breathing in

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Energy for muscular contraction and other bodily functions is provided by the breaking of high-energy bonds of ATP, a high-energy compound.
- Muscle cells can only store limited amounts of ATP, and more must be produced in order to continue physical activity.
- The energy required to produce more ATP is provided by carbohydrates, fats and proteins in our diet.
- Three systems of energy production work in combination to produce ATP, depending on the intensity and duration of activity.
- The ATP–PC system and the lactic acid system do not require oxygen in order to produce energy, so are classified as anaerobic. Energy is supplied at a fast rate but only lasts for a limited time.
- The aerobic system requires oxygen in order to produce energy, which is supplied at a slow rate for an indefinite amount of time.
- Fast-twitch muscle fibres use predominantly anaerobic energy systems to produce and use ATP, and therefore produce large amounts of force but fatigue quickly.
- Slow-twitch muscle fibres use aerobic energy systems to produce ATP, and therefore produce smaller forces but are more resistant to fatigue.
- Slow-twitch muscle fibres are recruited first in producing muscular force, but as more force is required, fast-twitch fibres are utilised.
- The ATP–PC system provides energy to produce ATP at a very rapid rate for approximately 10 seconds. It is limited by the amount of PC stored in the muscles.
- The lactic acid system provides energy to produce ATP at a rapid rate for approximately 60–75 seconds. It is limited by muscular fatigue, which coincides with the accumulation of lactate.
- The aerobic system provides energy to produce ATP at a slow rate, but can continue producing energy indefinitely.
- The aerobic system uses glucose, predominantly released from glycogen in the initial stages of an endurance activity, but as supplies run low, fat becomes the major fuel source.
- The energy requirements of a physical activity depend on how intense the activity is, how long it will continue and the periods of rest time available.
- Oxygen deficit describes the imbalance of oxygen available to that required by the body at the commencement of physical activity and during higher-intensity activity requiring anaerobic energy.
- A steady state occurs when oxygen supply meets oxygen demand. This occurs at rest and at exercise levels below an individual's VO_2 max.
- EPOC occurs to replenish energy systems in working muscles back to a resting state.
- Oxygen demand is determined by both the exercise intensity level and the efficiency of our bodies to utilise oxygen.
- The initial component of EPOC is involved predominantly in the replenishment of ATP and PC stores.
- The latter component of EPOC works to replenish the lactic acid.
- As the intensity of exercise increases, there comes a point where not all the required energy (ATP) can be produced anaerobically, and a proportion of the energy required is produced aerobically. This is known as the lactate threshold.
- When the lactate threshold is reached, lactate levels in the working muscles (and the blood) rise sharply, as does the rate of ventilation.
- Percentage of maximum heart rate can be used as an indicator of exercise intensity.
- The aerobic training threshold represents a level of exercise intensity where a training effect begins to occur.
- The aerobic training zone represents a band of exercise intensity where improvements in aerobic endurance occur with prolonged training.
- The anaerobic training zone represents a band of exercise intensity above the lactic threshold where improvements in anaerobic endurance occur with prolonged training.
- There are both acute and chronic physical adaptations to exercise and training.

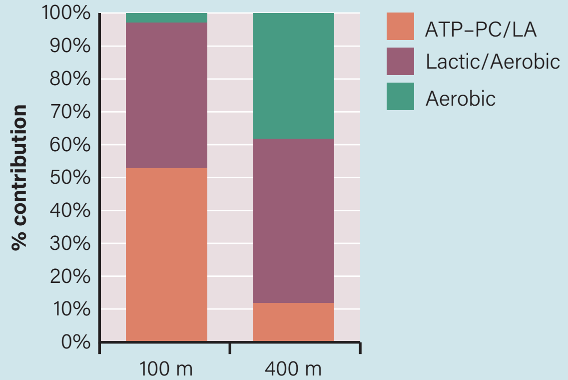
ISBN 978-1-009-31125-0 Stewart et al.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Phosphocreatine is a high-energy substance used to produce ATP while using the:
   A. aerobic system.
   B. oxygen system.
   C. lactic acid system.
   D. ATP–PC system.
2. The ATP–PC energy system can supply high amounts of energy for approximately:
   A. 35 seconds.
   B. 70 seconds.
   C. 10 seconds.
   D. 120 seconds.
3. A level of exercise intensity where the body is capable of supplying enough oxygen so that all energy can be supplied aerobically is known as:
   A. oxygen deficit.
   B. EPOC.
   C. steady state.
   D. maximal.
4. The lactate threshold describes the level of exercise intensity where:
   A. oxygen demand increases.
   B. the athlete must stop or slow down.
   C. stores of PC are exhausted.
   D. lactate begins to accumulate in the blood.
5. An average athlete will begin working above their lactate threshold when exercising at:
   A. 10–20% of their VO_2 max.
   B. 20–40% of their VO_2 max.
   C. 50–60% of their VO_2 max.
   D. VO_2 max.

Questions 6 and 7 are in relation to Stimulus 1 below.

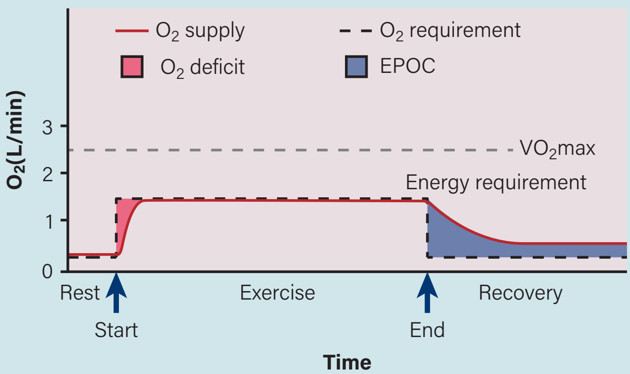


STIMULUS 1 Energy system contributions for performances of the 100 m and 400 m track events

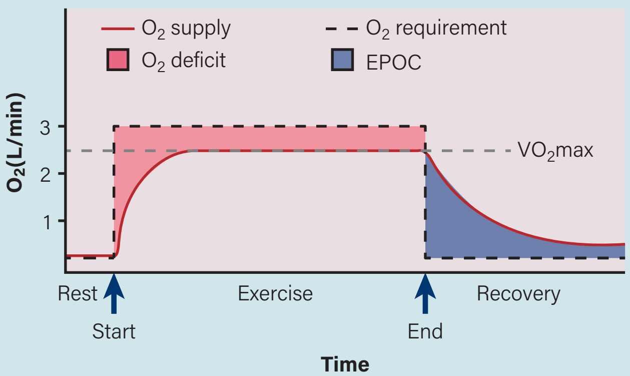
6. Running a competitive 400 m race would predominantly involve energy from the:
   A. aerobic system.
   B. lactic acid system.
   C. lactic and aerobic systems.
   D. ATP–PC system.
7. Which of the following best depicts the energy system contributions for a high school student jogging slowly and continuously for five minutes?
   A. 5% ATP–PC, 25% lactic acid, 70% aerobic
   B. 30% ATP–PC, 55% lactic acid, 15% aerobic
   C. 60% ATP–PC, 30% lactic acid, 10% aerobic
   D. 60% ATP–PC, 10% lactic acid, 30% aerobic

ISBN 978-1-009-31125-0 Stewart et al.

Questions 8–11 are in relation to Stimulus 2 and Stimulus 3 below.



STIMULUS 2 Oxygen supply and requirements during sub-maximal exercise



STIMULUS 3 Oxygen supply and requirements during maximal exercise

8. A level of exercise intensity where the body is capable of supplying enough oxygen so that all energy can be supplied aerobically is known as:

A. oxygen debt.

B. steady state.

C. EPOC.

D. maximal.

9. What does EPOC stand for?

A. Excess post-exercise oxygen consignment

B. Excess pre-exercise oxygen consignment

C. Excess post-exercise oxygen consumption

D. Excess pre-exercise oxygen consumption

10. EPOC occurs to:

A. replenish energy systems in working muscles back to a resting state.

B. remove excess PC from non-working muscles.

C. remove lactic acid.

D. replenish blood glucose levels.

11. The lactate threshold is the level of exercise intensity at which:

A. ATP levels in the muscles begin to fall.

B. lactate begins accumulating in the working muscles.

C. energy is supplied almost exclusively by the aerobic system.

D. the supply of oxygen is sufficient to meet demand.

SHORT-RESPONSE QUESTIONS

1. Outline the factors that limit energy supply in each of the three energy systems.

2. Explain why a person finishing a 100 m sprint continues to maintain a higher breathing and heart rate during recovery even though most of the energy for this event was produced by the ATP–PC system.

3. Explain why the body works in oxygen deficit during the initial stages of increased exercise intensity demand.

4. Explain the factors that force a person to have to slow down or stop when exercising above their lactate threshold.

5. What types of training activities could be used to allow athletes to train in their anaerobic training zone? How can heart rate be used as a guide to training zones?

EXTENDED-RESPONSE QUESTIONS

1. In a short response (120–250 words), explain the differences in energy system contributions for the 100 m and 400 m track events shown in Stimulus 1. In your response, refer to duration, intensities and ATP resynthesis.

2. In a short response (120–250 words), explain how oxygen requirements change during exercise and recovery for maximal and sub-maximal efforts. In your response, refer to the graphs in Stimulus 2 and Stimulus 3, lactate threshold, oxygen debt and EPOC.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 21

Analysing the demands of physical activity

What's ahead?

Chapter 21
Analysing the demands of physical activity

- **21.1** Components of fitness
- **21.2** Analysing the energy and fitness demands of physical activity

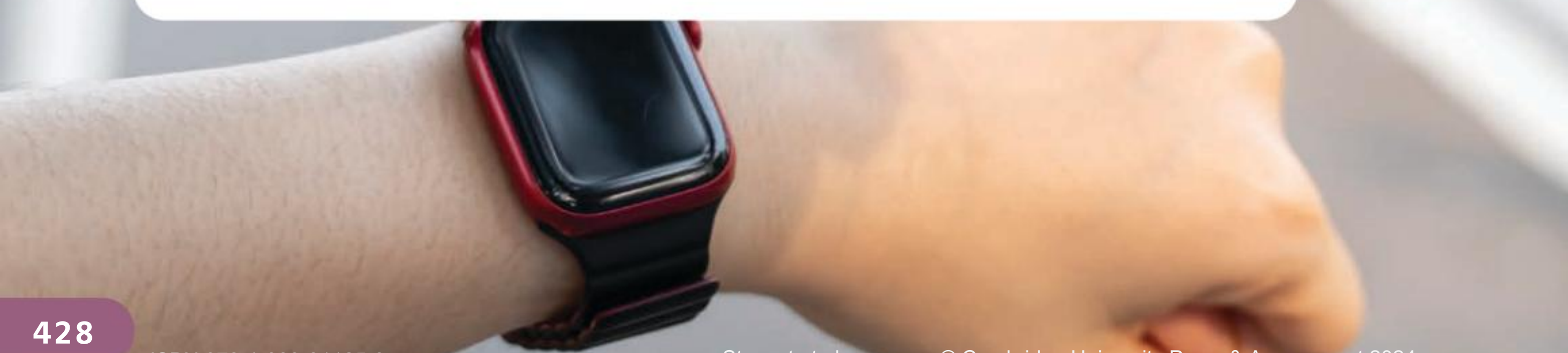
Key subject matter

- Recognise and explain how fitness requirements for physical activity are classified as components of fitness and include aerobic capacity, muscular endurance, speed, strength, power, flexibility and agility.
- Identify and explore the fitness requirements for physical activity contexts by considering the components of fitness necessary for specialised movement sequences.
- Analyse and synthesise primary data and secondary data about position- or event-specific fitness testing of the relevant components of fitness to identify personal performance capacities.
- Use primary and secondary data to analyse how energy, fitness and training concepts and principles can influence performance in physical activity.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- What are the components of fitness?
- What physiological responses occur in response to training?
- How can analysis of the energy and fitness demands of particular physical activities and specific player roles contribute to developing specific training activities and programs?
- What data can be gathered to determine the personal fitness and training requirements of various physical activities, and various roles and positions within them?



ISBN 978-1-009-31125-0 Stewart et al.

21.1 Components of fitness

An understanding of the various **components of fitness** that contribute to physical performance (such as strength, power and endurance) will assist athletes and coaches in determining the specific requirements of the activity being trained for and therefore assist in the design of training programs specific to the activity and individual athletes. This understanding may also assist in making personal choices about the suitability to particular types of physical activities, modifying techniques or tactics to suit individual or team capacities, or choosing playing positions within an activity. Just as various sports have particular energy requirements, differences also exist in the fitness components required to meet the physical demands of the activity. This section discusses the various fitness components that contribute to performances in physical activities.

> **components of fitness** a set of categories that describe the range of different intensities, durations and movements the body and its systems can produce; each category relates to a different element of fitness

The term *fitness* is used to refer to the physical performance capacities required to perform in various physical activities. This term can tend to be a little misleading, as people often think of physical fitness merely as being the ability to sustain physical work for longer periods of time (aerobic capacity). However, many other components of fitness contribute to performance and our state of total health. For example, the fitness components required to perform well at sport aerobics are vastly different from those required to perform well at sumo wrestling.

One major consideration when examining the physical capacities required for optimal performance in any given physical activity is the requirement for *endurance*. Endurance refers to the body's ability to sustain a particular level of physical effort. The level of effort required determines how much energy is required and at what rate – in other words, which combination of energy systems will be used. A 200 m sprinter ideally wishes to maintain sprint pace for the entire distance, and therefore requires endurance of the ATP–PC energy system. Through training, the sprinter would aim to increase the rate of phosphate and glycolytic energy release in order to make efficient use of as much energy as possible in the shortest amount of time. (The sprinter could not ignore aerobic endurance, however, as an enhanced aerobic capacity allows for larger training volumes and speeds up recovery from anaerobic training and performance.) In contrast, a triathlete requires peak endurance of the aerobic energy system in order to maintain a competitive pace.

The **intensity** and duration of an activity determines the type of endurance required. Recovery time may also affect the endurance requirements of an activity. Team games with breaks in play and substitution rules allow for repeated periods of intense physical work followed by periods of recovery. A touch football player, for instance, would use aerobic, lactate and alactate energy during intermittent periods of intense physical work and recovery. Endurance can therefore be discussed in two broad categories: aerobic capacity or endurance; and muscular or anaerobic endurance.

> **intensity** the magnitude of exertion required

Major fitness components

The major fitness components are:

- aerobic capacity
- muscular endurance
- speed
- strength
- power
- flexibility
- agility.

ISBN 978-1-009-31125-0

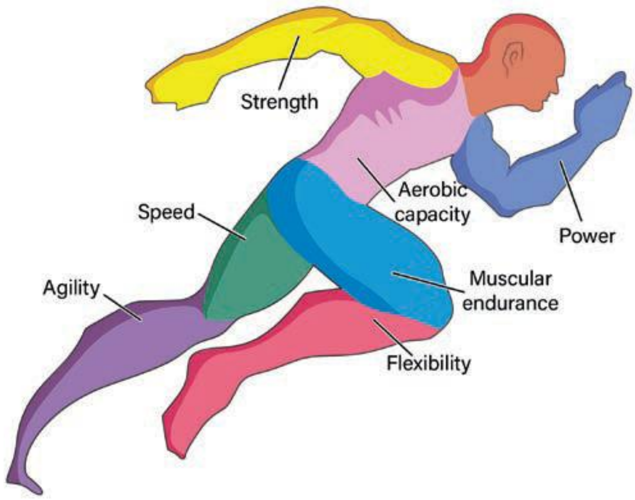


FIGURE 21.1 An athlete's ability in the major fitness components determines their physical capacity to perform the movements required for their selected physical activity. Some physical activities require high levels of specific fitness components to maximise performance, while other activities benefit from developing the capacity of several components.

Aerobic capacity

Aerobic capacity (sometimes referred to as aerobic endurance or aerobic power) can be defined as the ability to exercise for extended periods using energy produced by the aerobic energy system. Aerobic capacity is determined by the efficiency of muscle cells in utilising available oxygen, and the efficiency of the circulatory and respiratory systems in collecting oxygen from the inspired air and transporting it to working muscles. Individuals with high levels of aerobic capacity can exercise at higher-intensity levels without accumulating lactate (sub-maximal exercise) and can recover more quickly from periods of activity. It follows that aerobic capacity is an important component of almost all physical activities.

Accurate testing of maximum aerobic capacity requires sophisticated equipment such as a bicycle ergometer or treadmill, and specialised gas analysis devices used in exercise physiology laboratories. However, various sub-maximal predictive tests have been developed that can be conducted outside of a laboratory setting, such as the 12-minute run test and the 20 m multi-stage shuttle run (sometimes known as the beep test). A range of fitness tests are outlined in the following section of this chapter.

Muscular endurance

Muscular endurance (sometimes referred to as anaerobic endurance) can be defined as the ability of specific muscle groups to sustain activity at high intensity using energy produced by anaerobic energy systems. These activities require energy from alactate (ATP–PC system) and lactate (lactic acid system) sources, and ultimately lead to the accumulation of lactate in the working muscles and blood, and fatigue of the muscle. The ability of specific muscles to store energy sources and recover quickly determines their ability to continue the action – in other words, the muscle's level of muscular endurance. Push-ups and chin-ups are examples of activities requiring muscular endurance specific to a particular muscle group. Physical activities with continuous intense movement sequences, such as the contraction of shoulder and arm muscles in kayaking and swimming, require high levels of muscular endurance.

Tests of specific muscular endurance may involve push-ups, chin-ups or sit-ups, but where possible should involve the muscle groups specific to the physical activity.

aerobic capacity (or aerobic endurance) the ability to exercise for extended periods using energy produced by the aerobic energy system

muscular endurance (anaerobic endurance) the ability of specific muscle groups to sustain activity at high intensity using energy produced by anaerobic energy systems

FIGURE 21.2 Rowing requires high levels of muscular endurance.

ISBN 978-1-009-31125-0 Stewart et al.

Speed

Speed can be defined as the ability of muscles to contract quickly and repeatedly, resulting in fast body motion. Speed can be specific to the rate of movement of certain body parts or of the change in position of our whole body. The leg speed of a sprinter contributes to the overall time taken to complete a 100 m event. Moving quickly after serving in tennis, to intercept a return down the line, also illustrates whole body speed. The speed at which any movement can occur depends on reaction time as well as the time taken for muscles to cause the movement. Linear speed (or velocity) is represented as distance per unit time ($v = d/t$) and in physical activity is usually measured in metres per second (m/s).

Strength

Strength can be defined as the ability of muscles to exert a force against a resistance in one maximal effort. The greater the muscular strength, the greater the force that can be generated. Factors that contribute to the generation of force by muscles include the cross-sectional area of the muscle, the initial muscle length prior to contraction, the type of muscle fibres (slow-twitch or fast-twitch fibres) and the speed of contraction.

Two principal types of strength are important in the performance of physical activity: *isotonic strength* and *isometric strength*. Isotonic strength involves the shortening and lengthening of muscle fibres during a specific movement. In the performance of kicking a soccer ball, isotonic strength is displayed in the action of the quadriceps causing flexion at the knee. As discussed in Chapter 5, isotonic muscle contractions may be either **concentric contractions**, where the muscle is shortening under force, or **eccentric contractions**, where the muscle is lengthening under force. Generally, concentric muscle actions apply direct force, whereas eccentric muscle actions control the deceleration of movements or control the speed of movements assisted by gravity.

speed the ability of muscles to contract quickly and repeatedly, resulting in fast body motion

strength the ability of muscles to exert a force against a resistance in one maximal effort

concentric contractions the muscles are developing force while shortening to cause movement

eccentric contractions the muscles lengthen in a controlled way under tension to absorb force

Isometric strength (sometimes called static strength) involves no change in length of muscle fibres, so no joint movement. Although no movement occurs, force is still being exerted by the muscles. In the maintenance of a gymnastics handstand, the arm and shoulder muscles are exerting force against the ground, but no joint motion is occurring.

The testing of strength usually involves measuring the maximum force that can be exerted by a muscle group in a single contraction – for example, recording maximum lifts in the gym. Strength testing also needs to consider the muscular strength required by the specialised movement sequences specific to the sport.

It is recommended that tests of absolute strength involving maximum force should only be used with trained athletes, and, as such, no maximum strength test has been provided with other fitness tests later in this chapter

Power

Power can be defined as the ability of muscles to generate force and apply it quickly. Power is a combination of muscular strength (force) and speed (velocity):

$$\begin{aligned}\text{Power} &= \text{force (strength)} \times \text{speed (velocity)}\\ &= \text{force} \times \text{distance/time}\end{aligned}$$

The ATP–PC energy system is used predominantly to help supply the explosive force needed in activities such as the sprint start, javelin throw, shot-put, jumping for rebounds in basketball or the take-off for the long jump.

As power is a combination of strength and speed, sometimes the terms 'strength-related power' and 'speed-related power' are used to help identify the major contributing factor. Of the above examples, jumping for rebounds and shot-putting are

power the ability of muscles to generate force and apply it quickly

ISBN 978-1-009-31125-0 Stewart et al.

strength-related power activities, whereas the sprint start, javelin throw and long-jump take-off could be termed speed-related power activities. For strength-related power testing, a vertical wall jump or standing long jump may be used. Speed-related power may be tested through a 35 m sprint test.

Flexibility

Flexibility can be defined as the ability of a joint to move through its full range of motion. Factors that limit the flexibility of our muscles include gender, age, body shape, the surrounding connective tissue and the range of motion of the joint. However, flexibility can be improved through training, which assists not only to improve performance but also to avoid injuries to ligaments, tendons and muscles.

Two types of flexibility have been identified: dynamic (or functional) flexibility and static flexibility:

- **Dynamic flexibility** refers to the range of joint movement possible while moving and contributes to the body's ability to make rapid or quick, repeated movements. The actions of the trunk, lead leg and trail leg of a hurdler illustrate the need for dynamic flexibility.
- Static flexibility refers to the range of motion possible at a specific joint of the body while holding a stationary position. Static flexibility is displayed in the execution of the splits in a gymnastics routine. The splits help to illustrate the range of motion about the hips of the gymnast. The testing of flexibility usually focuses on static flexibility.

Goniometers can be used to help measure the angle between two body segments at their maximum range of motion. A more common method of testing the flexibility of the hamstring muscles about the hip joint is the sit-and-reach test.

Agility

Agility can be defined as a rapid whole-body movement with change in velocity or direction in response to a stimulus. Power and flexibility are contributing factors in the level of agility we can display. Agility is an important attribute when involved in physical activity requiring movement to avoid an opponent or move to a projectile – for example, basketball, soccer, badminton, volleyball or touch

flexibility the ability of a joint to move through its full range of motion

dynamic flexibility the range of joint movement possible while moving; it contributes to the body's ability to make rapid or quick, repeated movements

agility a rapid whole-body movement with change in velocity or direction in response to a stimulus

football. A modern understanding of agility recognises the need for an athlete to respond to this stimulus (the opponent or implement), particularly in invasion and ball and court games, such as those mentioned. It is now widely accepted that agility also involves components of situation recognition, decision-making and reaction time. Traditionally, the Illinois agility test is commonly used to test agility. It measures the ability to accelerate quickly, turn and weave through a number of cones in the shortest possible time. While this test is still used to measure 'agility', it more accurately measures change in direction (a subcomponent of agility), as it does not fully replicate the agility required in many physical activities.

FIGURE 21.3 Sports such as netball require excellent agility to change direction quickly and evade opponents.

Additional capacities that affect performance outcomes

While fitness components affect the speed, strength, duration and intensity of movements and can be trained through targeted fitness activities, there are a number of additional capacities that may affect

ISBN 978-1-009-31125-0 Stewart et al.

movement performance. These generally involve a significant cognitive aspect and are less responsive to gains through fitness training. These capacities include balance, coordination and reaction time.

Balance may be defined as the ability to maintain the equilibrium of the body while either moving or in a stationary position. *Dynamic balance* is the term used when referring to maintaining balance while moving. *Static balance* is evident when it is necessary to hold a stationary position. Walking involves dynamic balance. This is particularly evident when we observe a young child learning to walk. Maintaining equilibrium during the execution of a handstand requires static balance.

Coordination may be defined as the ability to link the messages received by the brain from the senses (such as sight and hearing) to our body parts, to produce smooth, quick and efficiently controlled movements. 'Hand–eye coordination' for physical activities such as tennis or netball and 'foot–eye coordination' for soccer are terms sometimes used to help specify the sense and body part associated in the movements. Performing a dance routine to music is an example of our auditory senses being required to perform in a coordinated manner with the working muscles. A simple catch-and-throw test, involving catching and throwing a tennis ball against a wall, is an example of a coordination test.

Reaction time can be defined as the time it takes to respond to a stimulus. The time taken from the firing of the starter's gun (stimulus) to the initial push against the blocks when running or swimming is an example of reaction time. On average, this time is around 170 milliseconds. However, in many team ball sports, it is difficult to determine whether fast response times are due to an athlete demonstrating superior reaction times or a refined ability to anticipate play, and therefore respond earlier.

balance the ability to remain in a stable position, whether moving or stationary

coordination the ability to link the messages received by the brain from the senses to our body parts to produce smooth, quick and efficiently controlled movements

reaction time the time it takes to respond to a stimulus

Sport-specific fitness requirements

The majority of physical activities rely on a combination of fitness capacities. Very few sports require the development of a single fitness component. Some sports, however, require a wider range of fitness capacities than others. Javelin throwers, for example, require good arm speed and core power, whereas sports like Rugby League rely on speed, endurance, strength, power, flexibility and agility. The relationship between the reliance on the fitness components of strength, speed and endurance is often used to determine the training needs of particular sports. This relationship is represented in Figure 21.4. The extent of the reliance of a particular sport on these qualities can be represented at a point in the triangle. Rugby League, for example, relies equally on all three components, whereas running a marathon relies mostly on endurance.

Understanding the fitness demands of a specific physical activity is essential for developing specific and effective training sessions and programs. This reflects the training principle of *specificity*, which will be discussed in Chapter 22, and is achieved through comprehensive game-play analysis to ascertain the movement requirements for successful performance.

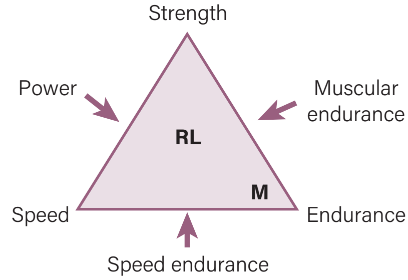


FIGURE 21.4 The relationship between strength, speed and endurance for Rugby League (RL) and marathon running (M)

ISBN 978-1-009-31125-0

CHECK-IN 21.1

1. In a small group, choose one physical activity from each of the following syllabus categories:
   - net and court
   - invasion
   - striking and fielding
   - target
   - performance
   - aesthetic.
2. Draw a strength/speed/endurance triangle (see Figure 21.4) on a whole page. Discuss the relative strength, speed and endurance requirements of each of your selected activities. When your group has reached a consensus, indicate the placement of the activity on the triangle.

ENGAGE 21.1

RECOGNISE & EXPLAIN

ANALYSE & SYNTHESISE

Inquiry question: What are the specific fitness requirements of various physical activities, including the physical activity that is the focus of your study this term?

Recognise and explain

1. Identify the most important physical capacities required for success in the following physical activities. What aspects of each activity helped you make your selection?
   - **a.** Badminton player
   - **b.** Tennis player
   - **c.** Volleyball player
   - **d.** Australian Rules football player
   - **e.** Basketball player
   - **f.** Futsal player
   - **g.** Netball player
   - **h.** Touch football player
   - **i.** Water polo player
   - **j.** 100 m sprinter
   - **k.** Javelin thrower
   - **l.** Distance swimmer.

Analyse and synthesise

KEY COGNITION

Consider: use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation

2. Consider the physical activity that is the focus of your study this term. Rate the importance of each fitness component to successful performance in your activity on a scale of 1–5, with 1 being not important to 5 being very important.

ISBN 978-1-009-31125-0 Stewart et al.

3. What is the relationship of the reliance on speed, strength and endurance of this activity?
4. Does the importance of the various fitness components vary during the activity? Why? Why not?
5. Does the importance of the various fitness components vary with different playing positions in this activity? If so, how?
6. What tests could be used to measure a person's suitability for this activity, or a specific playing position within the activity?

21.2 Analysing the energy and fitness demands of physical activity

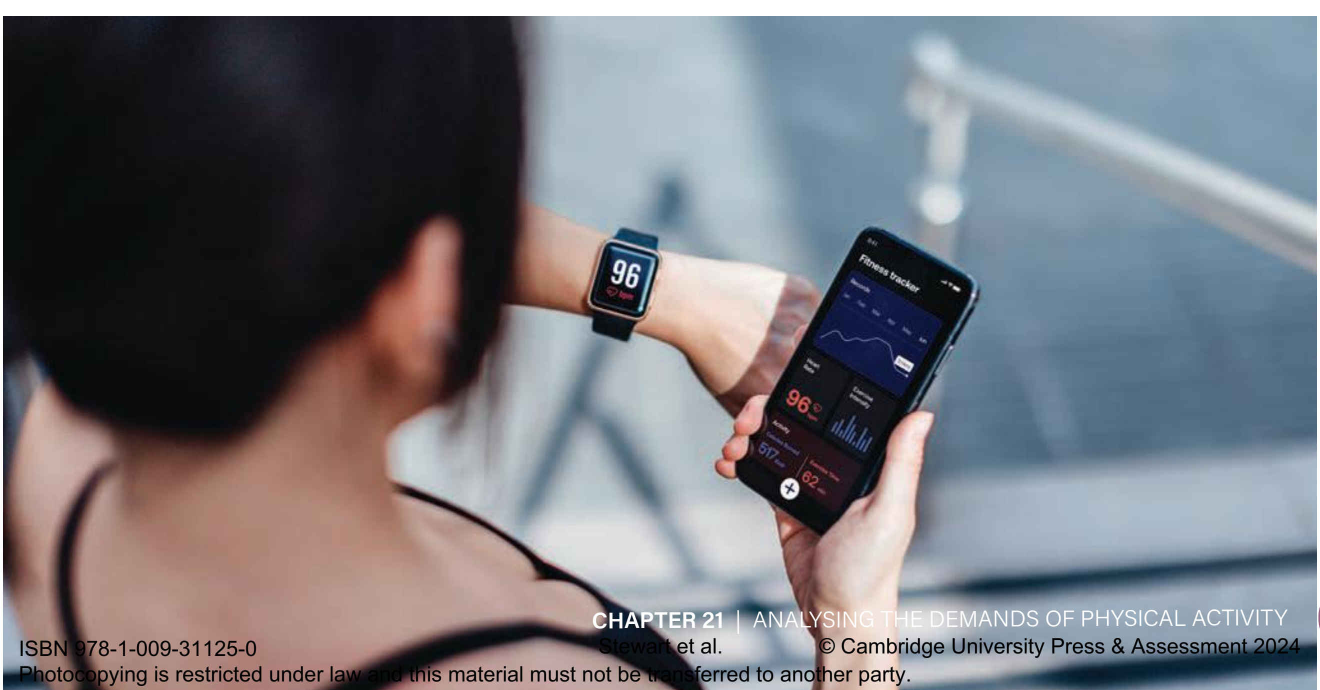
The physical demands of specific physical activities determine which fitness components should be the target of fitness training activities. The energy requirements of physical activities also guide decisions about the types of training activities that will best prepare athletes for performance. Primary and secondary data sources can be used to make justifiable decisions about suitable training activities. Decisions about training activities also need to consider the physical capacities of individual athletes. This is usually done by conducting a range of fitness tests that relate to the physical demands of the activity.

A range of data can be considered in determining the physical demands of particular physical activities and specific roles or playing positions within them.

Data collection could include:

- rating the importance of each of the components of fitness to determine training priorities
- plotting the movement of athletes while in authentic performance environments (such as competition) to determine suitable training activities that replicate movement patterns involved in the activity
- measuring the heart rate responses of athletes while in authentic performance environments to identify appropriate training zones
- calculating work-to-rest (W:R) ratios to determine suitable recovery times in training activities
- investigating existing analyses of the demands of the physical activity in research literature
- investigating recommended training activities for the physical activity in research literature.

Specific movement sequences unique to different physical activities and playing positions may also guide decisions about what specific data to collect. For example, calculating a W:R ratio in the performance of a sprint race would not be useful.



ISBN 978-1-009-31125-0

ACTIVE INVESTIGATION 21.1

Inquiry question: What are the specific physical demands of the physical activity that has been the focus of your study?

Demonstrate and apply

1. Collect primary and secondary data by doing the following.
   a. Create a table of the components of fitness. Based on your experience performing in the activity, rate the importance of each of the fitness components.
   b. Complete a player movement observation. On a diagram of the playing area, plot the movement of one player over a short period of competitive play. Indicate on the diagram the intensity of movement being performed.
   c. Collect heart rate data for a number of players. This could be done manually or using heart rate monitors. Identify players' maximum heart rates and average heart rates to determine the training zone in which they are predominantly working. It may be appropriate in some physical activities to measure players in different roles or positions. Calculate class averages of average and maximum heart rate.
   d. Calculate the W:R ratio of several players. This is done by observing a player during competition over a fixed time span and measuring the time (in seconds) that they spend at rest. You may need to agree on what is considered to be 'at rest' in this particular activity. Use two stopwatches, one to start and stop during periods of rest (measuring a total 'time at rest') and one to measure the duration of game play. The 'time at work' can be calculated by subtracting 'time at rest' from the duration of game play. Class averages of 'time at work' and 'time at rest' can be used to calculate a W:R ratio. Express the ratio in its simplest form.
   e. Conduct a literature search to investigate research relating to the physical demands and recommended training priorities of the physical activity.
2. Your class could split into groups to conduct this investigation. Each group could collect one of the data sets listed above and report its findings to the whole class. Decisions about the physical demands of the activity can be based on these reports.

Analyse and synthesise

3. Through examination and analysis of the primary and secondary data collected, discuss the following questions.
   a. Which components of fitness are the most important contributors to successful performance in this activity?
   b. What are the specific energy demands of this activity? Does this vary for players in different roles or positions?
   c. Towards which training zone would training activities need to be targeted?

ISBN 978-1-009-31125-0 Stewart et al.

d. What does the W:R ratio of this activity imply for recovery times required in training sessions and activities?

e. What training activities should be considered to develop player capacities for the demands of this activity?

Evaluate and justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

4. In a 200–300-word evaluative report, recommend three fitness training priorities for inclusion in pre-season training for this activity. Justify each of your recommendations using evidence gathered from primary and secondary data sources.

Analysing and measuring fitness capacities and performance

After coaches and/or athletes have determined the fitness and energy demands of a particular physical activity, they need to analyse the physical attributes of individual athletes in these particular areas of demand. Various fitness tests and measures are used to determine those fitness components that are an asset to the performer, and those that need to be prioritised for improvement. Therefore, the tests that are used need to measure the physical demands specific to the activity. Activity-specific personal fitness profiles can guide decisions about training priorities for teams and individuals, allow coaches to determine suitable training activities specific to the demands of the activity and the needs of the athletes, allow coaches and athletes to set training goals and allow for the monitoring of progress towards these goals.

A range of simple fitness tests can be used to profile the physical capacities of athletes. The specific fitness requirements of the sport or physical activity determine the range of tests to be conducted. The results of these tests can be used to highlight specific fitness components to target for improvement and guide a coach's planning of group and individual training programs.

Fitness testing

The battery of fitness tests shown in Table 21.1 can be used to develop a personal fitness profile across a range of fitness components. Other tests may need to be included to measure physical capacities specific to a particular physical activity. Raw scores on fitness tests can be compared with age- and sex-specific norms in order to rate performances and target areas for improvement.

TABLE 21.1 Fitness tests for various fitness components

Fitness component	Fitness test
Aerobic capacity	20 m multi-stage fitness test (beep test) 12-minute run test
Muscular endurance	Sprint fatigue test One-minute sit-up test
Speed	35 m sprint test
Power	Vertical jump test (lower body) Basketball throw test (upper body)
Flexibility	Sit-and-reach test
Agility	Illinois agility test

ISBN 978-1-009-31125-0 Stewart et al.

Aerobic capacity: 20-metre multi-stage fitness test (beep test)

The 20 m multi-stage fitness test (MSFT) is a commonly used test of aerobic capacity. It is also known as the 'beep test'.

The beep test can be used as a way of estimating maximal oxygen uptake (VO_2 max). Online conversion tools can be located to convert beep test results into an estimated VO_2 max, and rate this against age-based norms.

Alternatively, an estimate of VO_2 max (measured in millilitres of oxygen per kilogram of body weight per minute – mL/kg/min) can be calculated by substituting beep test results (level number and shuttle number) into the following formula, where LN is the level number and SN is the shuttle number.

FIGURE 21.5 Athletes undertaking the beep test as part of the National AFL Draft Camp

$$VO_2 \text{ max (mL/kg/min)} = 3.46 \times \left(\text{LN} + \frac{\text{SN}}{\text{LN} \times 0.4325 + 7.0048}\right) + 12.2$$

TABLE 21.2 20 m multi-stage fitness test protocols and norms

Equipment	Flat non-slip floor at least 25 m long and wide enough for the number of participants, markers, 20 m tape, beep test audio recording, audio device						
Procedure	This test involves continuous running between two lines 20 m apart in time to recorded beeps. Instructions and protocols for this test are contained on the audio recording. These must be adhered to closely to get a reliable result.						
Scoring	The athlete's score is the level and number of shuttles (20 m) reached before they were unable to keep up with the recording according to test protocols. Pay careful attention to the last level and shuttle number you were able to complete.						
Performance norms	Very poor	Poor	Fair	Average	Good	Very good	Excellent
Male	<5/2	5/2–7/1	7/2–8/5	8/6–10/1	10/2–11/5	11/6–13/10	>13/11
Female	<4/5	4/5–5/7	5/8–7/2	7/3–8/6	8/7–10/1	10/2–12/7	>12/7
Note: Quoted norms provide a guide to the quality of performance for the 17–18 years age group and may be based on research from a wider or slightly older age group.							

TABLE 21.3 VO_2 max norms

VO_2 max norms (mL/kg/min)	Very poor	Poor	Fair	Average	Good	Very good	Excellent
Male	<30	30–36	37–41	42–46	47–51	52–60	>60
Female	<28	28–32	33–37	38–41	42–46	47–56	>56
Note: Quoted norms provide a guide to the quality of performance for the 17–18 years age group and may be based on research from a wider or slightly older age group.							

ISBN 978-1-009-31125-0 Stewart et al.

Aerobic capacity: 12-minute run test

The 12-minute run test is a commonly used test of aerobic capacity that is very easy to set up and administer.

TABLE 21.4 The 12-minute run test protocols and norms

Equipment	400 m athletics track or another running circuit of known distance				
Procedure	Run continuously around the track/course aiming to run as far as you can in 12 minutes. If you need a break from running, at least keep walking so that you are still covering distance.				
Scoring	The athlete's score is the number of metres covered in the 12-minute duration of the test. Observers tally the number of laps and part laps completed. Multiply this by the track distance to give the distance covered in metres.				
Performance norms	Poor	Fair	Average	Good	Very good
Male	<1600	1600–2199	2200–2399	2400–2800	>2800
Female	<1500	1500–1799	1800–2199	2200–2700	>2700
Note: Quoted norms provide a guide to the quality of performance for the 17–18 years age group and may be based on research from a wider or slightly older age group.					

Muscular endurance: sprint fatigue test

The sprint fatigue test is designed to measure the muscular endurance (anaerobic capacity) of the muscles involved in running. This test is a good indicator of general muscular endurance and the capacity of muscles to provide energy using the lactic acid system.

TABLE 21.5 The sprint fatigue test protocols and norms

Equipment	Straight 30 m track with 10 m stopping distance at each end of the track, two stopwatches, markers			
Procedure	The subject will complete sets of 10 × 30 m sprints at maximum speed, starting each 30 m sprint at 30-second intervals. Markers are placed 30 m apart on a sprint track to show the start and finish points. Two more markers are placed 10 m past the start and finish and are used to indicate the slow-down zone at each end. Two timekeepers and a recorder are required. One timer records the time taken for each sprint and one signals the start of each sprint at 30-second intervals. On the go signal, the two stopwatches are started simultaneously, and the subject sprints at maximum speed for 30 m, ensuring that they do not slow down before reaching the finish line. One stopwatch is used to time the sprint of each interval; the other continues to run. The timekeeper measuring the time for the sprint, calls the time for the first sprint to the recorder and resets the stopwatch ready to record the next sprint. The subject uses the 10 m to the next marker to slow down, turn and return to the 30 m finish marker, which then becomes the next start line. The next sprint will be in the opposite direction. Each 30 m sprint starts 30 seconds after the previous run started. This continues until the 10 sprints are completed; therefore sprints start at 30 seconds, 1 minute, 1.5 minutes, 2 minutes, etc. after the start of the first sprint. The recorder notes the time taken for each of the 10 sprints.			
Scoring	The athlete's sprint fatigue index is calculated by taking the average time of the first three sprints and dividing this by the average time for the last three sprints. Convert this to a percentage by multiplying by 100. For the vast majority of people, this should return a value between 75 and 95%. The higher the score, the higher the anaerobic capacity of the subject.			
Performance norms	Poor	Average	Good	Very good
Male and female	<80%	80–84%	85–89%	>89%
Note: Quoted norms provide a guide to the quality of performance for the 17–18 years age group and may be based on research from a wider or slightly older age group.				

ISBN 978-1-009-31125-0 Stewart et al.

Muscular endurance: one-minute sit-up test

The one-minute sit-up test measures muscular endurance of the abdominals and hip-flexor muscles. This can be used as an indicator of general muscular endurance; however, other tests of muscular endurance (such as the flexed arm hang test and the one-minute push-up test) can be used to measure the endurance of other muscle groups that may be more specific to particular sports.

TABLE 21.6 The one-minute sit-up test protocols and norms

Equipment	Carpeted or cushioned floor space, stopwatch						
Procedure	Lie with your knees bent at approximately 90 degrees with feet flat on the ground. Rest your hands on the front of your thighs. Keeping your back as straight as possible, raise high enough for your hands to slide along your thighs to touch the tops of your knees. Then return to the starting position. A partner can be used to secure your feet to the floor.						
Scoring	The athlete's score is the number of correctly performed sit-ups performed in one minute. A partner rather than the test subject should conduct the count.						
Performance norms	Very poor	Poor	Fair	Average	Good	Very good	Excellent
Male	<25	25–30	31–34	35–38	39–43	44–49	>49
Female	<18	18–24	25–28	29–32	33–36	37–43	>43
Note: Quoted norms provide a guide to the quality of performance for the 17–18 years age group and may be based on research from a wider or slightly older age group.							

Speed: 35 m sprint test

The 35 m sprint test measures running speed over a straight 35 m track. More specific tests of speed would be required for swimming or cycling speed testing.

TABLE 21.7 The 35 m sprint test protocols and norms

Equipment	Straight 35 m track with adequate stopping distance, stopwatch				
Procedure	Subjects need to undergo a suitable sprint warm-up for at least 10 minutes before undertaking this test. Use a three-part starting command – take your mark, set, go signal. Complete the 35 m course as fast as possible, taking care not to slow down before the finish. Subjects complete three trials of the test with adequate rest (at least five minutes) between trials.				
Scoring	The athlete's score is the best time in seconds taken over three trials of the 35 m sprint.				
Performance norms	Poor	Fair	Average	Good	Very good
Male	>5.60	5.30–5.60	5.10–5.29	4.80–5.09	<4.80
Female	>6.20	5.90–6.20	5.60–5.89	5.30–5.59	<5.30
Note: Quoted norms provide a guide to the quality of performance for the 17–18 years age group and may be based on research from a wider or slightly older age group.					

ISBN 978-1-009-31125-0 Stewart et al.

Power (lower body): vertical jump test

The vertical jump test measures the muscular power of the lower body.

TABLE 21.8 The vertical jump test protocols and norms

Equipment	Space adjacent to a wall, chalk, measuring tape						
Procedure	There are alternative methods to measure vertical jump. The vertical jump test can be measured using a specialised piece of equipment called a Vertec, where the subject jumps up to displace vanes that indicate the height achieved. The Vertec is adjusted so the lowest vane is at the height of the subject's extended arm and fingers. Alternatively, vertical jump can be measured by the subject jumping to place a chalk mark as high up a wall as possible. Whichever method is used, the vertical jump test is usually performed starting in a standing position side on to the Vertec or wall, and bending the knees immediately prior to jumping off both feet. (This test is sometimes performed off one leg, with a step into the jump, or with a run-up off two feet or one foot, depending on the relevance to the sport involved.)						
Scoring	The athlete's score is the difference between the height achieved by the jump and the height of the subject's raised arm with fingers extended measured in centimetres. The recorded score is the best achieved over three trials.						
Performance norms	Very poor	Poor	Fair	Average	Good	Very good	Excellent
Male	<21	21–30	31–40	41–50	51–60	61–70	>70
Female	<11	11–20	21–30	31–40	41–50	51–60	>60
Note: Quoted norms provide a guide to the quality of performance for the 17–18 years age group and may be based on research from a wider or slightly older age group.							

FIGURE 21.6 An athlete completes the vertical jump test using Vertec equipment during an AFL State Combine event.

Power (upper body): basketball throw test

The basketball throw test measures the muscular power of the upper body.

TABLE 21.9 The basketball throw test protocols and norms

Equipment	Solid wall with 15 m free space in front, basketball, measuring tape			
Procedure	The subject sits on the floor with legs fully extended, feet comfortably apart and back firmly against a solid wall. The ball is held with the hands on the side and slightly behind the centre of the ball, with the ball touching the centre of the chest. The forearms are held parallel to the ground. The subject throws the basketball with a chest pass as far as possible. The subject may require a few trial throws to learn the optimal angle of release to achieve the best result.			
Scoring	The athlete's score is the best distance recorded in metres, taken over three trials.			
Performance norms	Poor	Fair	Good	Very good
Male	<6.0	6.0–7.2	7.3–8.1	>8.1
Female	<5.1	5.1–6.1	6.2–6.9	>6.9
Note: Quoted norms provide a guide to the quality of performance for the 17–18 years age group and may be based on research from a wider or slightly older age group.				

ISBN 978-1-009-31125-0 Stewart et al.

Flexibility: sit-and-reach test

The sit-and-reach test measures the flexibility of the spine and hamstrings.

TABLE 21.10 The sit-and-reach test protocols and norms

Equipment	Sit-and-reach box (or a 1 m rule could be used)						
Procedure	The subject sits on the floor with legs fully extended and the soles of the feet flat against the box. Shoes should be removed. With the palm facing downwards, the subject reaches forward as far as possible with both hands along the measuring line (or rule). Both hands must remain level rather than one reaching out further than the other. After two or three practice reaches, the subject reaches and holds the position for two seconds while the distance is recorded. Subjects need to hold the maximum stretch position for a valid result.						
Note	To produce a reliable result over a number of tests, the same warm-up should be used each time the test is applied. This test could be done immediately after a test of aerobic endurance, providing a consistent warm-up procedure.						
Scoring	The score is measured to the closest centimetre. The level of the feet is considered the zero point. A positive score indicates the subject has reached past the level of the feet.						
Performance norms	Very poor	Poor	Fair	Average	Good	Very good	Excellent
Male	<–20	–20 to –9	–8 to –1	0–5	6–16	17–27	>27
Female	<–15	–15 to –8	–7 to 0	1–10	11–20	21–30	>30
Note: Quoted performance norms are listed as a guide only for the 17–18 years age group but may be based on research from a wider or slightly older age group.							

Agility: Illinois agility test

The Illinois agility test measures the ability to change direction with speed by measuring the time taken to run through a course of markers that requires constant changes in direction.

TABLE 21.11 The Illinois agility test protocols and norms

Procedure	Subjects should lie on their front (head to the start line) with their hands by their shoulders. On go, the subject gets up as quickly as possible and runs around the course as indicated in the diagram, without knocking the cones over, to the finish line. Subjects may require a trial or two to become used to the direction of running the course.

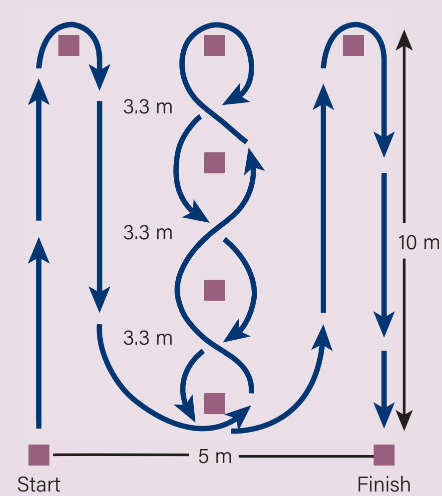


FIGURE 21.7 Course layout for the Illinois agility test

ISBN 978-1-009-31125-0 Stewart et al.

Equipment	Flat non-slip surface at least 15 m × 10 m, eight markers, stopwatch				
Scoring	The athlete's score is the best time in seconds to complete the course, taken over three trials.				
Performance norms	Poor	Fair	Average	Good	Very good
Male	>19.3	18.2–19.3	16.2–18.1	15.2–16.1	<15.2
Female	>23.0	21.8–23.0	18.0–21.7	17.0–17.9	<17.0
Note: Quoted norms provide a guide to the quality of performance for the 17–18 years age group and may be based on research from a wider or slightly older age group.					

Sample personal fitness profile

Table 21.12 shows a sample of a personal fitness profile that could be constructed to record fitness results and used to determine individual and team training priorities. The battery of tests used needs to be matched to the specific fitness and energy requirements of the sport. For example, including a test of upper body strength may be highly relevant for a Rugby League team but not as relevant for a cyclist.

TABLE 21.12 Sample personal fitness profile

Subject name:		**Date:**	
Fitness component	**Selected test**	**Result/score**	**Rating**
Aerobic capacity	Beep test		
Aerobic capacity	12-minute run test		
Muscular endurance	Sprint fatigue test		
Muscular endurance	One-minute sit-up test		
Speed	35 m sprint test		
Power (lower body)	Vertical jump test		
Power (upper body)	Basketball throw test		
Flexibility	Sit-and-reach test		
Agility	Illinois agility test		

CHECK-IN 21.2

1. In small groups, select a sport (choose a different sport for each group).
2. Create a list of five fitness tests to best measure the specific fitness and energy demands of the activity. The tests you choose could come from the tests outlined in this section or other suitable tests you have found in research literature. You may adapt tests to make them more specific to the movement requirements of your selected physical activity.
3. Present your sport-specific fitness test to the class.

ISBN 978-1-009-31125-0

ACTIVE INVESTIGATION 21.2

RECOGNISE & EXPLAIN ANALYSE & SYNTHESISE

Inquiry question: How can a personal fitness profile guide decisions about training priorities and activities?

Recognise and explain

1. Using your research findings in Active investigation 21.1 regarding the physical fitness and energy demands of the physical activity that has been the focus of your study this term, construct a list of fitness tests that could be used to determine your fitness training priorities. You may choose fitness tests solely from those described earlier in this chapter or include other tests that are specific to the physical demands of the activity.
2. Discuss the selection of tests in small groups or as a class, and decide on a battery of five to seven tests to be used by the group. More than seven tests may become difficult to manage.
3. Construct a personal fitness profile similar to the sample in Table 21.12 based on the agreed battery of tests. This profile can be used in the collection of your results. You may consider developing a spreadsheet to record your results over time in order to monitor training progress and goals.
4. Conduct the first round of testing. This will probably require several lessons to complete. You will need to plan carefully:
    - individual roles in conducting testing
    - equipment required
    - recording methods
    - testing schedule
    - catch-up testing.
5. Once testing is complete, scores can be converted into ratings using available norm data. Individual test data can be entered into personal and/or class recording systems such as a spreadsheet.

Analyse and synthesise

KEY COGNITION

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

6. Analyse both your individual results and the results of others in the class. This may involve calculating class averages for each test.
7. Consider the following discussion questions.
    a. What are your personal fitness training priorities for improvement based on your profile?
    b. What training activities may be included in a training program to address your priorities?
    c. What are the training priorities for the class as a whole?
    d. Are the class training priorities similar to your personal priorities?
    e. How may training priorities vary for individuals in different playing roles or positions?
8. Based on your initial personal fitness profile, construct a set of fitness training goals. Your goals should set an achievable target for improvement in a suitable time period. You need to set sub-goals at intervals leading towards your final goal. These can be used to check progress, adjust goals if necessary and keep you motivated to achieve your goals.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Movement requirements for physical activity are classified as components of fitness. They include aerobic capacity, muscular endurance, speed, strength, power, flexibility and agility.
- Aerobic capacity is important for all physical activities.
- For sustained physical activities, repeated muscular contraction without the development of high levels of fatigue signals developed anaerobic or muscular endurance.
- Isotonic strength involves the lengthening and shortening of muscle fibres.
- Isometric strength involves no change in the length of muscle fibres, and therefore no joint movement.
- Dynamic flexibility contributes to the body's ability to make quick, repeated movements.
- Static flexibility illustrates the range of motion possible about a specific joint of the body.
- Power is a combination of muscular strength and speed.
- Speed of muscular contraction and reaction time contribute to the overall time taken to move from one position to another.
- Agility incorporates the ability to accelerate quickly, dodge, weave and turn in an efficient manner.
- A range of fitness tests can be used to determine the fitness training priorities of individuals and teams.
- Fitness tests can be used to determine the suitability of individuals to performance in various physical activities.
- Coaches need to analyse the physical fitness and energy demands of physical activity and the fitness levels of their athletes in order to plan specific training activities.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Which of the following is not a component of fitness as described in the senior Physical Education syllabus?

A. Flexibility

B. Coordination

C. Muscular endurance

D. Agility

2. A suitable test to determine an athlete's level of aerobic endurance is the:

A. 40 m sprint test.

B. 12-minute run test.

C. sprint fatigue test.

D. Illinois agility test.

3. Which of the following components of fitness is most closely aligned with the ATP–PC energy system?

A. Flexibility

B. Agility

C. Muscular endurance

D. Aerobic capacity

4. Which definition best describes the fitness component of power?

A. The ability to apply a repeated force over an extended period of time

B. The ability to repeat movements rapidly

C. The ability to apply a large force for 15 repetitions

D. The ability to generate a large force quickly

ISBN 978-1-009-31125-0

Question 5 relates to Stimulus 1.

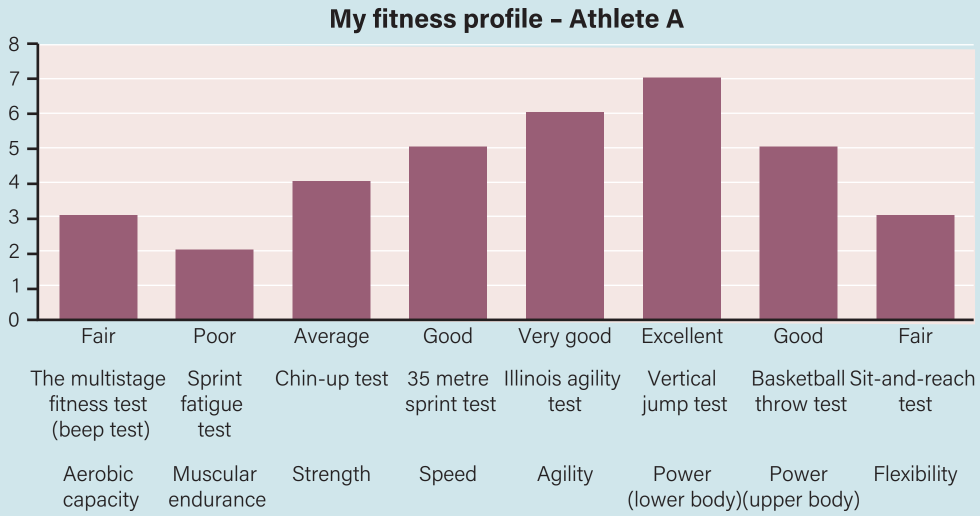
5. According to reported fitness results, Athlete B is best suited to which of the following track and field events?

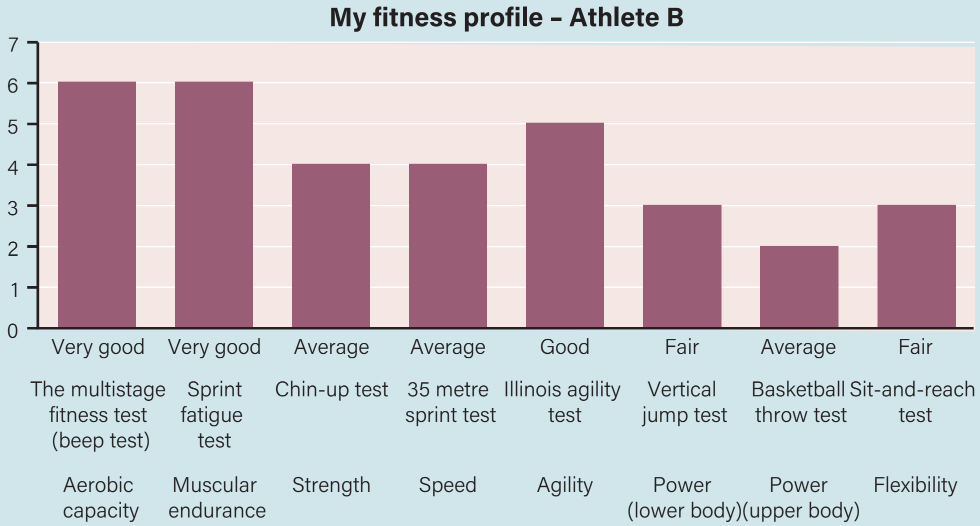
A. Triple jump

B. Javelin

C. 100 m sprint

D. 400 m hurdles





STIMULUS 1 Fitness test results for two athletes

ISBN 978-1-009-31125-0 Stewart et al.

SHORT-RESPONSE QUESTIONS

1. This question relates to Stimulus 1 above.

   In a short response (120–250 words), evaluate which of the athletes depicted in Stimulus 1 would be most suited to perform specialised movement sequences in the physical activity you are currently studying. Remember to note the physical activity you are referring to.

2. Using a specific sport as an example, explain the relationship between analysing the fitness demands of a physical activity, testing the fitness capacities of an athlete and devising training activities.

EXTENDED-RESPONSE QUESTIONS

1. Develop a fitness profile that you could use and is suitable to track your training progress in a particular physical activity, possibly in the physical activity that is your focus of study in Unit 4. Justify your inclusion of fitness tests targeted to measure physical capacities required by the sport. Include personal targets for improvement over time.

2. This question relates to Stimulus 2 below.

   In an extended response (400 words or more), evaluate the athlete's suitability to perform in the physical activity that is the focus of study in Unit 4. Justify your response by referring to specific energy system and fitness component requirements of the activity. Recommend two training activities that would allow this athlete to improve their physical capacities for performance in this activity, referring to recommended training methods and the principles of specificity, duration and intensity.

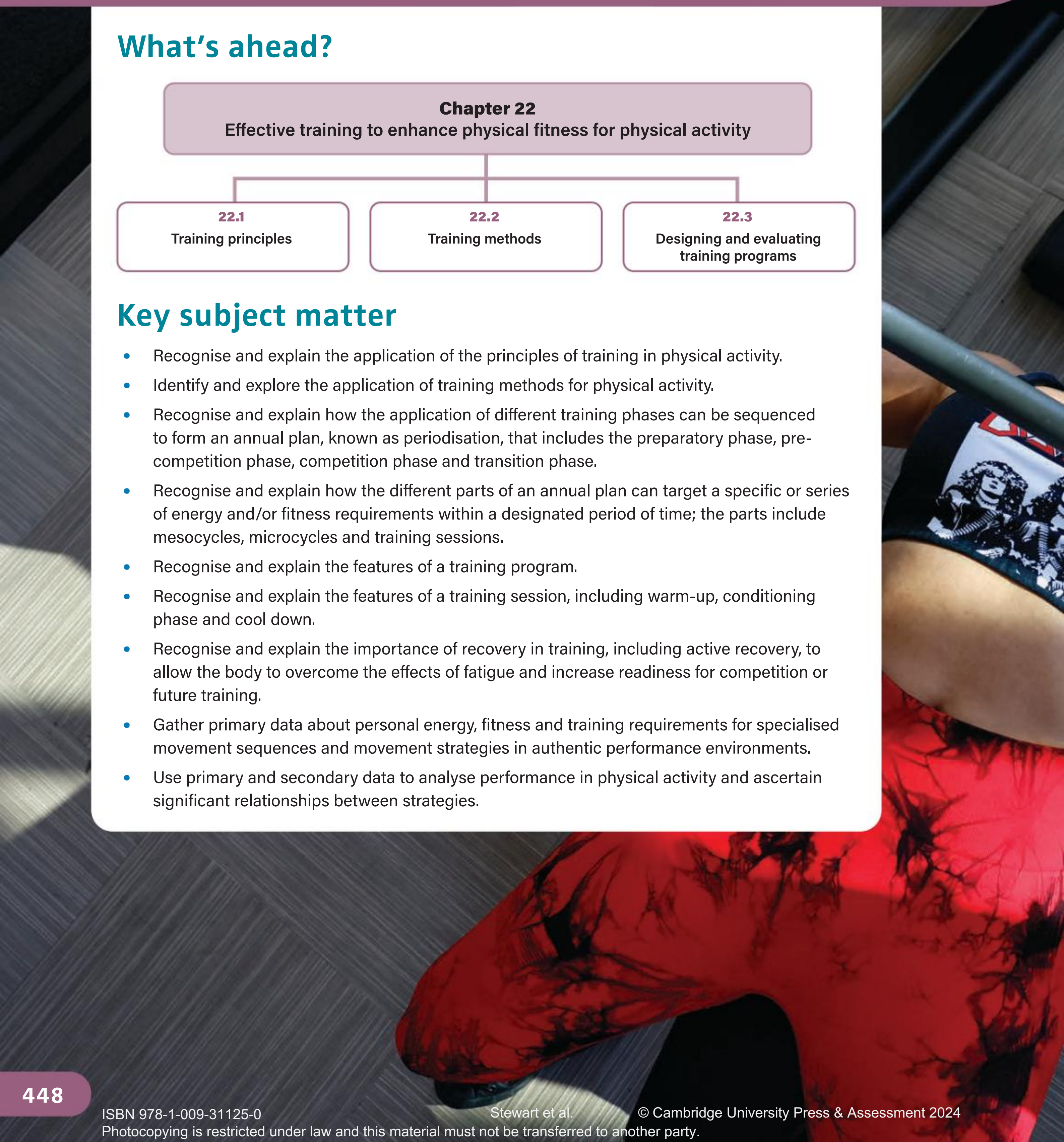
Fitness test	Fitness component	Standards				
		Very good	Good	Average	Below average	Poor
Multistage fitness test (beep test)	Aerobic capacity				✔	
Illinois agility test	Agility		✔			
40-metre sprint test	Speed		✔			
Sprint endurance test	Anaerobic endurance			✔		
Vertical jump test	Muscular power		✔			

STIMULUS 2 An athlete's standardised results in a battery of five fitness tests

ISBN 978-1-009-31125-0

CHAPTER 22

Effective training to enhance physical fitness for physical activity



What's ahead?

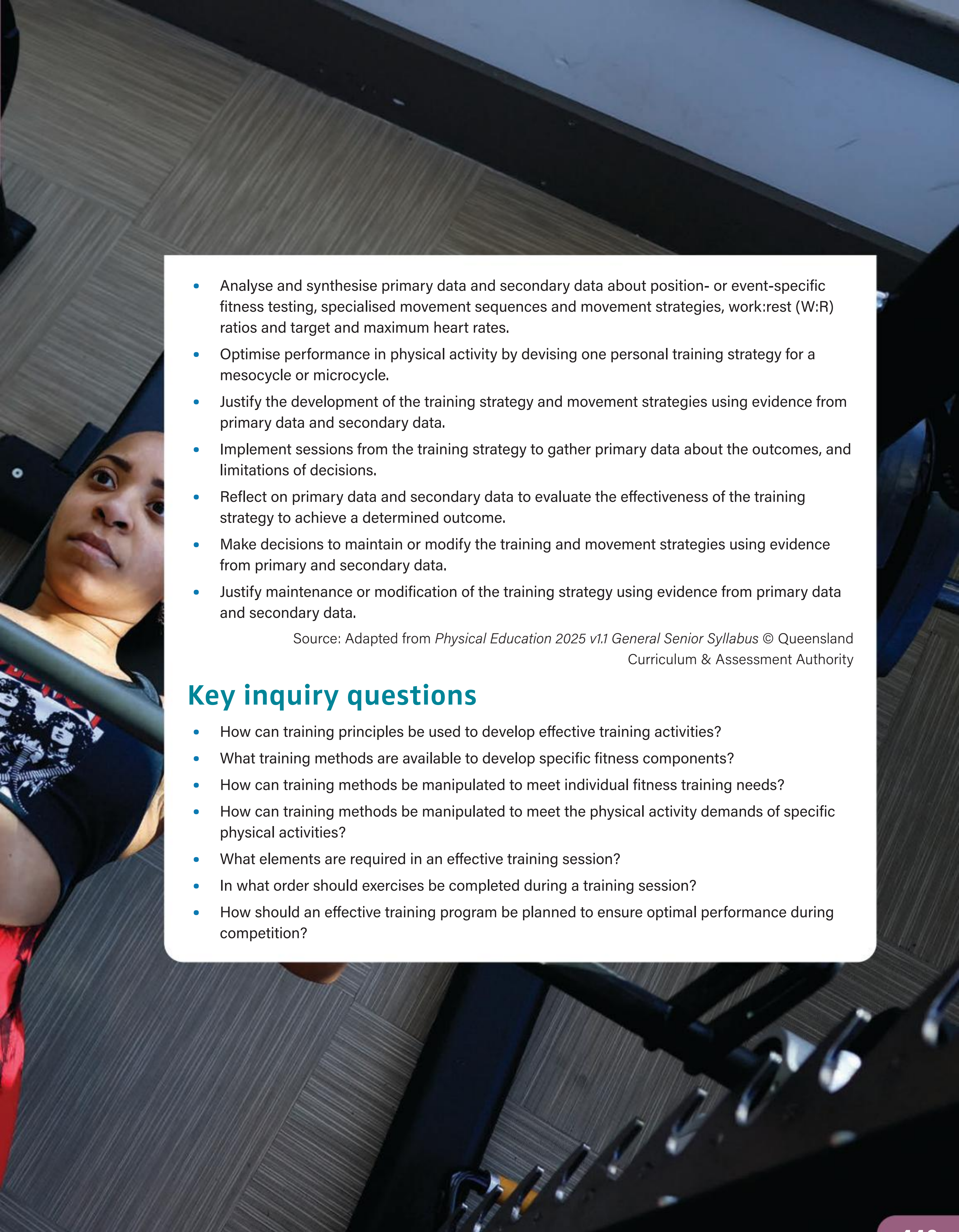
Chapter 22
Effective training to enhance physical fitness for physical activity

- **22.1** Training principles
- **22.2** Training methods
- **22.3** Designing and evaluating training programs

Key subject matter

- Recognise and explain the application of the principles of training in physical activity.
- Identify and explore the application of training methods for physical activity.
- Recognise and explain how the application of different training phases can be sequenced to form an annual plan, known as periodisation, that includes the preparatory phase, pre-competition phase, competition phase and transition phase.
- Recognise and explain how the different parts of an annual plan can target a specific or series of energy and/or fitness requirements within a designated period of time; the parts include mesocycles, microcycles and training sessions.
- Recognise and explain the features of a training program.
- Recognise and explain the features of a training session, including warm-up, conditioning phase and cool down.
- Recognise and explain the importance of recovery in training, including active recovery, to allow the body to overcome the effects of fatigue and increase readiness for competition or future training.
- Gather primary data about personal energy, fitness and training requirements for specialised movement sequences and movement strategies in authentic performance environments.
- Use primary and secondary data to analyse performance in physical activity and ascertain significant relationships between strategies.

ISBN 978-1-009-31125-0 Stewart et al.



- Analyse and synthesise primary data and secondary data about position- or event-specific fitness testing, specialised movement sequences and movement strategies, work:rest (W:R) ratios and target and maximum heart rates.
- Optimise performance in physical activity by devising one personal training strategy for a mesocycle or microcycle.
- Justify the development of the training strategy and movement strategies using evidence from primary data and secondary data.
- Implement sessions from the training strategy to gather primary data about the outcomes, and limitations of decisions.
- Reflect on primary data and secondary data to evaluate the effectiveness of the training strategy to achieve a determined outcome.
- Make decisions to maintain or modify the training and movement strategies using evidence from primary and secondary data.
- Justify maintenance or modification of the training strategy using evidence from primary data and secondary data.

Source: Adapted from *Physical Education 2025 v1.1 General Senior Syllabus* © Queensland Curriculum & Assessment Authority

Key inquiry questions

- How can training principles be used to develop effective training activities?
- What training methods are available to develop specific fitness components?
- How can training methods be manipulated to meet individual fitness training needs?
- How can training methods be manipulated to meet the physical activity demands of specific physical activities?
- What elements are required in an effective training session?
- In what order should exercises be completed during a training session?
- How should an effective training program be planned to ensure optimal performance during competition?

ISBN 978-1-009-31125-0 Stewart et al.

22.1 Training principles

Modern training takes many forms, and typically involves the development of a holistic athlete – that is, training will simultaneously incorporate aspects of technical, tactical, perceptual, physical and psychological performance development. While all of these aspects are essential, the training elements outlined in this chapter focus solely on physical gains for improved fitness in response to the physical demands of the activity.

When designing training for improved physical performance, a number of **principles of training** must be considered. The most significant are the principles of:

- specificity
- individuality
- intensity
- duration
- frequency
- reversibility
- progressive overload
- variety

Specificity

The principle of **specificity** refers to the need for training to target the essential components of fitness, energy systems and movement sequences required for a selected physical activity. For example, marathon runners train primarily to develop their muscular endurance and aerobic capacity. Most of the training involves completing long slow distance (LSD) efforts in order to improve their ability to transport oxygen and nutrients throughout their body during exercise. In contrast, a 100 m sprinter targets their training on the development of their ATP–PC energy system, speed and power. As well as working on refining technique, their training focuses on strengthening the large leg, lower back and core muscles critical for generating the required forces. In designing fitness activities for training using the principle of specificity, it is essential to have a clear understanding of the energy and fitness requirements, as well as the position-specific movements for the activity. This understanding can be achieved through comprehensive game analysis.

principles of training a set of eight guidelines that should be considered when designing effective training activities

specificity (as a training principle) training that is relevant to the energy systems, position-specific movements and fitness requirements of an activity

Individuality

In addition to targeting the specific demands of a physical activity, training should be performed to meet the needs of the athlete and take their situation into consideration. **Individuality** reflects the need for a **training program** to be written to consider the personal needs, goals, fitness levels, motivation and skills strengths, weaknesses and goals of the athlete. During a strength and conditioning session, it would be pointless for two athletes with different levels of strength to lift the same weight the same number of times. Either the weaker athlete would struggle to complete the set effectively and be at risk of injury, or the stronger athlete would find it too easy and not experience enough stress to facilitate adaptation within their body. To design effective training activities that target individuals, it is important to have a clear understanding of their fitness and skill levels, as well as their needs, goals and motivation. This knowledge can be gained through regular fitness testing and developing a productive coach–athlete relationship.

individuality training that considers the personal needs, goals, fitness levels, motivation and skills of an athlete

training program an organised plan for long-term athlete/team development, based on training objectives, game analysis, required adaptations, tapering and recovery

ISBN 978-1-009-31125-0 Stewart et al.

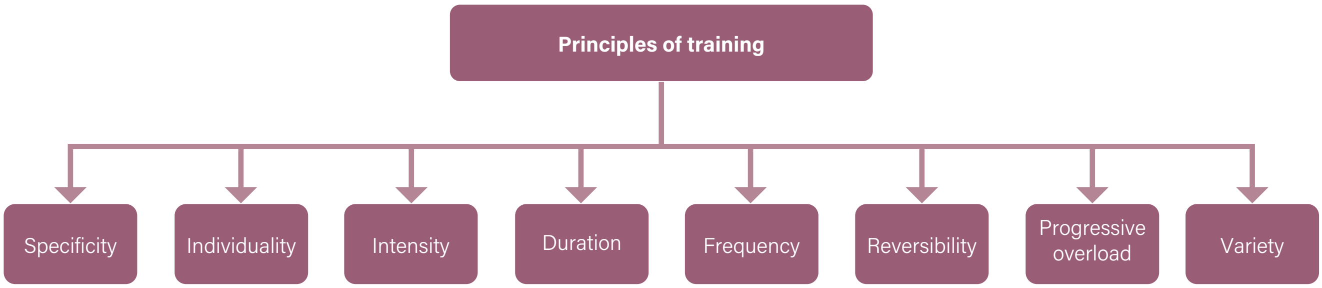


FIGURE 22.1 Principles of training

CHECK-IN 22.1

1. Explain the difference between specificity and individuality.
2. Identify the most important energy systems and components of fitness required in your current physical activity.
3. Compare the importance of the identified energy systems and components of fitness for two different positions or disciplines of your current physical activity.
4. For each of the following physical activities, explain whether including 'bench press' exercises into a training program would follow the principle of specificity:
   a. tennis
   b. touch
   c. long jump
   d. netball
   e. shot-put.
5. Identify three individual training needs that would be different from another class member for a selected physical activity.

KEY MESSAGE
Training needs to get progressively harder to produce continued adaptations.

KEY MESSAGE
Effective training is specific to the requirements of the physical activity.

KEY MESSAGE
Effective training targets the individual needs and goals of each athlete.

Intensity

Intensity refers to the magnitude of exertion required to complete set movements – in simple terms, how hard an athlete trains. To achieve maximum benefit from training, the intensities used in training should be specific to the energy systems and components of fitness required for the chosen physical activity. Measuring and monitoring training intensities can be done using:

- target heart rates
- perceived exertion
- percentage of maximum strength or speed.

Target heart rate

With technological advances in fitness tracking, it is becoming easier to track heart rates during physical activity. **Training zones** are used as a guide for athletes

training zone specific intensity range that identifies the dominant energy system used

ISBN 978-1-009-31125-0 Stewart et al.

to ensure that they are working at the intensities needed to train the required energy systems. Most heart rate trackers allow athletes to set training zones and provide alerts when not training in the specified zones.

Calculating target zones for individual athletes

According to the earlier principle of individuality, individual differences need to be recognised when establishing actual training zone heart rates for the purpose of setting appropriate training intensity. Primary training zones rely on knowing or predicting an athlete's **maximum heart rate (MHR)** to calculate percentages. Maximum heart rates can vary according to age, gender, level of fitness, ethnicity and the overall health of the heart.

The maximal HR is the highest HR that the individual can achieve. The most accurate way to determine the maximal heart rate of athletes is to subject them to VO_2 max tests (beep test, yo-yo test) that gradually push them towards exertion. Less-accurate predictions of maximal heart rate can be determined using the age-predicted maximum heart rate (APMHR) calculation below:

Age-predicted maximum heart rate = 220 – age

This equation suggests that a 17-year-old athlete would have a maximum heart rate of 203 beats per minute.

Target training zones can be calculated by applying the respective percentages of an athlete's maximum heart rate. However, the Karvonen method of calculating an athlete's heart rate is considered a more accurate measure for target heart rates as it is more specific to the VO_2 max of each individual. **Heart rate reserve** can be calculated by subtracting the **resting heart rate (RHR)** from the maximum heart rate. Target heart rates can then be determined by adding the percentage of heart rate reserve to the resting heart rate. Essentially, this value indicates the amount of variance in the athlete's heart rate, and can provide a more individualised prediction of target heart rate.

MHR – RHR = heart rate reserve

Target heart rate = ((MHR – RHR) × intensity) + RHR

maximum heart rate (MHR) the highest safe heart rate at maximal exercise;
MHR = 220 – age

heart rate reserve (HRR) the difference between an athlete's maximum and resting heart rates

resting heart rate (RHR) the number of times the heart beats per minute when at rest

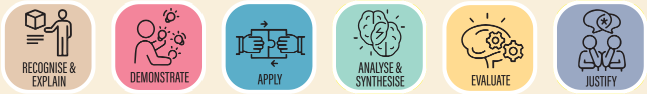
TABLE 22.1 Heart rate zone training

Purpose	Target zone	Intensity % (MHR)	Duration (minutes)	Benefits
High performance	Anaerobic zone (very hard)	90–100	< 5	Develops maximal performance and speed, and is only recommended for fit athletes
Performance	Threshold zone (hard)	80–90	2–10	Develops speed endurance and maximising performance capacity
Fitness	Aerobic zone (moderate)	70–80	10–40	Improves aerobic fitness by making the heart stronger, enhancing lung capacity and improving efficiency of clearing lactic acid
	Endurance zone (light)	60–70	40–120	Improves basic endurance and strengthens the body in preparation for more intense exercise
Health improvement	Recovery zone (very light)	50–60	20–40	Aids recovery and maintains a healthy heart by maintaining blood flow

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 22.2 Training vests can be used to monitor heart rate and track player movements using GPS.

ENGAGE 22.1



Inquiry question: How accurate are age-predicted calculations in determining maximum heart rates for your class?

Note: This activity should only be completed by healthy athletes in the company of others.

Recognise and explain

1. Determine and record each classmate's resting heart rate (RHR). This should done following an extended period of rest.
2. Use the APMHR equation to determine the maximum heart rate values for each person in your class.
3. Determine and practise a method for measuring heart rates (heart rate trackers, pulse counting).
4. Review the protocol for completing a selected VO_2 max test.

Demonstrate and apply

5. Following a suitable warm-up, complete the VO_2 max test. Record each person's highest heart rate (if using the pulse counting method, this should be done as soon as the exercise finishes).

Analyse and synthesise

Analyse: examine or consider something in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences

6. Analyse maximal heart rates achieved during the VO_2 max test. Explain the differences between the predicted and recorded MHR values for the class.

Evaluate and justify

7. Write a sentence justifying how accurate the APMHR calculation was in estimating maximum heart rate values.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 22.2 Calculating the heart rate training zone

Example: Calculate the heart rate training zone for the following athlete:

- maximum heart rate (MHR) = 206 beats per minute
- resting heart rate (RHR) = 60 beats per minute
- desired training intensity = 80–90% (threshold training zone)

% maximum heart rate	Karvonen method
Step 1: Calculate the lower limit of the training zone: 80% of 206 = 0.8 × 206 = 164.8 beats per minute **Step 2**: Calculate the upper limit of the training zone: Target heart rate = 90% of 206 = 0.9 × 206 = 185.4 beats per minute	**Step 1**: Calculate the heart rate reserve (HRR) by subtracting the resting heart rate (RHR) from the maximum heart rate (MHR): HRR = MHR – RHR HRR = 206 – 60 HRR = 146 beats per minute **Step 2**: Calculate the lower limit by adding the desired percentage of HRR to the RHR: Target heart rate = 80% of HRR + RHR = (0.8 × 146) + 60 = 116.8 + 60 = 176.8 beats per minute **Step 3**: Calculate the upper limit: Target heart rate = 90% of HRR + RHR = (0.9 × 146) + 60 = 131.4 + 60 = 191.4 beats per minute

A variance between heart rate targets can be seen when exercising. The values calculated using the % maximum heart rate method are lower than those calculated using the Karvonen method (% HRR); however, there is significant overlap. Fitter athletes with higher VO_2 max values also have lower resting heart rates, so this variance between the two methods of calculating target heart rates will decrease as fitness improves.

CHECK-IN 22.2

1. In your own words, explain how the Karvonen method is used to calculate target heart rates.
2. Calculate the target heart rates using the % MHR method for the following athletes:
   a. 85% intensity (MHR = 200)
   b. 60% intensity (MHR = 185)
   c. 95% intensity (MHR = 205).
3. Calculate the target heart rates using the Karvonen method for the following athletes:
   a. 70% intensity (MHR 200, RHR 75)
   b. 80% intensity (MHR 190, RHR 90)
   c. 55% intensity (MHR 195, RHR 85).
4. Calculate the % MHR and % HHR for an athlete who is training at an intensity of 170 bpm (MHR 200, RHR 70).

ISBN 978-1-009-31125-0 Stewart et al.

Rate of perceived exertion

A simpler form of monitoring training intensities involves relying on the athlete's perception of their effort. The **rate of perceived exertion**, or RPE scale can be used to regulate training intensities by having athletes monitor their internal physiological responses. As exercise intensities increase, the body works harder to continue the supply of oxygen to the muscles. As a consequence, less oxygen is available in the lungs and it becomes more difficult to talk. Table 22.3 shows the relationship between ratings of perceived exertion and the ability to talk.

rate of perceived exertion (RPE) the level of intensity an athlete believes they are experiencing

FIGURE 22.3 Athletes need to understand their bodies; how they are feeling and what stage of exertion they are experiencing.

TABLE 22.3 Rate of perceived exertion scale

Zone	Exertion scale	Exertion level	Talk test	Range (% of MHR)
High performance zone	10	Severe	Can't talk; gasping for breath	93–100
	9	Strenuous/severe	Can't talk; very heavy breathing	86–92
Performance zone	8	Strenuous	Only able to speak in syllables; very heavy breathing	81–85
	7	Vigorous/strenuous	Broken sentences; heavy breathing	76–80
Fitness zone	6	Vigorous	Can only complete one or two sentences; heavy breathing	68–75
	5	Moderate; vigorous sweat	Can carry on a conversation; heavy breathing	61–67
Health improvement zone	4	Moderate; sweat	Can carry on a conversation; moderate breathing	56–60
	3	Moderate; no sweat	Can carry on a conversation; light breathing	51–55
Inactive	2	Light	Normal breathing; can talk normally	46–50
	1	Very light	Normal breathing; can talk normally	40–45

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 22.2

DEMONSTRATE APPLY EVALUATE JUSTIFY

Inquiry question: How accurate is the rate of perceived exertion scale in monitoring intensities?

Demonstrate and apply

1. Your teacher will split the class into three groups.
2. Review the suggested physiological responses associated with RPE scales 4, 6 and 8.
3. Select a suitable method for recording heart rate. This should be recorded at the end and not during the exercise.
4. Following a suitable warm-up, complete three to five minutes of running or walking at an RPE of 4.
5. Record the highest heart rate reached and calculate the % MHR for this level.
6. Repeat steps 4 and 5 twice for RPE of 6 and RPE of 8 respectively.

Evaluate and justify

KEY COGNITION

Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgements about the ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria

7. Evaluate the accuracy of your perceived level of exertion by comparing your heart rates with the suggested % MHR ranges in Table 22.3 on the previous page.

Percentage of maximum strength

When considering **resistance training**, intensities are measured using a percentage of the maximum weight an athlete can lift once. This is also known as their 1RM or one **repetition maximum**. High-intensity training results in the athlete only being able to lift the weight once or twice. Obviously, as the intensity decreases the ability to complete more **repetitions** increases. Knowledge of an athlete's 1RM score can be used to plan the amount of weight to lift for the desired number of repetitions. Inversely, knowing the number of times an athlete can lift a certain weight can be used to predict their 1RM. Testing for 1RM can be completed using free weights or machines, and can be conducted for a range of resistance exercises.

resistance training exercise that incorporates specific muscle contractions to move or hold weight

repetition maximum (RM) the maximum weight an athlete can lift over a prescribed number of repetitions

repetitions the number of times an exercise is completed

The following is the protocol for testing 1RM.

1. Complete a warm-up set of 6–10 repetitions. Rest for three minutes.
2. Complete a 3RM set (approximately 80 per cent of predicted 1RM). Rest for three minutes.
3. Increase the weight to 5 kg below predicted 1RM. Rest for three minutes.
4. If the previous lift is successful, increase the weight by a further 5–10 per cent; if unsuccessful, decrease the weight by 5–10 per cent. Rest for three minutes.
5. Repeat this process until the maximum weight for one repetition is reached.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 22.4 Testing 1RM

Maximum number of repetitions performed per set	% of 1RM	To predict 1RM, multiply weight by:
1	100	1.00
2	95	1.05
3	93	1.08
4	90	1.11
5	87	1.15
6	85	1.18
7	83	1.20
8	80	1.25
9	77	1.30
10	75	1.33
11	70	1.49
12	67	1.54

ACTIVE INVESTIGATION 22.1

RECOGNISE & EXPLAIN · DEMONSTRATE · APPLY · ANALYSE & SYNTHESISE · EVALUATE · JUSTIFY

Inquiry question: How effective are % 1RM predictions in determining multiple repetition weights?

Note: This activity should only be completed by healthy athletes in the company of others trained in correct lifting and spotting techniques for the chosen exercise.

Recognise and explain

1. Collect secondary data by conducting background research into 1RM data used by athletes in a selected physical activity.
2. Choose an exercise to test an athlete's 1RM, preferably one that will assist in the specific development of movements in the chosen physical activity. Common examples are bench press, squat, lat pull-down, triceps press and leg extension.
3. As a class, allocate members to five groups (4RM, 6RM, 8RM, 10RM, 12RM), ensuring at least one person in each group is willing and able to complete two repetition maximum tests.

Demonstrate and apply

4. Conduct a 1RM test using the protocol outlined previously in this chapter.
5. Use Table 22.4 to determine the recommended weight required for the allocated repetitions for your group.
6. After at least 30 minutes' rest (preferably on a different day), complete as many repetitions of the exercise as possible with the selected weight.
7. Collate results from other groups.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

8. Analyse and interpret the primary data by developing a series of graphs and tables that demonstrate the main findings. Some examples of graphical displays are:
   - column graphs that show results of predicted and actual number of repetitions completed
   - line graphs representing the number of repetitions and the variance between predicted and actual repetitions.

Evaluate and justify

KEY COGNITION

Evaluate: examine and determine the merit, value or significance of something, based on criteria

9. In a paragraph, evaluate the effectiveness of a 1RM test in predicting the weight required for multiple repetition sets. Use both primary and secondary data to justify your evaluation.

FIGURE 22.4 Knowing an athlete's 1RM score can be used to plan the amount of weight to lift for the desired number of repetitions.

Duration

The length of the **training session** or activity is known as the **duration**. Depending on the activity, this may range from five minutes to five hours. The less intense the activity, the longer the duration can be. These lengthy sessions develop muscular endurance. Short, hard efforts are used to develop muscular strength, power and/or speed. It is important to train for a sufficient time to achieve the appropriate physiological response, whether it is for strength or endurance.

A trap for some athletes is that they train for too long and do too much of a given activity, often resulting in intensities that are below what is required to receive training benefits for the component of fitness being targeted. For example, there is little benefit in training for 60 minutes at 75 per cent intensity doing resistance training or sprint training activities when trying to target power or speed. Training should focus on appropriate quality and intensity of movement rather than quantity. Guidelines for duration are provided in the next section on **training methods**.

training session an individual period of time, consisting of different activities designed to improve performance in relation to the goal of the individual or team

duration the length of the training session or individual training activity

training methods a set of different training types, each having its own focus or way of training in order to achieve different training benefits or goals in relation to the fitness component(s) to be developed

ISBN 978-1-009-31125-0 Stewart et al.

Training intensity can be manipulated in a variety of ways.

The Karvonen method of calculating % MHR accounts for individual difference.

It is recommended that resistance training intensities are linked to percentage of 1RM.

Frequency

Adaptation will only occur after repeatedly subjecting the body to stresses greater than it is used to. However, an athlete needs to balance the amount of training they do with ample recovery time to fully adapt. **Frequency** refers to the number of training sessions completed over a given period – for example, a week. Overtraining occurs when the training frequency does not allow adequate rest and time for the body to recover effectively. This can result in increased risk of injury and illness, and decreased performance in training and competitions.

frequency the number of times training occurs in a given period

FIGURE 22.5 Rest time is essential for any training program to allow the body to recover.

The recovery time required is specific to the nature of the training and/or competition. Heavy weights sessions or plyometric training place a large amount of stress on the muscles and joints, requiring adequate rest between sessions. The recommended frequency for this type of training is to not exceed once or twice per week for each muscle group. Conversely, low-impact or non-weight-bearing activities like swimming do not place as much stress on the muscles and result in the body recovering much faster. This can be reflected in a higher frequency of training for swimmers: their training can be conducted twice daily, and top swimmers perform 11 sessions a week in the pool.

Reversibility

As previously mentioned, placing stress on our body in the form of exercise results in adaptations and increased fitness. However, when this training stops and the stressors placed on the body are removed, an athlete will see a regression in their fitness as they slowly start to lose those adaptive gains. This is known as the principle of **reversibility**. The rate at which reversibility occurs depends on the quality and length of the training that has ceased. If an athlete rapidly gains muscle over a short period of time before stopping their training, they will see a faster rate of reversibility than someone who has gradually developed their muscle mass.

reversibility the reversal of adaptations due to discontinuation of training or training load

The rate of reversibility also depends on the type of training stress the athlete has adapted to. Endurance-based training is most susceptible to the effects of reversibility, and up to 25 per cent reduction in fitness can occur after 3–4 weeks without training. Training that had focused on developing strength and power is considered more resistant to reversibility. Athletes probably don't see any great decrease in fitness within 2–3 weeks, and a gradual regression of between 2 and 3 per cent per week after that. If wishing to avoid reversibility during the offseason, it is recommended that athletes maintain at least one gym-based session with moderate intensity and volume to maintain

ISBN 978-1-009-31125-0 Stewart et al.

strength and power. For endurance, a moderate frequency and lower volume of training completed at the same intensity as the body has adapted to is recommended.

Progressive overload

After exercise, the body undergoes a period when it repairs and replenishes the essential tissues and systems that have been used. Following adequate recovery, the body is then more prepared to deal with the demands of the training session and will find it easier to cope. This concept is known as **adaptation**, as the body changes to account for the physical demands it has experienced. This process continues until the body feels comfortable with the training. To facilitate continued improvement throughout a training program, it is important to plan gradual increases in the physical demands of the training. This is known as **progressive overload**. Although fast progression is desirable, it is important to avoid **overtraining**. This occurs if the increase in duration, **volume** and intensity is too rapid. The '10 per cent rule' is a good guideline to follow when determining how much overload should be done – that is, the changes made to training demands should not exceed 10 per cent of the previous effort.

adaptation physiological changes due to the stress of exercise

progressive overload the planned, gradual increase in training load to ensure that fitness continues to be optimised

overtraining impaired physical, emotional and psychological responses due to the training intensities exceeding recovery

volume the number of repetitions or sets completed

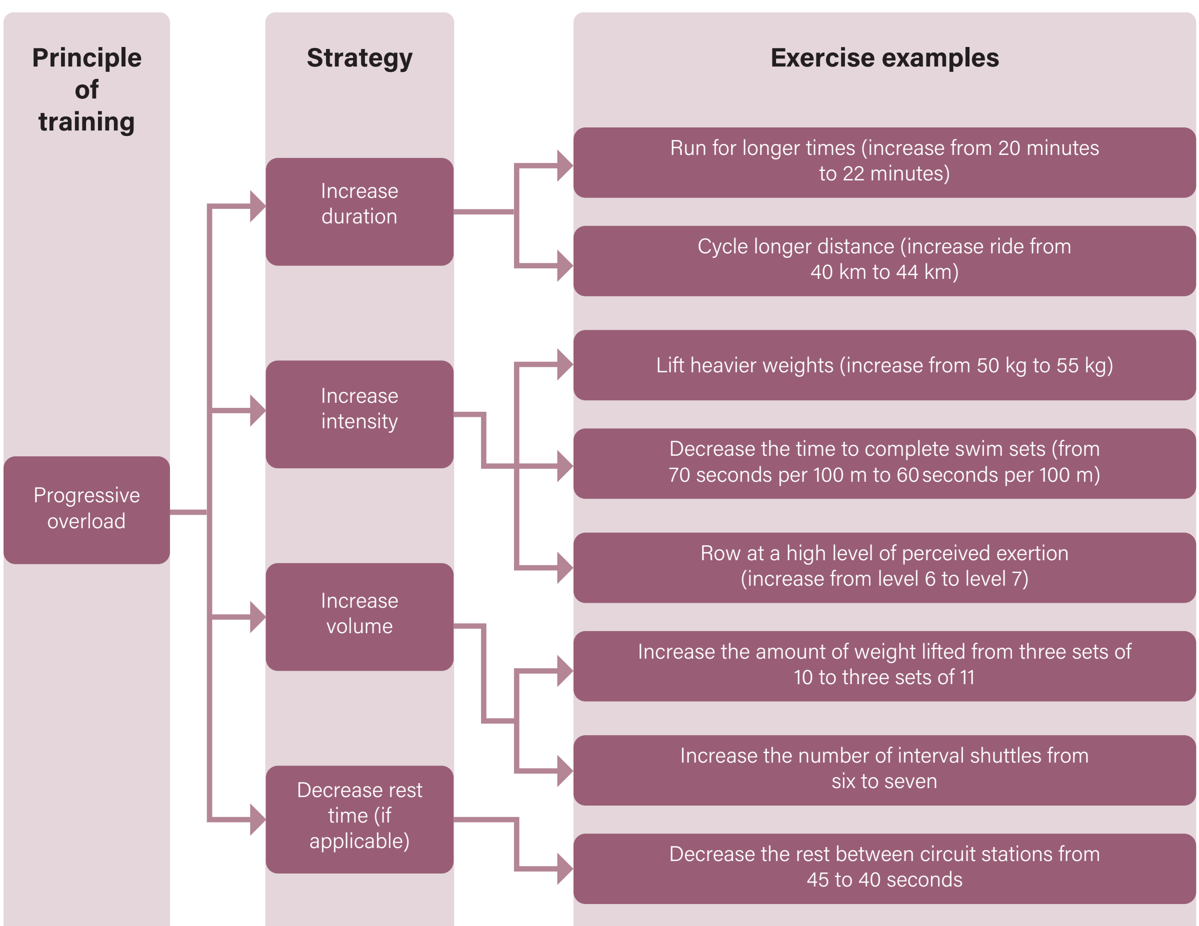


FIGURE 22.6 A variety of strategies can be used when applying the training principle of progressive overload in order to increase training load and continue training gains.

ISBN 978-1-009-31125-0 Stewart et al.

Variety

Variety in training can be achieved by changing training methods or the application of training principles. It can also refer to a change in the training venue or training partners. Incorporating variety into a training plan can lead to increased motivation and concentration, as it reduces the boredom associated with repetitive activity. Additionally, training in a variety of ways conditions the body to adapt to a range of physical movements. Variety is commonly incorporated during the off-season or when recovering from injury. Examples are incorporating boxing to maintain aerobic fitness for a netball team, or a soccer player doing Pilates to improve core strength.

> **variety** (as a training principle) training in different ways, incorporating different training methods, utilising different training principles, as well as venues and equipment; all aid to increase training benefits

22.2 Training methods

Continuous training

Continuous training is used mostly by athletes training for racing endurance sports like distance running, cycling, rowing and swimming. Continuous training involves prolonged periods of repetitive exercise that is generally completed at a steady pace and lasts longer than 20 minutes. Athletes utilising continuous training normally incorporate both **long slow distance training** and **tempo training** efforts into their training regimes.

> **continuous training** sub-maximal training completed over a long period without pause
>
> **long slow distance training** a form of continuous training of moderate intensity, performed over an extended duration
>
> **tempo training** a type of aerobic training at or just below the anaerobic threshold

Long slow distance (LSD) training involves exercising at an intensity that could be maintained for a very long period of time. Sometimes referred to as marathon pace, LSD training is conducted in the aerobic training zone at an intensity between 70 and 80 per cent of maximum heart rate. Training at this intensity is considered vigorous (REP of 6 or 7) and the heart rate range falls between the aerobic and anaerobic thresholds. LSD training generally lasts for between 30 and 120 minutes. This type of training is beneficial to an athlete, as it helps them to increase their muscular endurance and biomechanical technique. Exercising at this intensity also improves their ability to transfer oxygen and nutrients to the working muscles and their ability to utilise fat as the primary fuel source.

Continuous training at or just below the lactate threshold is called tempo training or threshold training. It requires an intensity of about 85 per cent of an athlete's maximum heart rate and is perceived as strenuous exercise resulting in an RPE of 8 as it is a comfortably hard pace. At this intensity, the body adapts by improving its ability to clear lactic acid from the muscles more effectively. Continued training at this level results in increasing the lactate threshold and ultimately the intensity of work that can be done using aerobic energy. Because of the higher intensity, the duration of tempo training is less than LSD training.

FIGURE 22.7 Cyclists utilise continuous training and long slow distance training.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 22.3

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: How can physiological responses be used to determine target heart rates for tempo training?

Demonstrate and apply

1. Recall your maximum and resting heart rates determined in Engage 22.1.
2. Select an appropriate continuous activity that can be completed for 10–15 minutes without interruption.
3. Select a suitable method for recording heart rate.
4. Following a suitable warm-up, commence 10–15 minutes of exercise at your tempo pace, applying the following physiological responses as a guide.
   - It is hard to say two or three words like 'steady pace.'
   - The working muscles have a slight burning sensation.
   - Your rate of perceived exertion is about 8.
5. If using a heart rate tracking device, monitor your heart rate until it plateaus or remains steady. Continue monitoring until the end and record the highest rate at which it plateaus. This will indicate your tempo training heart rate.

Note: If using the pulse counting method, determine your heart rate immediately after the exercise.

6. Conduct a warm-down at a lower intensity for 3–5 minutes.

Analyse and synthesise

KEY COGNITION

Apply: use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation

7. Calculate both the % MHR and % HRR of your tempo training intensity.
8. Explain how your results compare with the suggested rating of 85 per cent intensity. Can you think of any reasons for variations?

Fartlek training

A variation of continuous training involves running at differing intensities above and below your lactate threshold by switching between jogging, running, sprinting and even walking. **Fartlek training** is an effective training method for improving lactate threshold and the body's ability to recover from hard efforts while still working.

fartlek training a series of high-intensity bursts followed by low-intensity recovery periods

Derived from the Swedish word for 'speedplay', fartlek training is effective for most team sports that continuously use aerobic energy but have regular anaerobic efforts interspersed. Examples of these sports are netball, soccer and touch football. The intervals of fartlek training can be determined by marking out set distances or by using time periods of elevated intensity that can be indicated by a whistle or alarm. For example, a netball team may complete

ISBN 978-1-009-31125-0 Stewart et al.

a fartlek session where they jog along the sidelines of the court and sprint the baselines. Alternatively, a soccer team may complete continuous laps of the field with five-second sprints signalled after each 30 seconds of jogging. Ideally, applying the principle of specificity, the work-to-recovery ratio would replicate distances and the ratio of high-intensity work to lower-level recovery would be similar to that found during competition for the targeted physical activity. For example, Figure 22.8 replicates the period of continued aerobic movements with high-intensity sprints interspersed throughout. This replicates the physical demands of a netball player who would be tracking a defender off the ball before sprinting to get an intercept and establish court position.

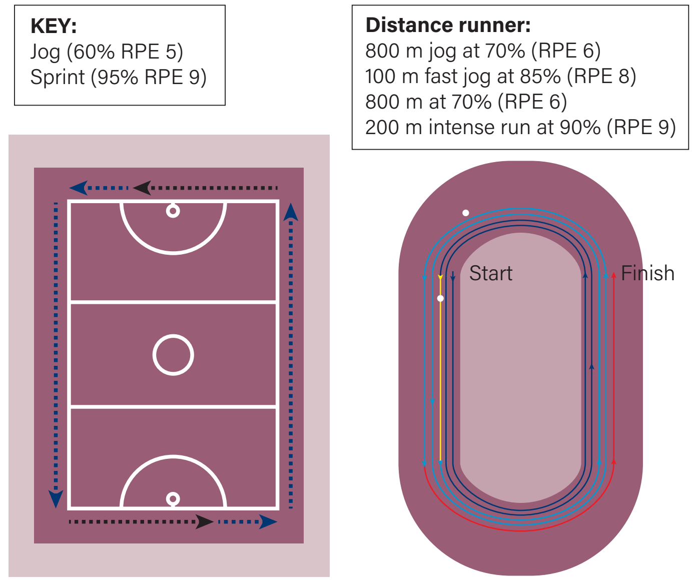


FIGURE 22.8 Fartlek training examples

ENGAGE 22.4

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: What are the physiological responses to fartlek training?

Demonstrate and apply

1. Recall your maximum and resting heart rates determined during Engage 22.1.
2. Select an appropriate fartlek training protocol specific to your sport using Table 22.3 to help determine the levels of exertion and talk test cues.

Fartlek period	Duration	Intensity	Sets/time
High-intensity work			
Low-intensity recovery			

3. Select a suitable method for recording heart rate.
4. Following a suitable warm-up, commence 5–10 minutes of your selected fartlek training.

Note: If using the pulse counting method, determine your heart rate immediately after the exercise.

5. Conduct a warm-down at a lower intensity for 3–5 minutes.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Analyse and synthesise

6. Calculate both the average % MHR and % HRR of your fartlek training.

KEY COGNITION

Explain: use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation

7. Explain the proportion of time spent above and below the lactate threshold and how this would improve your fitness for the selected physical activity.

Interval training

Interval training is another method used when training the anaerobic energy systems. It incorporates defined periods of exercise followed by periods of rest. Well-trained or elite athletes benefit more from using interval training compared with continuous or fartlek training. It allows the athlete to complete multiple high-intensity (above 95 per cent) training efforts to produce adaptations in strength and speed. The intensity and duration associated with intervals should be specific to the physical activity. The rest periods adhere to the recommended work-to-rest ratios associated with the predominant energy systems involved.

One of the most effective forms of training for improving physical performance in athletes is known as **high-intensity interval training (HIIT)**. As the name suggests, it includes periods of high-intensity efforts followed by periods of rest. HIIT training sessions can encompass a range of exercises, but may only last for 20–30 minutes. If completed properly, HIIT produces physiological adaptations similar to continuous training sessions with double or triple the duration. Unlike other types of training, HIIT produces increases in both anaerobic and aerobic capacities. Aerobic adaptations as a result of HIIT include increases in stroke volume, cardiac output and ultimately VO_2 max. Although the exercise is conducted above the anaerobic threshold, the cardiovascular system reacts during the rest period in order to clear lactic acid and replenish the energy stores in the muscles in preparation for the next bout of high-intensity exercise. Prolonged exposure to this stress results in increased efficiency and shorter recovery times. Another benefit of HIIT is that the muscle tissues develop a greater density of mitochondria, allowing for more ATP to be produced. To achieve benefits associated with HIIT, it is essential that adequate recovery times are used between both training sets and training sessions. Without proper recovery, athletes will be unable to push themselves to maximal effort required for the gains associated with HIIT.

interval training incorporates defined periods of exercise followed by periods of rest

high-intensity interval training (HIIT) interval training that includes periods of very high or maximal effort and longer rest periods

FIGURE 22.9 High-intensity interval training includes periods of high-intensity efforts followed by periods of rest.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 22.5 Work-to-rest ratios for specific energy systems

Energy system	Intensity (%)	Duration	Work-to-rest ratio
ATP–PC	95–10	5–10 seconds	1:12 to 1:20
Lactic acid	80–95	15–30 seconds	1:3 to 1:5
Aerobic	65–80	60–180 seconds	5:1 to 1:2

A specific form of HIIT is **sprint interval training (SIT)**. Most commonly associated with cycling and running or rowing, SIT involves periods of sprinting interspersed with periods of active recovery. An example of a SIT workout is exercising flat out for 30 seconds and then completing active rest for three minutes before repeating.

Another variation of interval training is **aerobic interval training**. In contrast to HIIT, aerobic interval training focuses on longer periods of work with shorter recovery periods. This type of training is effective at rapidly building aerobic endurance. Generally, work intervals range from two to five minutes and are conducted as close to the anaerobic threshold as possible. This is followed by a much shorter rest period of 30 seconds to one minute and repeated throughout a workout that usually lasts for approximately 30 minutes.

sprint interval training (SIT) a form of HIIT that involves bursts of sprinting interspersed with rest

aerobic interval training interval training performed with longer durations and shorter rests, with intensities close to the anaerobic threshold

KEY MESSAGE

Continuous, fartlek and interval training can target different training zones.

KEY MESSAGE

Training at or above the anaerobic threshold produces the greatest aerobic gains.

KEY MESSAGE

Adequate recovery time is required between very high-intensity efforts.

ACTIVE INVESTIGATION 22.2

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How do heart rates fluctuate during HIIT and aerobic interval training?

Note: This activity should only be completed by healthy athletes in the company of others.

Demonstrate and apply

1. Select at least two members of the class with comparable fitness levels to complete the interval training protocols in the table on the following page.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

2. Determine a suitable mode of exercise (cycling, running, rowing) that both students can use, to maintain consistency.
3. Determine a suitable method to record heart rate data at key points throughout the session – for example, record heart rates at the:
    - start, middle and end of each rest period for the HIIT participant(s)
    - start, middle (if possible) and end of each work period for the aerobic interval participant(s).
4. Collect secondary data by conducting background research into predicted fluctuations in heart rates during interval training.

HIIT protocol		Aerobic interval protocol	
Time (minutes after start)	**Intensity**	**Time (minutes after start)**	**Intensity**
0:00–0:30	Maximal effort	0:00–3:00	RPE 8
0:30–4:30	Rest	3:00–3:30	RPE 6
4:30–5:00	Maximal effort	3:30–6:30	RPE 8
5:00–9:00	Rest	6:30–7:00	RPE 6
9:00–9:30	Maximal effort	7:00–10:00	RPE 8
9:30–13:30	Rest	10:00–10:30	RPE 6
13:30 –14:00	Maximal effort	10:30–13:30	RPE 8
14:00–18:00	Rest	13:30–14:00	RPE 6
18:00–18:30	Maximal effort	14:00–17:00	RPE 8
18:30–25:00	Gradual cool down	17:00–17:30	RPE 6
		17:30–20:30	RPE 8
		20:30–25:00	Gradual cool down

5. As a class, instruct the athlete through their respective interval training and record their heart rates in a suitable table.

Analyse and synthesise

6. Calculate each athlete's 85 per cent target heart rate using either the MHR or Karvonen method.

KEY COGNITION

Examine: investigate, inspect or scrutinise carefully; inquire or search into; consider or discuss critically an argument or concept in a way that uncovers the assumptions and interrelationships of the issue

7. Examine the primary data by developing a combined line graph showing the fluctuations of heart rates during the two types of interval training.

Evaluate and justify

8. In a paragraph, evaluate the effectiveness of each training protocol for each athlete. You should use primary and secondary data to justify your evaluation.

ISBN 978-1-009-31125-0 Stewart et al.

With any type of interval training, variations in duration, intensity and/or volume of work or rest will ensure that this training method meets both the fitness demands of the physical activity (specificity) and the fitness levels and goals of the individual (individuality). Interval training modifications to account for specificity and individuality include varying the:

- *duration* of the work interval
- *intensity* of the work interval
- duration of the *rest* interval
- *volume* of the training (the number of times each interval is repeated).

Circuit training

An effective method of developing a range of fitness components and game-based skills in one session is the use of **circuit training**. The name 'circuit training' refers to how the session is set up rather than the types of exercise involved. Typically, a variety of exercises are completed in a given time frame or following a prescribed number of repetitions. Completing multiple stations with minimal rest periods in between maintains a high heart rate and results in both strength and aerobic conditioning being completed in the one training session.

circuit training training that involves progressing through a number of exercise stations

A well-balanced circuit allows for continued high-intensity workout without the risk of muscular fatigue. This is achieved by ordering stations in a way that allows activated muscle groups a chance to rest before they are required again – that is, following body weight squats with an upper-body exercise like push-ups or a core exercise like plank holds rather than another leg exercise.

Circuit training can take many forms, based on the availability of equipment, the specific requirements of the physical activity and the individual needs of the participants.

FIGURE 22.10 Circuit training

ISBN 978-1-009-31125-0 Stewart et al.

The difficulty of the circuit can be manipulated through:

- increasing the volume (adding more stations or the number of times the circuit is completed)
- increasing the duration of stations
- increasing the intensity of work required at each station (adding weight, increasing distance or height)
- reducing the rest time between each station.

TABLE 22.6 Examples of circuit training

	Type of circuit		
	Body weight/free weight	**Gym**	**Sport-specific (basketball)**
Instructions	• 30 seconds work • 30 seconds rest • Complete as many repetitions as possible • Complete two rounds	• Work with a partner – reps working – reps rest (partner working) • Move to next station after both have finished one set • Complete four rounds	• 45 seconds work • 15 seconds rest • Complete as many repetitions as possible • Complete two rounds
Order of exercises	1. Push-ups 2. Bicep curls (dumbbells) 3. Crunches 4. Front squats (barbell) 5. Bench dips 6. Back extensions 7. Tuck jumps 8. Upright row (dumbbells) 9. Lying leg raises 10. Weighted lunges (dumbbells) 11. Medicine ball twists 12. Burpees	1. Bench press 2. Seated row 3. Leg press 4. Hamstring curls 5. Lat pull-down 6. Shoulder press	1. Lay-up drives (return to outside three-point line) 2. Continuous board touches 3. Through-the-legs dribble (sideline to sideline) 4. Feet shuffles from restriction circle to outside the three-point line 5. Dribbling through cones (left hand up, right hand back) 6. Set shots from the corners 7. Shuttle runs (base line to top of key) 8. Dribbling court laps (jog the sidelines and sprint the baselines)

ENGAGE 22.5

DEMONSTRATE APPLY ANALYSE & SYNTHESISE

Inquiry question: What are the physiological responses to increased circuit training variables?

Demonstrate and apply

KEY COGNITION

Consider: use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation

1. In groups of two to four, design a 20-minute circuit training session that incorporates at least 10 different stations and would develop the performance capabilities of the students in your class in the selected physical activity. Consider the order, type, intensity and duration of each training activity.

ISBN 978-1-009-31125-0 Stewart et al.

2. Select a suitable method for recording heart rate.
3. Following a suitable warm-up, complete the first round of your circuit.
4. Conduct a warm-down at a lower intensity for 3–5 minutes.
5. Reflect on your body's physiological responses by copying and completing the table below.

Activity	Heart rate	Talk test (How easy was it to speak?)	Muscle fatigue (Could the exercise be completed to reps of time?)	Additional notes (Record other information about how the body felt)
1				
2				
3				

6. After suitable recovery, increase the difficulty of the circuit by 10–20 per cent using one of the following options:
   - increasing the duration of intervals at each station
   - increasing the intensity of work required at each station (adding weight, increasing distance or height)
   - reducing the rest time between each station.
7. Complete the circuit again at the new difficulty level. Again, record your new reflections.

Analyse and synthesise

8. Compare the main differences between your body's responses for the two difficulty levels of the circuit.
9. Use your understanding of energy systems to explain the key differences you have identified.

Flexibility training

Some sports, such as gymnastics, swimming and dancing, and some athletics events require intensive **flexibility training** to increase the normal range of motion around a joint for the athlete to perform at a high level.

flexibility training training with the use of activities specifically designed to increase the normal range of motion around a joint

Many other athletes require flexibility training to maintain a normal range of motion. One of the contributing factors to impaired range of motion around a joint is muscle tightness. Training that helps to minimise this tightness is important because it:

- improves movement capacities and resultant performance
- reduces the chance of injury
- improves posture and muscle balance.

ISBN 978-1-009-31125-0

Static stretching is a method of gradually releasing tightness and increasing the length of the muscles while the body is at rest. The ideal intensity of a static stretch is the point where the athlete feels mild discomfort but never pain. The end point of these stretches should be held for between 15 and 30 seconds. Athletes such as gymnasts and dancers, who depend on high levels of flexibility, benefit the most from these stretches. However, this type of flexibility training is not recommended when preparing for a performance that involves running or jumping. Studies have shown decreases in muscle strength and power immediately after static stretching. Furthermore, static stretching is beneficial when completed 5–10 minutes after a workout or performance. This is because muscles and tendons all have greater elasticity following exercise, when the increased movement and blood flow have made these tissues more pliable. As a result, the extra tension provided through static stretching at this stage produces greater adaptations in flexibility.

Another, more strenuous, method of flexibility training is known as **proprioceptive neuromuscular facilitation (PNF)** stretching. This involves engaging the use of a partner or fixed resistance to further increase the range of motion of a joint. A typical PNF stretch involves stretching and holding the target muscle or group of muscles to the point of mild discomfort before activating it against a resistance. This resistance can be in the form of a partner, a stretching band, a towel or even a bench. Following the activation phase, the muscles are relaxed and the joint is extended through a slightly greater range of motion. Due to the more intense nature of this stretch, only one stretch per muscle group is required, and a rest period of at least 48 hours should be allowed between PNF stretching routines.

proprioceptive neuromuscular facilitation (PNF) advanced flexibility training that involves both stretching and contracting the muscle

TABLE 22.7 Hamstring stretches

PNF hamstring stretch		Method
Partner as resistance		1. With one leg remaining flat on the ground, extend the leg to be stretched until a mild discomfort is felt in the hamstring. Hold this position for 10 seconds.
Band as resistance		2. Activate the muscle by pushing against the resistance for six seconds. The resistance should be strong enough to prevent movement.

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 22.6

Inquiry question: How much increased range of motion can be gained through PNF stretching?

Demonstrate and apply

Note: Stretching should always be completed to the point of discomfort but never pain. A goniometer is a device that measures the range of motion at a joint. If one is not available, there are many instructional videos on YouTube that show how to make your own. There are also applications for smart devices that conduct these measurements.

1. Familiarise yourself with the hamstring PNF stretch protocol outlined previously.
2. When lying on your back, use a goniometer to measure the range of hip flexion when completing:
   a. an active stretch (moving the muscle to its full range of motion without assistance)
   b. a passive stretch (using the assistance of a partner or band to progress the range of motion).
3. Record the results for both legs.
4. Use the protocol in Table 22.7 to measure the range of hip flexion produced following the activation phase.

Analyse and synthesise

Investigate: carry out an examination or formal inquiry in order to establish or obtain facts and reach new conclusions; search, inquire into, interpret and draw conclusions about data and information

5. Represent your data in a column chart comparing the active, passive and PNF range of motion.
6. Calculate the percentage increases from the:
   a. active-to-passive stretch
   b. passive-to-PNF stretch.

The majority of athletes participating in active, fast-paced sports such as tennis, volleyball, soccer, netball, basketball and touch football incorporate **dynamic stretching** into their training routine. Dynamic stretching involves gradually and repeatedly moving parts of the body in a controlled manner through their full range of motion. Leg swings, walking lunges and arm swings are all examples of dynamic stretches. A dynamic stretching routine that mimics the movements associated with the physical activity is the most beneficial form of stretching before training or a game.

Dynamic stretching is beneficial because it:

- increases blood flow to the muscles and joints
- prepares the body for the movements involved in the activity
- improves efficiency and performance
- minimises risk of injury.

Resistance training

A form of exercise that incorporates specific muscle contractions to move or hold weight is known as resistance training. Resistance training is key for athletes wishing to develop muscular strength, muscular power, muscular endurance or **hypertrophy**.

dynamic stretching the use of momentum and active muscle contractions to increase a joint's range of motion

hypertrophy an increase in muscle mass usually associated with an increase in muscle size and strength as a result of resistance training

ISBN 978-1-009-31125-0 Stewart et al.

Types of muscular contractions

Muscle contractions during exercise can be categorised as isotonic, isometric or isokinetic. **Isotonic contractions** are the most common type of contraction used in resistance training. This type of contraction is defined by the constant tension applied throughout the movements, and can further be classified as concentric contractions and eccentric contractions. Traditional bicep curls, triceps extensions, leg extensions and hamstring curls are all examples of *concentric contractions*, as the muscles producing the movement shorten as they contract.

> **isotonic contractions** when the length of a muscle changes when contracting

These contractions are the most common in resistance training. For example, when completing bicep curls, the bicep muscle shortens as it contracts and produces flexion at the elbow. On the other hand, *eccentric contractions* involve the muscles lengthening as they contract. Eccentric bicep curls typically use assistance to lift a heavy weight so that the elbow is flexed before slowly lowering the weight unassisted. The controlled lowering of the weight is achieved through the constant contraction of the muscle as it lengthens, and the elbow extends. It is believed that the heavier weights and slow, controlled nature of eccentric contractions result in increases in strength adaptations due to the more intensive damage done to the muscles. However, as the resistance force lengthening the muscle is greater than the force being produced to shorten the muscle, there is an increased risk of injury.

Isometric contractions refer to muscle contractions that do not produce changes in muscle length. Most notably, these contractions involve holding the body or object in a specific position for a period of time. Examples of isometric exercises are plank holds and wall sits, as the body is not moving but the muscles are constantly contracting to maintain its position. Isometric exercises have been shown to improve strength; however, these gains are restricted to the muscles activated during the holding phase. Typically associated with the development of core strength, it is recommended that isometric training complements other training types that involve moving joints through a range of motion.

> **isometric contractions** when a muscle contracts but its length does not change

FIGURE 22.11 Plank holds are an example of an isometric exercise.

Finally, **isokinetic contractions** involve muscle contractions that move the limbs at constant speed throughout a movement. Although a range of movement is possible, this type of contraction is rare in sports. It is mostly reserved for rehabilitation as the force exerted by the muscles can be controlled more closely.

> **isokinetic contractions** a type of muscular contraction where the muscles remain in motion

Sources of resistance for training

The source of the resistance during training is generated in four main ways:

- body weight (including plyometrics)
- weight machines (pin-loaded, plate-loaded)
- free weight (dumbbells, barbells, kettle bells, medicine balls)
- resistance bands (therapy bands, resistance tubes, flat bands).

Body weight and resistance band training are simple and effective ways of completing high-repetition, low-intensity training. Added benefits of these two methods of training are that they are cheap and can be done almost anywhere with limited specialist equipment. This type of training is most beneficial for

ISBN 978-1-009-31125-0 Stewart et al.

athletes wanting to improve their muscular endurance. However, if an athlete wants to increase their muscular strength or size, more substantive resistance is needed in the form of weights. Weight machines are designed with specific movements in mind, and the amount of weight can be changed by inserting a pin into a weight stack or adding additional weight plates. These are recommended for beginners, as the guided movements minimise the risk of joints being placed in unstable or dangerous positions. Free weights, including dumbbells, barbells and kettlebells, are preferred by more experienced athletes, as they require the additional activation of stabilising muscles and therefore result in more functional strength gains. Finally, resistance bands of different lengths and thicknesses can be used in a variety of training exercises. Commonly, these are used to gently add resistance as a joint moves through a range of motion when warming up the body and recovering from injuries.

Specific resistance training goals

When incorporating resistance training into a fitness program, it is important that the training is specific to the athlete's desired training adaptations. The specific adaptation goal of resistance training determines the intensity, volume, duration and rest associated with their training. For athletes wishing to develop their strength, higher intensities (% 1RM) are required. However, due to the large amount of physiological stress placed on the body, only a limited number of repetitions can be completed. Furthermore, a greater period of rest between both sets and sessions is required to allow for sufficient recovery.

In comparison, training to improve muscular endurance is exemplified by more repetitions using much lighter intensities. Although the volume is similar, the lower intensity results in a shorter rest time between sets. Finally, hypertrophy training involves a higher training volume while maintaining a relatively high intensity. The slow, controlled contractions result in the ability to complete more repetitions per set and more sets during a session. This method is considered optimal in producing increased **muscle fibre recruitment**, which is essential for muscle growth.

Training for power involves manipulating the balance between the resistance intensity and the speed of muscular contraction. Typically, the intensities required when training muscular power are less because the explosive speed with which the muscles are contracted to complete each repetition is much faster. Training in this way also inflicts large amounts of physiological stress on the body, which limits the number of effective repetitions (volume) and requires similar rest periods to strength training.

muscle fibre recruitment the increased use of muscle fibres as a result of resistance training

TABLE 22.8 Weight training guidelines

	Load (% 1RM)	Speed of contraction	Repetitions	Sets	Rest
Muscular strength	Very heavy >70–85%	Moderate to slow	1–6	2–6	2–5 min
Muscular hypertrophy	Heavy >85%	Moderate	6–12	3–6	2–3 min
Muscular endurance	Moderate or light 50–70%	Moderate	15+	2–3	1–3 min

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 22.9 Weight power training methods

Method	Description	Load (% 1RM)	Sets	Reps	Rest	Example of sport that uses this method
Speed–strength method	Light resistance, focus on fast acceleration	10–20	5–15	6–10	30 s–2 min	High jump
Strength–speed method	Balance between fast acceleration and heavy resistance	30–70	5–20	3–10	30 s–2 min	Rugby League
Maximum explosive strength	Slow acceleration, focus on very heavy resistance	80–100	5–15	1–5	2–10 min	Olympic lifting

TABLE 22.10 Specificity and exercise selection

Functional movement	Exercises	Muscle groups trained
Jumping and running	Squats and Olympic lifts	Gluteals, quadriceps and hamstrings
Kicking	Leg (knee) extensions and leg raises	Quadriceps and hip flexor
Pushing or throwing forwards	Bench press, flat dumbbell fly and triceps push-down	Pectoral and triceps
Pulling	Lat pull-down and seated row	Latimus dorsi, rear deltoid and other back muscles
Twisting, bending and straightening the trunk	Various Swiss ball or Pilates exercises	Abdominal, transverse abdominal, obliques and erector spine

Plyometric training

Plyometric training is a specific type of high-impact training that is used to develop strength, speed and power. It includes movements that require rapid force production, such as power jumping and bounding.

Plyometric exercises all have a period of rapid deceleration where the muscles are lengthened as they contract (eccentric contractions), followed by a period of rapid acceleration where the muscles shorten as they contract (concentric contractions).

Imagine that an athlete is trying to jump as high as they can. Naturally, they will bend down by flexing their knees immediately before jumping. As the knee is being flexed, the quadriceps muscle is responsible for controlling the motion and contracts eccentrically on the way down. At the bottom of the movement, the quadriceps quickly becomes the main force for extending the leg and contracts concentrically as the knee extends and pushes the body vertically. If this movement is completed quickly, the elastic energy stored in the muscle during the eccentric phase is transferred into a greater concentric force and ultimately a higher jump. This is known as the stretch shortening cycle, as it involves the same muscles being stretched before shortening to produce a movement. For greater intensities, well-trained athletes may increase the intensity of their training by increasing the continuation of the exercise, incorporating resistance or using gravity to increase the load during the deceleration phase.

Increases in maximal force production do not occur if the muscles are fatigued. Plyometric training, like other forms of high-intensity training, should be completed no more than two or three times per week with adequate rest days in between. Between each set, 1–2 minutes of rest or a work-to-rest ratio of 1:10 is required. In terms of training volume, it is not recommended that the number of explosive ground contacts exceeds 80–100 repetitions for a young

plyometric training a form of training that involves jumping and bounding

ISBN 978-1-009-31125-0 Stewart et al.

athlete and 120–140 for an experienced adult athlete. Training progressions should focus on increasing the volume of the training load before increasing the frequency or intensity. This ensures that the athlete has sufficient technique and neuromuscular control over the movement. Common plyometric exercises include:

- *box jumps* – jumping from the ground onto a raised box or platform
- *depth jumps* – dropping off a box or platform, landing, then jumping again
- *bounding* – continual single or double leg jumping without pause; can be completed as a means to traverse a distance or over stationary lines or objects
- *dynamic push-up* – completed like a normal push-up but with an explosive force lifting the hands off the ground before landing again.

ACTIVE INVESTIGATION 22.3

DEMONSTRATE APPLY ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: How does the intensity of load in the stretch shortening cycle impact vertical jump height?

Note: This activity should only be completed by healthy athletes in the company of others.

Demonstrate and apply

1. As a class, become familiar with a suitable protocol for determining vertical jump heights.
2. Conduct a suitable warm-up with specific focus on the activation and mobilisation of the leg joints and muscles.
3. Measure the vertical jump of each athlete using the following protocol variations.
   a. *Load–unload jump:* Starting in an upright position with arms straight up above the head, flex at the knees and hips into a squat position before immediately jumping as high as possible. This should be a fluid movement with no pause. Record the results.
   b. *Load–pause–unload jump:* Following adequate rest, assume the same starting position as the previous test. This time, lower the body into the squat position and hold for three seconds before jumping as high as possible.
   c. (Optional) *Increased load–unload jump:* Set the test up so that the athlete can record their jump height after dropping off a 30 cm high box or platform. Assume the same starting position as previously, this time standing on the box or platform. Step off the box and land on two feet and continue with the downward motion into the squat position before immediately jumping back up as high as possible. This should also be a fluid movement with no pause. Record the results.

Analyse and synthesise

4. Analyse and interpret the primary data by developing a series of graphs and tables that demonstrate the main findings. Examples of graphical displays are:
   - column graphs that show results of the jump heights following the three protocols
   - tables showing the percentage increase or decrease between protocol a. and the other protocols.

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Evaluate and justify

KEY COGNITION

Justify: give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable

5. Evaluate the impact that pausing during the technique and dropping from height have on the force production of the legs and overall jump height. Use both primary and secondary data to justify your response.

KEY MESSAGE

Circuit training and resistance training are both effective for conditioning muscles for physical activities.

KEY MESSAGE

Muscle contractions can be categorised based on the movement of the muscles when contracting.

KEY MESSAGE

Plyometric training uses the stretch shortening cycle to generate great muscular force.

22.3 Designing and evaluating training programs

All good training sessions involve the following three key components: warm-up, conditioning phase and cool down. The duration of worthwhile warm-up and cool down sections of a training session are likely to be constant. Therefore, varying the duration of a session directly affects the length of the conditioning phase.

The warm-up

Warming up properly before physical activity is essential to prepare the body for the anticipated physical demands. An effective warm-up is beneficial, as it improves physical performance and reduces the risk of injury. Specifically, completing a 10–15 minute warm-up before a game will result in an increase in the physiological and psychological readiness of the athlete. In 2007, Dr Ian Jeffreys suggested that the structure of an effective warm-up should follow the RAMP protocol, which recommends that a warm-up should comprise three important sequential phases (Table 22.11).

TABLE 22.11 RAMP protocol

Phase 1	R	Raise the heart rate
Phase 2	A	Activate key muscle groups
	M	Mobilise key joints
Phase 3	P	Prepare to perform

Phase 1: Raising the heart rate

Raising the heart rate of an athlete increases blood flow around the body. In particular, muscles receive more blood. Traditionally, this involved completing arbitrary laps of a court or field at a slow pace. However, due to the lack of specificity, this is not considered time-efficient. Rather, a series of low-intensity dynamic movements more closely related to the demands of the activity should be incorporated. These could include:

- dynamic run-throughs (10–20 m) – for example:
  - high knees
  - fast feet
  - heel cycles/butt kicks
  - power skips
  - grapevine
  - sideways shuffle steps
- planned change of direction movements – for example:
  - weaving drills
  - cutting drills.

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 22.12 Dynamic stretches incorporated into a warm-up prepare the body for the conditioning phase of the training session.

Increases in heart rate and subsequent increases in blood flow are important, as the working muscles receive the required oxygen and nutrients. Additionally, increasing the blood flow to muscles also increases the internal temperature of muscles, and means they are more elastic and able to contract faster and with a greater force. Another benefit is the release of synovial fluid within the joints. This acts as a lubricant and allows joints to move more freely during exercise.

Phase 2: Activating and mobilising

The activation of muscles and the mobilisation of joints during this phase should be related directly to the movements required during the physical activity. For example, if a physical activity involves running, it would be essential to activate the necessary muscles to mobilise the hip, knee and ankle joints. This could be achieved by completing a series of dynamic movements such as lunges, squats, tuck jumps or leg swings that progressively take the joints through their full range of movement.

The major advantage of this phase of the warm-up is that it further reduces the risk of injury and prepares the neuromuscular pathways for the anticipated movements – that is, there is more efficient communication between the nervous system and the muscles that are being activated. This results in faster and stronger muscular contractions during a performance. This is also the phase of warm-up where athletes would incorporate any specific exercises that they require as part of a recovery or injury-prevention protocol.

TABLE 22.12 Dynamic movement techniques

Dynamic movement	Target muscles	Technique
Inchworm  	Hamstrings, gluteus maximus, gastrocnemius, soleus, erector spinae	• Start with body in the push-up position. • With palms flat on the ground, walk the feet in towards the hands to make a V shape with the buttocks in the air. • While keeping the feet still, slowly walk the hands out to return to the push-up position.

(continued)

ISBN 978-1-009-31125-0

TABLE 22.12 *(continued)*

Dynamic movement	Target muscles	Technique
Lunge walk  	Quadriceps, hamstrings, gluteus maximus	• Take a large step forward, planting the front foot flat and facing forward. • Keeping the torso vertical, flex the front knee and hip as the back knee is lowered to the ground. • Stand up with feet together and then repeat with the opposite foot forward.
Knees to chest  	Gluteus maximus, hamstrings	• Stand upright with feet shoulder-width apart. • Take a small step forward. • Flex the rear leg at the hip and knee. • Use both hands to grip the shin and raise the knee further towards the chest while maintaining a vertical spine. • Lower the leg and complete a small step forward. • Repeat with the opposite leg.
Inverted hamstring stretch  	Hamstrings, gluteus maximus, erector spinae, hip adductors, hip abductors	• Stand upright on one foot and raise the arm on the same side above your head. • Keep the back straight and flex at the hips. Push the raised leg backwards. • When the stretch is felt, slowly return to the starting position.

ISBN 978-1-009-31125-0 Stewart et al.

Dynamic movement	Target muscles	Technique
Spiderman plank crawl  	Internal obliques, external obliques, erector spinae, gluteus maximus, hamstring, quadriceps, gastrocnemius, biceps femoris	• Start in a push-up position with straight arms. • Simultaneously move one arm forward while externally rotating the opposite leg and moving the knee towards the outside of the stationary elbow. • Continue with the opposite arm and knee.
Lying leg crossovers  	Hip adductor muscles, gluteus medius, gluteus minimus, erector spinae, internal obliques, external obliques	• Lie flat on your back (supine position) with arms out to the side. • Lift one leg and slowly lower the leg to the ground on the other side of the body. • Keep shoulders flat on the floor. • Return to start and repeat on the other side.
Scorpions  	Erector spinae, hip abductors, internal obliques, external obliques, gluteus maximus, quadriceps	• Start by lying face-down (prone position) with arms out to the side. • Bend one leg at the knee and lift off the ground. • Slowly lower the leg to the ground on the other side of the body. • Keep shoulders flat on the floor. • Return to start and repeat on the other side.

(continued)

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 22.12 *(continued)*

Dynamic movement	Target muscles	Technique
Arm swings  	Latissimus dorsi, anterior and posterior deltoids, pectoralis major	• Stand upright with feet shoulder-width apart and one arm extended out to the side of the body and other flexed across the chest. • Alternate arm positions continuously.
Side bends  	Latissimus dorsi, internal and external obliques	• Stand upright with arms by the sides. • Slowly slide one arm down the side of the thigh towards the knee. • Bring the other arm up overhead. • Hold for one second before returning to the start position and repeating on the opposite side.
Open and close the gate  	Transverse abdominis, gluteus maximus	• Stand on two feet with hands on hips. • Raise one leg so the thigh is parallel and making a right angle to the torso. • Externally rotate the hip joint so the knee is facing out to the side and lower the foot. • Raise the same leg back up to a right angle and internally rotate until back in front of the body. • Return to the start and repeat with the opposite leg.

ISBN 978-1-009-31125-0 Stewart et al.

Phase 3: Preparation

The preparation phase incorporates drills or skills that are required during the performance. This is the most specific phase of a warm-up and usually involves the use of equipment required for a competition. For example, a touch football team would probably set a drill where they could practise passing and catching at pace. This phase not only amplifies the muscle memory required for the skills of the sport but also assists in regulating arousal and concentration levels.

Badminton warm-up

Raising the heart rate

Progress through the following court run procedure starting at position A:

1. Run from A to B
2. Run from B to C
3. Back step from C to A
4. Sidestep right from A to D
5. Run from D to B
6. Run from B to E
7. Back step from E to D
8. Sidestep left from D to A

Intensity: Progressing from 50 per cent to 80 per cent

Duration: complete 8–10 sets with 1:1 work-to-rest ratio

Activate and mobilise

Complete 10 times per side:

1. Leg swings
2. Lying leg crossovers
3. Scorpions
4. Arm circles

Complete across the court and back:

5. Lunge walk
6. Knees to chest
7. Inchworms
8. Spiderman crawl

Preparation

Partner drills

Complete 20 times each:

1. Net shots
2. Overhead clears
3. Underarm clears

Combinations

Complete 10 times each:

4. Clear to drop shot
5. Short serve to clear to smash

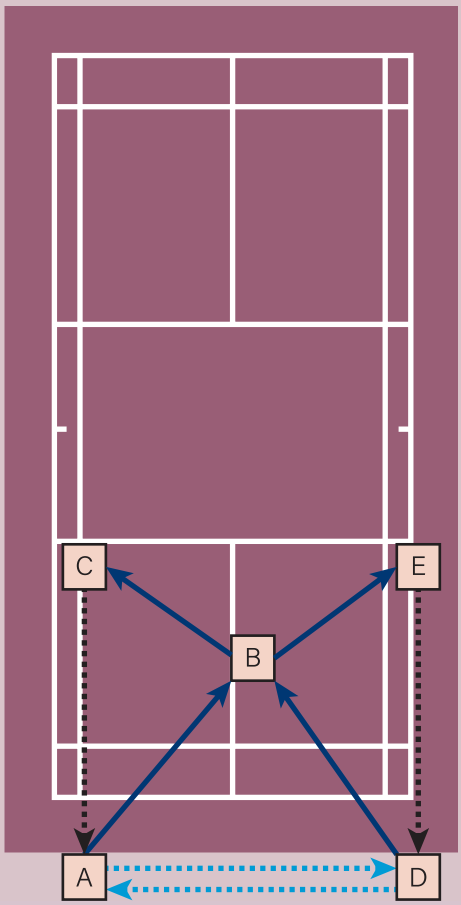


FIGURE 22.13 Badminton training – an example of the three phases

ISBN 978-1-009-31125-0 Stewart et al.

ENGAGE 22.7

Inquiry question: What is involved in an effective warm-up for a chosen physical activity?

Recognise and explain

1. List the key physical movements required of a selected physical activity (e.g. running).
2. Describe the key joint movements involved in these actions (e.g. knee extension).
3. Identify the key muscle groups responsible for the joint movements (e.g. knee extension produced by quadriceps).

Demonstrate and apply

KEY COGNITION

Apply: use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation

4. Apply RAMP protocol to design an effective warm-up that targets the specific requirements of your physical activity.
5. Complete the warm-up individually or as a group.

Analyse and synthesise

6. Analyse the effectiveness of the warm-up using a SWOT analysis.

Strengths	Opportunities
Threats	Weaknesses

Conditioning

The conditioning phase of a training session is where specific and individualised training activities occur. These activities should clearly reflect the specific goals of teams and/or individuals, and can include a combination of sport-specific conditioning, skill development and strategy development. Planning considerations should include the ability of the athletes, timing within the season, the available equipment and the order of exercises.

It is recommended that high-intensity training efforts be completed at the start of the session. This is because the body's ability to produce high-intensity efforts will reduce due to fatigue. For example, an athlete may struggle to reach top speed during sprint intervals if they have previously completed lower-intensity threshold training. The local fatigue and accumulation of lactic acid resulting from the threshold training inhibits the ability to generate maximum force. Likewise, plyometric exercises such as box jumps and depth jumps are much less effective

ISBN 978-1-009-31125-0 Stewart et al.

in stimulating power adaptations if completed under conditions of fatigue.

In terms of resistance training, complex multiple joint movements activating large muscle groups should be performed first – that is, exercises like squats and bench press or power movements like the Olympic lifts should be completed before any isolation exercises are completed on smaller muscles. The athlete's performance during a bench press will clearly be inhibited if their triceps are fatigued from previously completing isolated triceps extensions. This is because the damage already inflicted on the triceps muscles stops them from generating the required force to support the high-intensity effort produced by the non-fatigued muscles.

Although fatigue is not ideal for developing specific strength and power adaptations, it is useful when developing sport-specific endurance. For example, a volleyball coach may decide to incorporate jump-specific plyometric training at the end of their training session. Even though this is not going to efficiently improve the athlete's leg power and respective jump height, it will serve the purpose of replicating a game scenario where jumping is required even when fatigued. This same concept is often also used when executing set plays or essential skills – that is, athletes may be required to practise specific skills and solve problems while fatigued as this will prepare them for periods late in performance situations where effective decisions and execution are vital skills.

Recovery

Appropriate recovery is essential in the planning of a training session. Table 22.5 identified the appropriate training intensities, durations and work-to-rest ratios for the different energy systems. Remembering that the three energy systems never work in isolation, understanding recovery is important in planning as it allows for fuels to replenish and the removal of waste products.

The fuel for the ATP–PC system is phosphate creatine molecules, which are readily available in the muscles to resynthesise ATP. When training at high intensity, 50–70 per cent of the phosphate creatine stores are depleted within 5–30 seconds and almost completely depleted when training at very high intensities. If completing multiple high-intensity efforts within a training system, it is essential that the phosphate creatine stores are replenished in the muscles. This is achieved through aerobic glycolysis and can be almost fully restored in 3–5 minutes of passive recovery. Therefore, when planning a high-intensity training session an athlete would need to ensure appropriate rest between sets to ensure that phosphate creatine is replenished so the targeted intensities can be achieved.

Although the body can exercise at low intensities for long periods of time, when working anaerobically a by-product of lactic acid is produced. Exercise can only continue for 1–3 minutes when above the lactate threshold due to the build-up of lactic acid inhibiting muscle contractions. During rest periods in training, the lactic acid is effectively removed from the muscles to be processed by the liver and kidneys. The rate at which this lactate can be removed from the muscles can be increased with sustained oxygenated blood flow from lower-intensity exercise periods. This is known as active recovery.

Cool down

Effectively cooling down following a training session is important to aid recovery and reduce the risk of injury. Typically, a cool down comprises a low- to moderate-intensity continuous activity for at least 5–10 minutes, followed by 5–10 minutes of static stretching. Low- to moderate-intensity continuous exercise at the end of a training session ideally replicates the activity that has just been completed. An effective cool down routine can aid the body's recovery in numerous ways.

First, it facilitates the effective recirculation of blood that has pooled in the lower limbs during the exercise. Obviously, active muscles require greater blood flow to supply oxygen and nutrients. If vigorous activity suddenly ceases, the majority of this excess blood remains in these muscles. This can result in periods of dizziness and even fainting as a result of not enough blood returning to the heart and then the brain.

Additionally, this continued circulation of blood is an essential method of clearing lactic acid from the active muscles. By doing this, an athlete can minimise muscle soreness and speed up recovery times. Static stretching following a workout is important for reducing muscle tension and returning muscles to their resting length. Static stretching is most effective during a cool down, as the muscles are already warm and more likely to produce a greater range of motion. When completing static stretches, it is recommended that the stretch order progresses up the body from the feet. More time may be spent on the main muscle groups being activated as a result.

ISBN 978-1-009-31125-0 Stewart et al.

CHECK-IN 22.3

1. Recall the benefits of completing low-intensity continuous activity following a game or training session.
2. Explain the benefits of completing static stretches as part of a cool down.
3. What is the recommended time frame for holding a static stretch?
4. Construct a list of static stretches you would use when cooling down in a selected physical activity. Remember to order stretches from the bottom to the top of the body.

KEY MESSAGE The RAMP protocol is an effective guide to follow when designing warm-ups.

KEY MESSAGE High-intensity conditioning exercises should be placed prior to fatigue at the start of the conditioning phase.

KEY MESSAGE Low-intensity continuous activity during the cool down is essential for clearing lactic acid from the working muscles.

Designing a training program

In order to ensure that athletes are performing their best during competitions, a well-structured training plan is required.

The key features that influence the design of a training plan are:

- specific training objectives to achieve a determined outcome
- game analysis
- work volume, frequency, intensity and duration of exercise
- tapering and recovery to achieve the determined outcome for a particular phase.

For athletes competing across a season, a long-term annual plan is usually developed. Sometimes referred to as a **macrocycle**, an **annual plan** is designed to ensure that athletes have the best chance of achieving their goals. Specifically, annual plans work towards having the athlete peaking during the most competitive periods of the season. To facilitate this, the annual plan

macrocycle a complete training cycle from start to finish

annual plan a year-long macrocycle that varies training in response to competition and non-competition phases, as well as targeting times when peak performance is required

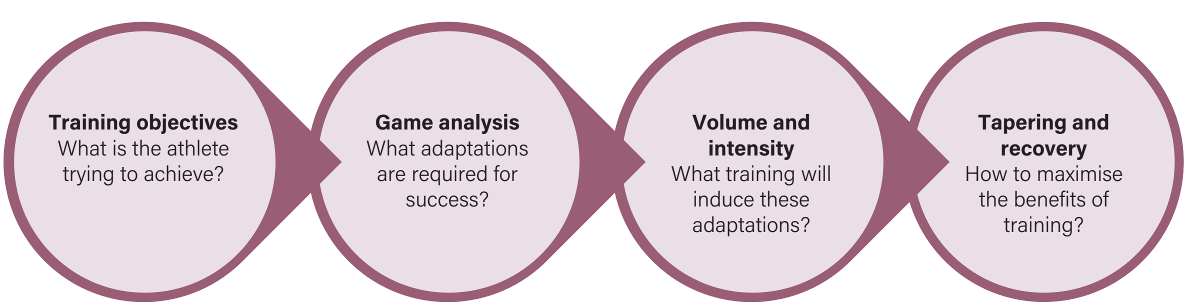


FIGURE 22.14 Training program design must incorporate these four key considerations.

ISBN 978-1-009-31125-0 Stewart et al.

is segmented into different **training phases** using the concept of **periodisation**. Each training phase, or 'period', has a specific focus identified to progress the athlete towards peaking at the essential time.

> **training phases** the different segments of an annual training plan, each with its own specific purpose in relation to the competition or time when the athlete must peak
>
> **periodisation** the process of using blocks of training to systematically develop an athlete's fitness and skill levels

Typically, an annual plan for a competitive athlete progresses through four phases that reflect the specific training methods, intensities and volumes required. The four overall phases of a training cycle are:

- preparatory phase
- pre-competition phase
- competition phase
- transition phase.

These phases consist of smaller training periods known as **mesocycles**, which usually last for between four and six weeks. Each mesocycle will have a specific focus to prepare the body in a way that reflects the stage of the season – the period of the annual plan that is being enacted. Furthermore, each mesocycle consists of multiple shorter phases known as **microcycles**, which provide a more specific week-long training focus for the athlete's individual training sessions.

> **mesocycle** a training block that lasts for 4–8 weeks and has a specific training focus
>
> **microcycle** the smallest block of training – usually one week in length, with a specific focus

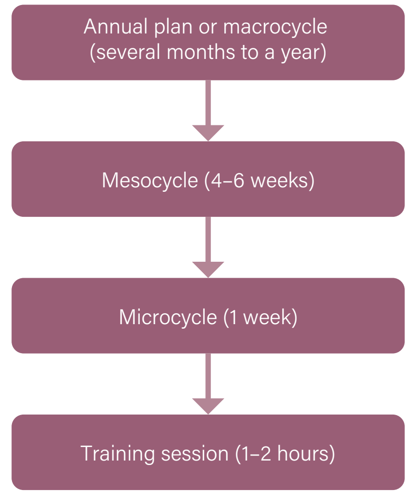


FIGURE 22.15 A structured training plan

Preparation phase

As the name suggests, the **preparation phase** is focused on preparing an athlete for the physical demands of the competitive season. It typically involves two distinct mesocycles known as the *general preparation phase* and the *specific preparation phase*.

> **preparation phase** the phase of an annual training plan that is focused on preparing an athlete for the physical demands of the competitive season

The general preparation phase is focused on developing base levels of aerobic and muscular endurance required for impending training loads. Typically, this phase of training involves a lot of training variations that are low-intensity and high-volume. Weight training sessions during this phase typically focus on developing muscular hypertrophy, and athletes will be learning or refining new skills consistent with their physical development and prior ability.

<table>
<tr><th colspan="7">Annual plan</th></tr>
<tr><th>Training phase</th><td colspan="2">Preparation phase</td><td rowspan="2">Pre-competition</td><td colspan="2">Competition</td><td rowspan="2">Transition</td></tr>
<tr><th>Mesocycle</th><td>General preparation</td><td>Specific preparation</td><td>Maintenance</td><td>Peaking</td></tr>
</table>

FIGURE 22.16 Components of an annual plan

ISBN 978-1-009-31125-0 Stewart et al.

In contrast, it is the responsibility of the specific preparation phase to develop sport-specific fitness to get the body ready for competition. The intensity of the training will increase, and the focus will primarily be on building necessary strength, speed and power required for the sport. As a result of the increased intensity, lower volumes of training are utilised to avoid overtraining.

Pre-competition phase

The final phase of preparation before a competition is known as the **pre-competition phase**. The focus of training is to transfer the fitness developed during the preparation phase into the competitive performance – that is, the athlete aims to maintain the strength and speed gains achieved during the preparation phase and to develop specific match fitness that will enhance their performance. To accomplish this, very high-intensity training is required accompanied by increased duration to simulate the physical demands of the performance.

As each training session places large amounts of stress on the body, increased recovery time between sessions is required. This is achieved through increased rest days or the inclusion of low-intensity training sessions. The final microcycle of this phase typically involves a much lighter workload to eliminate fatigue and allow full recovery before the competition. This process is known as tapering, and it allows for the replenishment of depleted muscular glycogen stores caused by the ongoing training.

pre-competition phase the phase of an annual training plan that is focused on transferring preparatory fitness training into match fitness in readiness for the season or competition ahead

competition phase the phase of an annual training plan that is focused on maintaining fitness levels while managing the recovery, team and tactical needs required through the competition period

Competition phase

During the **competition phase**, the focus is on maintaining the fitness levels developed through the preparation phase and working towards peak fitness during the most important parts of the competition. Often when aiming to maintain fitness during the competition phase, a delicate balance is required between volumes and intensities that are high enough to maintain fitness levels, yet low enough to allow adequate recovery between fixtures. An athlete participating in weekly matches is adding another very high-intensity session to their training load. Consequently, this requires additional rest time. The intensity of performance and corresponding rest will vary immensely between sports. Modern technology, including heart rate monitors and global positioning system (GPS) trackers, can be used by coaches to carefully track an athlete's intensity and workload during a performance, and they can adjust training accordingly. Performance analysis is also key during the competitive phase, for identifying areas requiring technical improvement for team and individual skills.

Maintaining an adequate balance between training intensity and volume in the lead-up to the most important phases of competition assists in the athlete reaching an optimal state of physiological, psychological and emotional readiness to perform. Again, training during the competition phase will vary according to the number of times the athlete is required to produce peak performance. A soccer player would want to develop their peak fitness levels during the finals series of a competition. In contrast, a swimmer would want to peak many times throughout the season, as they compete in multiple competitions such as local, regional and state championships. Typically, there is a definitive tapering period preceding the peaking stage to allow the athletes the opportunity to recover and restore before their competition.

FIGURE 22.17 Pre-competition phase

ISBN 978-1-009-31125-0 Stewart et al.

FIGURE 22.18 Fitness trackers as wearable technology can record GPS data on movements, speed, altitude, as well as heart rate from both training and games and help to identify specific training needs and gains.

TABLE 22.13 Training focus of the pre-competitive and competitive mesocycle

Mesocycle phase	Conditioning training	Skill training	Intensity	Volume
Pre-competition	Maintenance phase to retain preseason conditioning Develop 'match fitness'	Stress-proofing skills and strategies Application to game environments	High	Moderate
Competition (peaking)	Tapering phase	Mental rehearsals and visualisation drills Complete performance practice	Competition day(s) – very high Rest days – very low	Low
Competition (maintenance)	Minimal training only to retain conditioning and to avoid overtraining and injury	Addressing errors being made in competition Maintenance of skill base and reinforcing exact technique and execution	Competition day(s) – very high Rest days – very low Training days – moderate	Moderate

Transition phase

A longer restorative period of active rest typically occurs between the end of the competition phase and the commencement of the next macrocycle. This is known as the main **transition phase**, and is characterised by decreased training intensities and volume. It promotes both physical and mental recuperation, and is also the period where athletes are able to undergo rehabilitation of injuries.

transition phase the phase of an annual training plan that is focused on post-competition recovery, both physically and mentally in readiness for the next annual training cycle

Fitness training in the transition phase is often steered away from the specific physical activity and embraces the concept of cross-training. This involves an athlete participating in different recreational activities from those for which they have been training. For example, a netballer may take up lower-intensity activities like swimming or cycling during this phase as opposed to continuing with training that targets the continued development of strength and power. The downside of cross-training is that the reduced specificity depletes the athlete's fitness levels in the components most essential for their sport. If the transition period is extended, the preparation period for the following season would need to be lengthened to regain the lost levels of fitness. It is recommended that the transition phase last no longer than 4–6 weeks.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 22.14 A periodised training program for an athlete preparing for a single sporting performance

Phase	Frequency of sessions	Duration of sessions	Intensity of sessions	Weekly training volume
Preparation (2–4 weeks)	High	Short	Low–moderate	Low
General preparation (8–16 weeks)	High	Medium–high	Moderate	Moderate initially progressing to high at the end of the phase
Specific preparation (4–12 weeks)	Moderate–high	Medium–high	High	Moderate
Tapering (1–3 weeks)	Moderate progressing to low	Moderate progressing to short	High–moderate	Moderate progressing to low
Competition	Race at 100% (Heats at 90–100% depending on what is required for qualification)			
Transition or off-season	Low	Short	Low	Low

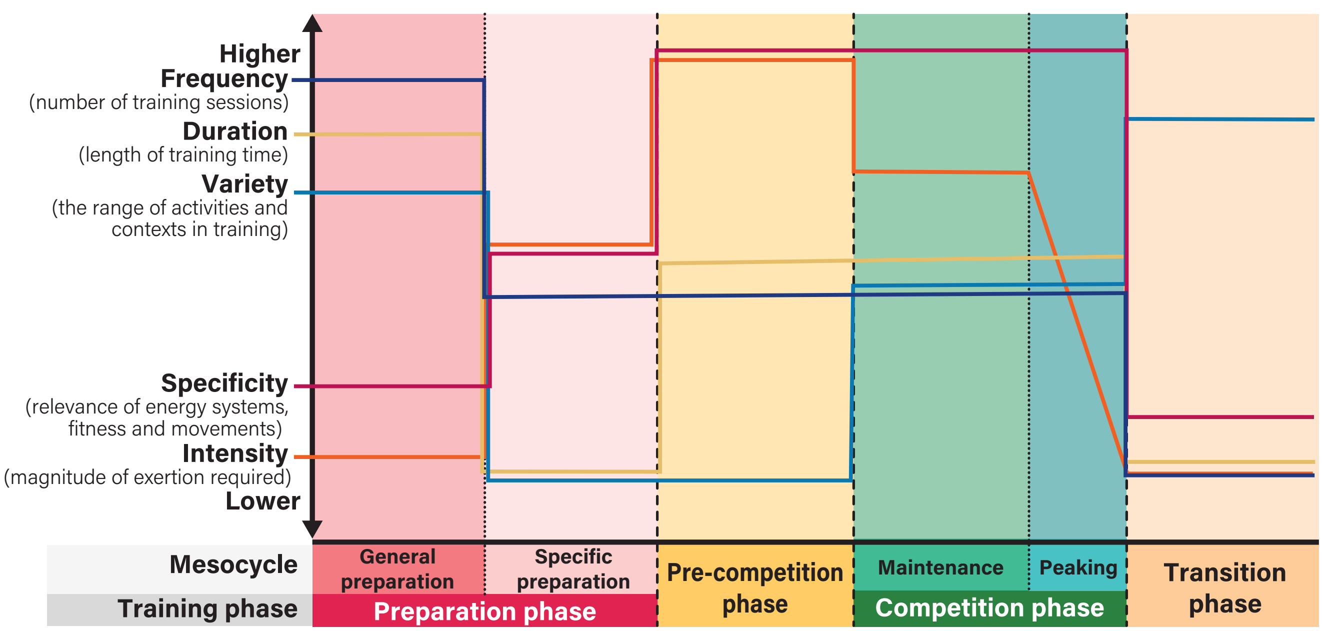


FIGURE 22.19 Each training phase has a specific purpose that can be met by identifying the training objective and manipulating the training principles accordingly.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 22.15 Sample training session plan

Mesocycle: Competition phase for a badminton player						
Component of session	**Phase**	**Description of training activity**	**Purpose**	**Intensity (% 1RM, % MHR, RPE)**	**Duration W:R**	**Volume Time, sets, reps**
Warm-up	Raise	Court runs	Raising the heart rate increases blood flow	Starting at 50%, building to 80%	1:1	10 reps
	Activate and mobilise	Dynamic stretches (A) **1.** Leg swings **2.** Lying leg crossovers **3.** Scorpions **4.** Arm swings	Progress joints through full range of motion	80%	2:1	(A) Complete 10 times per side
		Dynamic stretches (B) **1.** Lunge walk **2.** Knees to chest **3.** Inchworms **4.** Spiderman crawl				(B) 1 × across court and back
	Prepare	Partner drills (A) **1.** Net shots **2.** Overhead clears **3.** Underarm clears	Prepare athlete to perform specific skills and movement	80–85%	1:1	(A) 20 reps
		Partner drills (B) **1.** Clear to drop shot **2.** Short serve to clear to smash				(B) 10 reps

(continued)

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 22.15 *(continued)*

Mesocycle: Competition phase for a badminton player						
Component of session	**Phase**	**Description of training activity**	**Purpose**	**Intensity (% 1RM, % MHR, RPE)**	**Duration W:R**	**Volume Time, sets, reps**
Conditioning	Activity 1	Shadow play sprints • Start in the middle of the court • Have a partner identify a corner, sprint there, play an appropriate shot, return to the middle • Repeat when athlete has returned to the middle • Complete four sprints per set	Increase speed and agility	95–100%	1:5	4 reps per set 15 sets
	Activity 2	Multi-feed rally • Start in the middle of the court • Have a partner continuously feed shuttles onto the court • Shuttles should be fed as soon as the return shot is made and should vary in placement	Develop aerobic and muscular endurance	85–95%	1:3	Play 20 shuttles 15 sets 1 minute rest between sets
	Activity 3	1 vs. 2 rally • Play against two opponents (operating on one side of the court each)	Develop aerobic endurance, reaction time, agility and decision-making under fatigue	80–95%	1:3	10 minutes standard play

(continued)

ISBN 978-1-009-31125-0 Stewart et al.

Mesocycle: Competition phase for a badminton player						
Component of session	**Phase**	**Description of training activity**	**Purpose**	**Intensity (% 1RM, % MHR, RPE)**	**Duration W:R**	**Volume Time, sets, reps**
Cool down	Low-intensity cardio	Jogging around the venue	Slowly lower heart rate, clear lactic acid from muscles	50% HRM	5 min	1 set
	Static stretching	Calf stretch • Quadriceps stretch • Hamstring stretch • Gluteal stretch • Hip flexor stretch • Lower back stretch • Abdominal stretch • Chest stretches • Shoulder stretch • Bicep stretch	Return muscles to original length	Light	15–30 s	3 sets (each side)

CHECK-IN 22.4

1. Compare the suggested intensities and duration required for training sessions in the general preparation, specific preparation and the competition (focusing on maintenance) phases.

Mesocycle	Intensity	Duration
General preparation		
Specific preparation		
Competition		

2. Produce column graphs that represent the specific intensities and durations identified in the table above.
3. Select one of the mesocycles above and research typical training activities associated with a chosen physical activity during this phase.
4. Apply your knowledge of the training principles associated with the competitive phase of training to three selected training activities.

Activity	Description	Intensity	How will this be measured? (1RM, % MHR, RPE)	Duration of work	Duration of rest
1.					
2.					
3.					

ISBN 978-1-009-31125-0 Stewart et al.

KEY MESSAGE

A training season is broken down into smaller periods, each with a specific focus.

KEY MESSAGE

Tapering before progressing to a new period of training allows the body to be repaired and replenished.

KEY MESSAGE

An effective training session should synthesise a range of training considerations.

ACTIVE INVESTIGATION 22.4

RECOGNISE & EXPLAIN ANALYSE & SYNTHESISE EVALUATE JUSTIFY

Inquiry question: What information is required to plan and implement effective strength and conditioning sessions for athletes during the competitive phase of training?

Recognise and explain

1. As a class, a physical activity to design a one-hour training session to take place during the competition phase.
2. Collect primary and secondary data to identify key factors that will influence the design of the training session.
3. Collate this data using the planning considerations template on the following page.

Analyse and synthesise

KEY COGNITION

Synthesise: combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding

4. Synthesise the collected data and construct a detailed session plan for your selected physical activity.
5. Participate in the training session, ensuring that you monitor the duration and intensity of the exercise being completed.

Evaluate and justify

6. Use primary and secondary evidence to justify the effectiveness of your training session. Consider the following:
   a. Were all activities completed within the designated time frame?
   b. Were the activities completed at the planned intensities?
   c. Were work and rest periods completed for the planned duration?

Continued »

ISBN 978-1-009-31125-0 Stewart et al.

Physical activity mesocycle			
	Key factor	**Considerations**	**Training recommendations/activities**
Identify type of training	Availability of time, equipment or facilities	Session duration	1 hour: Allow 15 minutes for warm-up 35 minutes conditioning 10 minutes for cool down
		Is all required equipment available?	Yes/No
		Has the facility been booked?	Yes/No
	Performance analysis	ATP–PC %	
		Lactic acid %	
		Aerobic %	
		What are the primary fitness components of the activity?	
		What key skills or movement patterns need continued development?	
Identify duration, intensity and volume of training	The focus of the current mesocycle	What is the conditioning focus for the phase?	
		How will you monitor intensity?	
		What are duration and volume recommendations?	
		What is the skill focus for the phase?	
	Level of fitness of the athlete(s)	Fitness strengths	
		Fitness weaknesses	
	Level of ability of the athlete(s)	Skills/strategies the athlete can execute successfully	
		Skills/strategies the athlete needs to develop further	

ISBN 978-1-009-31125-0 Stewart et al.

Post-exercise recovery

The chronic adaptations as a result of exercise will only occur if paired with appropriate recovery. After being exposed to training stresses, the body requires time to repair damaged body tissues and replenish fuel sources. In doing this, it becomes more prepared to endure those stresses again. However, if an athlete hasn't adequately recovered from training, they will not be prepared to train at the desired intensities and durations and are more likely to suffer the effects of overtraining.

Principles of recovery

Just as planning for training is important, so too is planning for recovery. There are four key cornerstones that will enable effective recovery after exercise. These **principles of recovery** are known as the 4 Rs of recovery:

- Rehydrate – replenish the fluids lost
- Refuel – replenish the glycogen stores
- Repair – increase protein to support muscle tissue regeneration
- Rest – adequate rest and restorative sleep.

principles of recovery a set of strategies to minimise the detrimental effects of training sessions or matches on the body, and maximise the training benefits experienced

During exercise, the body is constantly breaking down glycogen stored in the muscles and liver to provide the **glucose** needed to fuel both aerobic and anaerobic glycolysis. It takes about 80 minutes to deplete glycogen stores if exercising at a steady state just below lactate threshold. With enough carbohydrates and rest, these glycogen stores are replenished at between 2 and 5 per cent per hour. Therefore, a recovery period of 20–48 hours is required before scheduling another endurance-based session.

glucose a type of sugar in plants, especially fruit; supplies an important part of the energy that animals need

For high-intensity exercise like strength and interval training, muscle tissues develop slight tears as a result of the additional loads placed on them. With adequate rest, the body can repair these tears using available proteins. This process can take between 48 and 72 hours. Athletes completing strength training often use a split training program to accommodate the need for this rest. For example, they may train upper body on one day, lower body the next and follow with a rest day and repeat. By splitting their training like this, they allow themselves a full 48 hours before using the same muscles again. These athletes also increase the amount of protein they consume to aid in this recovery.

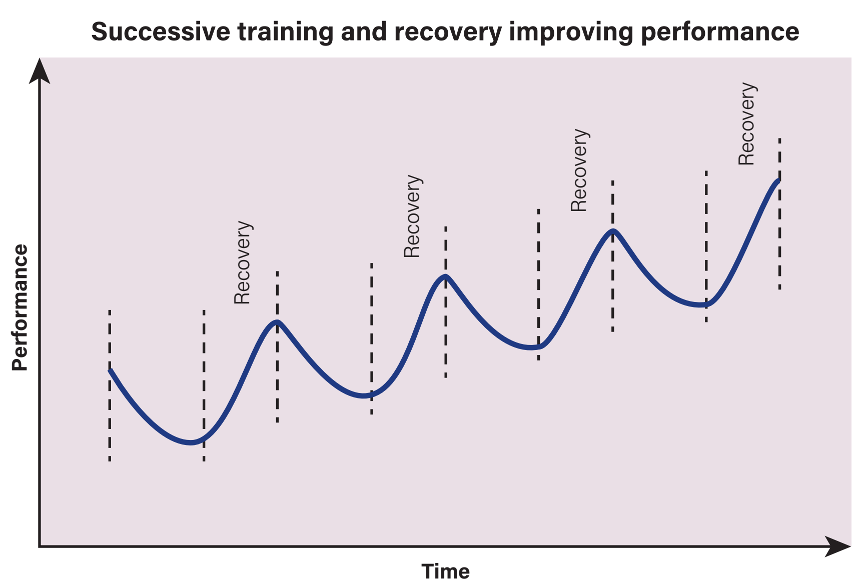


FIGURE 22.20 Adequate recovery between training sessions is essential to allow chronic adaptations in fitness to occur.
Source: Adapted with permission from RYPT website

ISBN 978-1-009-31125-0 Stewart et al.

Tapering through a periodised training plan is also important in allowing the body to recover. Tapering weeks planned typically before a competition or at the end of a training phase promote recovery from continued stresses placed on the body. In a tapering week, volume of training should be reduced by at least 50 per cent while maintaining intensity and frequency. This approach allows the body to 'catch up' on recovering from residual fatigue and damage caused from the previous block of training before competing or progressing.

The recovery hierarchy

There are many processes that athletes can use to improve the speed and efficacy of their recovery. The recovery hierarchy in Table 22.16 identifies the most important to least important for recovery.

TABLE 22.16 Recovery principles

Tier 1 – most important		
	Recommendations	**Importance**
Adequate sleep and rest	7–8 hours of unbroken sleep Consistent sleep and wake times Practise good sleep hygiene	Reduces stress hormones. Allows the heart to rest. Promotes the release of human growth hormones to repair and grow muscle tissue. Allows for fuel stores to regenerate. Improves immunity.
Nutrition	Eat as soon as you can after exercise (preferably within 30 minutes): • carbohydrates: 1–1.2 g per kg of body weight • protein: approximately 0.4 g per kg of body weight • foods low in fat (as fats can inhibit nutrient absorption).	Restoring glycogen stores is necessary for glycolysis. Protein to repair and grow muscle tissue. The body is most effective at replacing carbohydrate and promoting muscle repair and growth in the first 60–90 minutes after exercise.
Hydration	Within the first four hours after exercise: • replace 150% of body weight lost during the exercise period • combine electrolyte drinks and water if sweat loss is high (completing intense training that is more than 75 minutes or in hot conditions).	Rehydration restores blood volume, which: • reduces heart stress • supports the transfer of oxygen and nutrients around the body • removes waste produced from exercise • helps to regulate body temperature.

(continued)

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 22.16 *(continued)*

Tier 2 – moderate importance		
	Recommendations	**Importance**
Active recovery	Complete low-intensity exercise as a cool down AND/OR Complete low-intensity exercise on recovery days	Active recovery maintains blood flow to the muscles to help eliminate lactate and other toxins. Helps to reduce muscle soreness and stiffness.
Stretching	Three sets of 15–30-second stretches major muscle groups Night-time stretching routine	Stretching helps to relax muscles and minimise muscle tightness and soreness. Stretching before bed can promote a relaxation response to help athletes sleep better.
Cold-water immersion	Following exercise: Submerge working muscles or whole body in 10–15°C water for 5–15 minutes OR Alternate with cold water and warm water (1 minute each) for 10 minutes.	Decreases body temperature. Causes restriction in blood vessels and helps to flush out waste from the muscles to be filtered by the liver and kidneys faster. May also help to reduce inflammation.
Tier 3 – less important		
	Recommendations	**Importance**
Compression	Wearing tight elastic clothing or using inflatable compression devices immediately after exercise for up to four hours	Improves blood flow by compressing the blood vessels, helping them to pump blood more effectively to deliver nutrients and clear waste. This helps reduce muscle fatigue.
Massage	Gentle massage immediately after exercise (this can include foam rollers, therapeutic balls and massage guns)	Increases circulation of blood to muscles and decreases muscle soreness.

KEY MESSAGE

Recovery after exercise is essential for restoring fuel sources for energy systems.

KEY MESSAGE

With adequate rest and nutrition, the body repairs damaged muscle tissue.

KEY MESSAGE

Rehydration is essential for blood to deliver oxygen and nutrients and remove waste products.

ISBN 978-1-009-31125-0 Stewart et al.

Chapter summary

- Training needs to get progressively harder to produce continued adaptations.
- Effective training is specific to the requirements of the physical activity.
- Effective training targets the individual needs and goals of each athlete.
- Training intensity can be manipulated in a variety of ways.
- The Karvonen method of calculating % MHR accounts for individual difference.
- It is recommended that resistance training intensities be linked to percentage 1RM.
- Continuous, fartlek and interval training can target different training zones.
- Training at or above the anaerobic threshold produces the greatest aerobic gains.
- Adequate recovery time is required between very high-intensity efforts.
- Circuit training and resistance training are both effective in conditioning muscles for physical activities.
- Muscle contractions can be categorised based on the movement of the muscles when contracting.
- Plyometric training uses the stretch shortening cycle to generate great muscular force.
- The RAMP protocol is an effective guide to follow when designing warm-ups.
- High-intensity conditioning exercises should be placed prior to fatigue at the start of a session.
- Low-intensity continuous activity during the cool down is essential for clearing lactic acid from the working muscles.
- Consideration of time needed to replenish energy systems is important when planning training sessions.
- A training season is broken down into smaller periods, each with a specific focus.
- Tapering before progressing to a new period of training allows the body to be repaired and replenished.
- An effective training session should synthesise a range of training considerations.
- Various methods of recovery can assist the body to restore fuel sources and repair damaged muscle cells.

Chapter review

MULTIPLE-CHOICE QUESTIONS

1. Training that focuses on the energy systems, fitness components and movement patterns required to successfully complete a physical activity is known as:

A. individuality.

B. specificity.

C. overtraining.

D. variety.

2. Gradually increasing the intensity, duration or volume of exercise over time is known as:

A. the Karvonen method.

B. specificity.

C. progressive overload.

D. tempo training.

3. Tempo training can be characterised as:

A. training at or just below the aerobic threshold.

B. training at a minimum of 95 per cent intensity.

C. training at or just below the lactate threshold.

D. all of the above.

4. Which energy system would incorporate a W:R ratio of 1:1?

A. ATP–PC system

B. Lactic acid system

C. Aerobic system

D. All of the above

ISBN 978-1-009-31125-0 Stewart et al.

5. Which of the following is not a direct benefit of flexibility training?
   A. Improved posture and muscle balance
   B. Reduced chance of injury
   C. Increased speed
   D. Improved mobility and movement capacity

SHORT-RESPONSE QUESTIONS

1. Explain the relationship between heart rate, RPE and the ability to talk.
2. Explain how training volume would change over the course of each of the four training phases (refer to how the frequency and duration of training would be adapted to ensure optimal performance in competition).
3. Justify why it is important to incorporate tapering periods into a training plan.

EXTENDED-RESPONSE QUESTIONS

Select one physical activity from the following list.

Australian Rules football	Badminton
Basketball	Tennis
Futsal	Volleyball
Netball	Duathlon, aquathlon, triathlon
Soccer	Track and field – jump
Touch football	Track and field – throw
Water polo	Track and field – track

1. In an extended response (400 words or more), devise two single one-hour training sessions for the selected physical activity. Each session focuses on improving (the same) two fitness components and related energy systems required for optimal performance in the activity. One session is designed for use in the preparation phase of training and the other session is designed for use in the competition peaking phase.

   Justify how your devised training sessions target the selected fitness components and related energy systems.

   Justify how the principles of specificity, duration and intensity have been manipulated to suit the training goals for each phase of training.

2. In an extended response (400 words or more), explain the factors that would need to be considered when devising a resistance training session to develop muscular endurance.

   Devise two consecutive training sessions to develop muscular endurance in a physical activity that you have encountered during your Physical Education course.

   Justify the purpose of using resistance training to prepare for performance in your selected activity and explain the use of at least three training principles where appropriate. Remember to note the physical activity to which you are referring.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 23

Evaluations, evidence and assessment support

What's ahead?

Chapter 23
Evaluations, evidence and assessment support

- **23.1** Assessment techniques – an overview
- **23.2** Data in assessment responses
- **23.3** Addressing the visual personal performance evidence
- **23.4** Experiential learning and the inquiry approach in Physical Education assessment
- **23.5** Multimodal – folio: a response strategy
- **23.6** Research report: a response strategy
- **23.7** Examination: a response strategy

This resource is available in the digital version of the textbook.

ISBN 978-1-009-31125-0 Stewart et al.

References

Araújo D and Davids K (2011) 'What exactly is acquired during skill acquisition?', *Journal of Consciousness Studies*, 18(3–4):7–23.

Australian Bureau of Statistics (2022) *Physical activity*, https://www.abs.gov.au/statistics/health/health-conditions-and-risks/physical-activity/latest-release.

Australian Sports Commission (2012) 'The essence of Australian sport: what we stand for', https://assets.auscycling.org.au/s3fs-public/2021-03/sport-australia-beginning-coaching-4th-edition.pdf?ux1wwc_76poknXHeLy_4gJKgyqqC3yBg=.

Australian Sports Commission (2023) *AusPlay™ 2022–23 survey*, https://www.ausport.gov.au.

Davids K, Bennett SJ and Newell K (eds) (2006) *Movement system variability*, Human Kinetics, Champaign, Illinois.

Davids K, Button C and Bennett SJ (2008) *Dynamics of skill acquisition: a constraints-led approach*, Human Kinetics, Champaign, Illinois.

Department of Health (2018) *Report of the Review of Australia's Sports Integrity Arrangements*, https://www.sportintegrity.gov.au/sites/default/files/Report%20of%20the%20review%20of%20Australia%E2%80%99s%20Sports%20Integrity%20Arrangements.pdf.

Frost JL, Wortham SC and Reifel RS (2008) *Play and child development*, 3rd edn, Pearson/Merrill Prentice Hall, Upper Saddle River, New Jersey.

Martens R (2004) *Successful coaching*, Human Kinetics, Champaign, Illinois.

Oslin JL and Mitchell SA (1998) 'The Game Performance Assessment Instrument (GPAI): development and preliminary validations', *Journal of Teaching in Physical Education*, 17:23–243.

Queensland Curriculum & Assessment Authority (QCAA) (2024) Physical Education 2025 v1.1 General Senior Syllabus © Queensland Curriculum & Assessment Authority.

Renshaw I and Clancy J (2008) *Developing intelligent games performers*, Active Australia.

Renshaw I and Clancy J (2016) 'Reflecting on practice: an exploration of NLP in games teaching', *Research Quarterly for Exercise & Sport*, 87:sup. 1, S27–S62; 530.

Renshaw I, Chow JY, Davids K, Hammond J (2010) 'A constraints-led perspective to understanding skill acquisition and game play: a basis for integration of motor learning theory and physical education praxis?', *Physical Education & Sport Pedagogy*, 15(2):117–131.

Renshaw I, Davids K, Shuttleworth R, and Chow JY (2009) 'Insights from ecological psychology and dynamical systems theory can underpin a philosophy of coaching', *International Journal of Sport Psychology*, 40(4):540–602.

Renshaw I, Oldham T, Davids K and Golds T (2007) 'Changing ecological constraints of practice alters coordination of dynamic interceptive actions', *European Journal of Sports Sciences*, 7(3):157–167.

Rink JE, French KE and Graham KC (1996) 'Implications for practice and research', *Journal of Teaching in Physical Education*, 15(4):490–502.

Roulier R (14 October 2014) 'Feedback in athletic coaching – part 2', *Sport Psychology Today*, http://www.sportpsychologytoday.com/sport-psychology-for-coaches/feedback-in-athletic-coaching-part-2/.

Shuttleworth R (2013) 'Decision making in team sports', *Sports Coach*, 30:25.

Sport Integrity Australia (2020), *Sport Integrity Matters*, https://www.sportintegrity.gov.au/news/sport-integrity-matters.

Welford AT (1968) *Fundamentals of skill*, Methuen, London.

Whiting H (1969) *Acquiring ball skill*, Bell, London.

Medical Dictionary for the Health Professions and Nursing (2012) (Ch1)

UNESCO (Ch 10) *Remix of the Equality/Equity/Liberation image, a collaboration between Center for Story-based Strategy & Interaction Institute for Social Change* (Fig 10.6)

International Fair Play Committee (Ch17)

ISBN 978-1-009-31125-0 Stewart et al.

Glossary

abduction the movement of a part of the body away from the central part of the body or away from another body part

acceleration an increase or a decrease in the velocity of an object to which a force has been applied

access (to physical activity) the opportunity to participate or to be involved

acute physiological responses the body's responses when an increase in activity requires additional energy; these responses return to a steady state following the activity

adaptability the ability or willingness to change

adaptation physiological changes due to the stress of exercise

adduction the movement of a part of the body towards the middle of the body or towards another body part

adenosine diphosphate (ADP) a molecule by-product produced when ATP releases a phosphate molecule to produce energy

adenosine triphosphate (ATP) a molecule in living cells that provides energy for many processes, including muscle contraction and nerve impulse propagation

aerobic capacity (or aerobic endurance) the ability to exercise for extended periods using energy produced by the aerobic energy system

aerobic energy system produces ATP for low- to medium-intensity activity through the breakdown of glycogen (or fat) in the presence of oxygen; the oxygen allows for additional energy to be created in this process, as opposed to the lactic acid that accumulates when oxygen is not present

aerobic interval training interval training performed with longer durations and shorter rests, with intensities close to the anaerobic threshold

aerobic training threshold the level of intensity sufficient to cause a training effect

aerobic training zone the intensity at which your body is using its aerobic metabolism system to produce energy from fat and glycogen

affirmation a positive statement about you, your abilities or your goals that is true or reasonable enough to be valid in the future

affordances the opportunities for action provided by the environment or task in relation to the learner's ability

agent of socialisation an element or a section of a society through which learning occurs as part of the socialisation process

agility a rapid whole-body movement with change in velocity or direction in response to a stimulus

agonist the muscle that is shortening to produce movement of the skeletal system at the joint

anaerobic literally means 'without oxygen', but can also refer to stages of energy production where there is insufficient oxygen available to work totally aerobically; in relation to exercise, it relates to high-intensity activity where the body cannot reach a steady state that is supplying adequate oxygen for the energy demands

anaerobic training zone the heart rate above which you gain anaerobic fitness; you cross your anaerobic threshold at 80 per cent of your maximum heart rate

anatomical position a set pose of the body that allows common reference points when investigating the body and its systems

angular motion movement around a fixed point or axis of rotation

annual plan a year-long macrocycle that varies training in response to competition and non-competition phases, as well as targeting times when peak performance is required

antagonist the muscle that must relax and lengthen during a movement to control or slow down the movement created by the agonist muscle

ISBN 978-1-009-31125-0 Stewart et al.

anxiety an uncomfortable feeling of nervousness or worry about something that is happening or might happen

appendicular skeleton the bones of the skeletal system that are devoted to the production of movement

arousal a state of physical excitement or attentiveness

ATP–PC energy system produces ATP through the breakdown of phosphate creatine for high-intensity movement of very short duration

attention the act or state of applying the mind to something

attunement the ability to perceive information from the performance environment and identify the available affordances

autonomy the ability to make your own decisions without being controlled by anyone else

axial skeleton the bones of the skeletal system that are mainly devoted to protecting vital organs and providing structure

axis of rotation an imaginary line around which a body or object rotates

balance the ability to remain in a stable position, whether moving or stationary

barrier a factor that restricts or prevents access to physical activity

Bernoulli's principle the trajectory of an object moving through a fluid may be influenced by lift or Magnus forces

blocked practice chunked periods of time to practise a single skill of a multitask activity

body and movement concepts a framework for enhancing movement performance that incorporates four different aspects

body awareness what the body can do, or how the body is moving

built environments facilities or majorly modified natural environments that have been constructed specifically for engagement in physical activity

cardiac output the volume of blood expelled from the heart in one minute

cellular relating to the cells in the body

centre of gravity the point from which the weight of an object may be considered to act

chronic physiological adaptations the long-term changes to the systems of the body that result from regular ongoing increased energy and exercise requirements

circuit training training that involves progressing through a number of exercise stations

circumduction the movement of a joint in a circular pattern

class context the circumstances that form within your Physical Education cohort or faculty that provide a setting for an event, situation or idea

closed motor skills skills that occur in highly predictable environments

cognitive anxiety the specific thought processes that occur during anxiety

cognitive systems approach acquisition of information-processing abilities

commodification the process of transforming a product, person or service to increase its value and potential to make a profit

commodity a product that has value and thus can be bought, sold or traded

community context the circumstances that form within your local population and geographical location that provide the setting for an event, situation or idea

competence the ability to do something well

competition phase the phase of an annual training plan that is focused on maintaining fitness levels while managing the recovery, team and tactical needs required through the competition period

components of fitness a set of categories that describe the range of different intensities, durations and movements the body and its systems can produce; each category relates to a different element of fitness

concentration the ability to think carefully about something you are doing and nothing else

concentric contractions the muscles are developing force while shortening to cause movement

ISBN 978-1-009-31125-0 Stewart et al.

confidence the quality of being certain of your abilities or of having trust in people, plans or the future

consistency the degree to which the performance does not vary

constant practice the repetition of a specific skill without variation

constraints boundaries that shape a learner's self-organising movement patterns, cognitions and decision-making processes

constraints-led approach a pedagogical framework that utilises a dynamic systems approach and ecological psychology to design learning activities that develop all aspects of movement skill (technical, tactical and perceptual)

contact force a force applied through direct contact with objects, fluids or surfaces

continuous motor skills skills that do not have a defined end, but are repetitive in nature and may continue for an unspecified length of time

continuous training sub-maximal training completed over a long period without pause

coordination the ability to link the messages received by the brain from the senses to our body parts to produce smooth, quick and efficiently controlled movements

culture the values, beliefs, customs and behavioural norms of a group or population

curvilinear motion movement of an object from one place to another in a curved line

decision-making (information processing) selecting a motor program in response to the current situation

degrees of freedom factors affecting the directions in which independent motion can occur

deliberate practice a special type of practice that is purposeful and systematic

discipline (team) the expected level of self-control, commitment and effort that a team member should contribute to the group

discrete motor skills skills that have a distinct start and finish

displacement the distance and direction an object has moved from one point to another

distributed practice short intervals of practice that focus on refinement of a specific skill or subroutine within a skill

diversity the visible and invisible differences that exist between people, such as gender, culture, race, ethnic origin, physical and mental ability, sexual orientation, age, economic class, language, religion, nationality, education and family/marital status

dominant versions of gender the most common and socially accepted ideas associated with being either male or female

dorsiflexion the action of flexing the ankle joint upwards, raising the toes

drills the repetition of a specific skill or strategy, generally in a simplified, closed environment with limited external factors influencing skill implementation

duration the length of the training session or individual training activity

dynamic balance the ability to maintain balance while moving

dynamic flexibility the range of joint movement possible while moving; it contributes to the body's ability to make rapid or quick, repeated movements

dynamic stretching the use of momentum and active muscle contractions to increase a joint's range of motion

dynamic systems approach the theory that movement behaviour is the result of complex interactions between many different factors, such as the environment and the task at hand

eccentric contractions the muscles lengthen in a controlled way under tension to absorb force

ecological psychology how the body's systems coordinate actions with the environment, objects and surfaces

enabler a factor that facilitates access and equity in physical activity

energy the capacity to do work

energy systems collectively the name for the three ways our body produces ATP, and can include the breakdown of ATP itself, which provides energy for muscle movement

ISBN 978-1-009-31125-0 Stewart et al.

engagement (in physical activity) an individual or group taking up the opportunity to participate in or be involved with physical activity

enjoyment (of physical activity) the level of pleasure that is taken from engaging in or succeeding at physical activity

environmental constraints the social or situational factors that limit the decision-making and movement patterns that can be displayed by an individual during performance

equity concerned with giving value to and celebrating personal, social and cultural differences in society

equity strategy a plan of action devised to enhance equity, access and/or engagement

ethical behaviours the actions that reflect the ethical standards for expected conduct as set by the group

ethical decision-making (in Physical Education) decision-making that provides integrity and accountability in relation to the governance of physical activity

ethical decision-making framework a specific decision-making process that ensures integrity and accountability in the resolutions made for the governance of physical activity, especially when determining the actions required in response to ethical dilemmas

ethical dilemmas situations that extend across different areas of morality, and therefore available options to resolve the situation may not be totally ethically acceptable or preferable to all stakeholders involved

ethical standards a set of principles or guidelines that outline expected conduct reflecting underlying morals, such as trust, equality and kindness

ethics a system of moral principles and values by which actions and proposals may be judged good or bad, or right or wrong

ethics strategy a method or plan of action devised to bring about ethical behaviours and encourage individuals to act with integrity; typically involves the creation of ethical standards, guidelines, frameworks or codes

eversion when the ankle turns laterally so the sole of the foot faces outwards

excess post-exercise oxygen consumption (EPOC) the additional oxygen required by the body during recovery to facilitate a number of processes that return the body to its resting state

extension when the angle of the joint increases

external feedback feedback that comes from a source outside of the body, such as a teacher, coach or video, either during or after a performance

external force a force generated through the interaction of the body with the environment

extrinsic motivation participating in an activity for reasons other than enjoyment

fair play a set of values and associated behaviours that are designed to retain the hope, pride and integrity that is associated with sporting participation and performance

fairness where competitors have a relatively equal chance of success as all involved are undertaking the activity in accordance with the rules, ethics or logic

fartlek training a series of high-intensity bursts followed by low-intensity recovery periods

feedback (in motor learning) any information received during or after a performance about the movement itself or the level of success achieved by the movement in that situation

feedback loop a traditional approach concept where a performer is in a continual cycle of receiving information, deciding on an action and then performing a response; this response then provides new information to again be processed and governs the next action

fine motor skills small movements that use the small muscles

flexibility the ability of a joint to move through its full range of motion

flexibility training training with the use of activities specifically designed to increase the normal range of motion around a joint

flexion when the angle of the joint decreases

ISBN 978-1-009-31125-0 Stewart et al.

force a push or pull in a given direction

foundational movement skills basic skills upon which movement sequences and movement strategies are created

frequency the number of times training occurs in a given period

game performance assessment instrument (GPAI) an observational tool to analyse performance in games, using a range of different criteria

gender the male or female sex, when considered with reference to social and cultural differences rather than biological ones; or one of a range of other identities that do not correspond to established ideas of male and female

gender-neutral (physical activities) refers to activities that display characteristics, roles and behavioural norms that either equally share traditional male and female characteristics, or display characteristics of neither

general space the playing or performance area available to the performer

genetic predisposition the concept that a person's body type and systems, as a result of their genetic make-up, may provide natural benefits for success in specific physical activities

globalisation the process by which the world is becoming increasingly interconnected

glucose a type of sugar in plants, especially fruit; supplies an important part of the energy that animals need

glycogen a substance in the liver and muscles that stores glucose and is important in controlling sugar levels in the blood

green space an area of grass, trees or other vegetation set apart for recreational or aesthetic purposes in an otherwise urban environment

gross motor skills bigger movements that use the large muscles

heart rate reserve (HRR) the difference between an athlete's maximum and resting heart rates

high-intensity interval training (HIIT) interval training that includes periods of very high or maximal effort and longer rest periods

hyperextension when the joint extends beyond anatomical position

hypertrophy an increase in muscle mass usually associated with an increase in muscle size and strength as a result of resistance training

improvement the degree of progress observed in a movement

inclusion the practice or policy of providing equal access to opportunities and resources for people who might otherwise be excluded or marginalised

individual constraints the unique mental and physical abilities of the individual that affect their decision-making and movement patterns, and that can be displayed during performance

individuality training that considers the personal needs, goals, fitness levels, motivation and skills of an athlete

information processing model a cognitive systems approach to learning where the notion of input, processing and output is described as the phases of perception, decision-making and response execution

institution a body or group that establishes rules and procedures for how the group should behave or operate, and actively promotes these regulations

integrity the application of generally accepted values and norms in daily practice

intelligent performers those who can accurately read the play to assess affordances (opportunities), then select and appropriately adapt a motor sequence that will be successful given the rules and required task goal

intensity the magnitude of exertion required

internal feedback information received from the body's senses and proprioceptors during a performance

internal force a force generated by muscles and tendons acting to produce movement

interval training incorporates defined periods of exercise followed by periods of rest

ISBN 978-1-009-31125-0 Stewart et al.

intrinsic motivation participating in an activity purely for the enjoyment of the experience

invasion games team games whereby the main objective is for participants to invade their opposition's territory in striving to score more points within the allocated time frame

inversion when the ankle turns medially so the sole of the foot is facing inwards

isokinetic contractions a type of muscular contraction where the muscles remain in motion

isometric contractions when a muscle contracts but its length does not change

isotonic contractions when the length of a muscle changes when contracting

knowledge of performance feedback internal feedback that is concerned with either perception–action coupling, decision-making of the selected movement strategy or sequence, or how the movement sequence itself was enacted

knowledge of results feedback external feedback that is concerned with the outcome of the performance

lactate threshold the point at which lactate begins accumulating in muscle cells as the energy demands to resynthesise ATP require the energy systems to produce more lactate than the cells can remove

lactic acid energy system produces ATP anaerobically through the breakdown of glycogen when energy demands are higher than the usable oxygen supplied; this results in the formation of lactic acid

lever a simple machine consisting of a rigid or semi-rigid bar, a fulcrum (pivot point), an effort force and a resistance force (load)

linear motion movement of an object from one place to another

long slow distance training a form of continuous training of moderate intensity, performed over an extended duration

lung capacity the volume of air in the lungs upon the maximum effort of inspiration

macrocycle a complete training cycle from start to finish

Magnus force (or Magnus effect) when the pressure difference created on either side of an object moving through air or fluid causes the object to move towards the area of low pressure and away from the high-pressure area

massed practice the continual repetition of a specific skill in a closed environment with no or limited intervals between

maximum heart rate (MHR) the highest safe heart rate at maximal exercise; MHR = 220 – age

media the collective term for the main means of mass communication in society; includes broadcasting, publishing and the internet

megatrend an important pattern of social, economic or environmental change

mesocycle a training block that lasts for 4–8 weeks and has a specific training focus

microcosm of society a subsection of society (such as sport, education or politics) that reflects the values, beliefs and behavioural norms of the broader society

microcycle the smallest block of training – usually one week in length, with a specific focus

momentum the amount of 'hitting power' possessed by an object

morals an individual's sense of right or wrong developed through their own unique socialisation process

motion movement that occurs when an object has changed its position in space and in time, due to application of forces

motivation enthusiasm for doing something; the direction and intensity of effort

motor learning the study of the processes involved in acquiring and refining skills; the field of study concerned with understanding changes in motor control

motor sequence a combination of fundamental movement skills and movement elements to enable a body and/or objects to move in response to a stimulus; or a planned order of movements

movement a series of actions or activities directed towards a particular end

ISBN 978-1-009-31125-0 Stewart et al.

movement sequences the coordinated and timed movements in response to the demands of the surrounding environment

movement strategies the variety of approaches that assist a player or team to successfully achieve a movement outcome or goal; include moving into space to receive a pass or hitting a ball away from opponents to make it difficult to retrieve or return the ball

muscle fibre recruitment the increased use of muscle fibres as a result of resistance training

muscular endurance (anaerobic endurance) the ability of specific muscle groups to sustain activity at high intensity using energy produced by anaerobic energy systems

nationalism devotion and loyalty to your own country and the desire for national advancement

natural environments environments that occur inherently in nature

net and court games games in which a player sends an object towards a court or target area that an opponent is defending, trying to make it difficult for the opponent to return the object

Newton's laws of motion three laws that define the relationship between force and motion

non-contact force a force that acts on an object without physical contact, such as the force of gravity

non-linear there is no fixed, pre-programmed path or schedule by which learning occurs; instead, motor learning progresses and regresses as a stable pattern of performance develops based on personal preferences

normalised to cause something to be accepted as normal or expected

normalised behaviour a social process through which actions come to be seen as 'normal', typical or expected in relation to everyday life or specific contexts, such as the behaviours expected by a specific family, school or team

norms (team) the expected standard of behaviours for members of the team when acting as the team

open motor skills skills that occur in environments that are highly unpredictable

outcome goals goals that focus on a desired outcome, such as winning

over-aroused when arousal levels are too high for the athlete to produce optimal performance

over-confident a high level of confidence that is detrimental to performance

overtraining impaired physical, emotional and psychological responses due to the training intensities exceeding recovery

oxygen deficit the difference between the oxygen required for a given rate of work and the oxygen actually consumed; an oxygen deficit occurs whenever the demand for energy production exceeds the oxygen available to produce the required ATP to meet that energy requirement

part practice practice that involves breaking a skill down to hone separate sections or subroutines

perception the brain's interpretation of the current situation, based on the information received from the sensory system and proprioceptive information from the body

perception-action coupling a direct link between the process of interpreting or giving meaning to information from the environment and an action

perceptual rate limiter a restraint to motor learning that relates to the interaction between the body and the environment, and may be the result of inaccurate interpretation when forming an awareness of the situation and requirements

performance goals goals related to a measured performance

periodisation a process of using blocks of training to systematically develop an athlete's fitness and skill levels

persistence continuing to do something even if difficult

personal space the direct area surrounding a participant

physical rate limiter a restraint to motor learning that relates to the physical capabilities of the learner, where the athlete's components of fitness or energy systems may be restricting potential improvement

physiological rate limiter a restraint to motor learning that relates to the genetic make-up of body systems

ISBN 978-1-009-31125-0 Stewart et al.

planes of motion used to describe motion of the body, they are imaginary flat surfaces that divide the body equally in two through three different planes: the frontal plane, the sagittal plane and the transverse plane

plantar flexion the action of extending the ankle joint downwards, pointing the toes

plyometric training a form of training that involves jumping and bounding

population density a measure of the number of people who make up a population in a defined area

positive engagement (in physical activity) when an individual experiences enjoyment or gains constructive socialisation experiences through participation in physical activity

positive self-talk making positive comments to oneself, either silently or out loud

power the ability of muscles to generate force and apply it quickly

pre-competition phase the phase of an annual training plan that is focused on transferring preparatory fitness training into match fitness in readiness for the season or competition ahead

preference (for physical activity) a strong like for, or a predisposition in favour of, a physical activity or activity type

preparation phase the phase of an annual training plan that is focused on preparing an athlete for the physical demands of the competitive season

principles of decision-making a collection of cognitive processes resulting in a course of action influencing outcomes in physical activity

principles of play fundamental movement strategies used by individuals or teams to effectively adapt to any tactical situation in authentic performance environments

principles of recovery a set of strategies to minimise the detrimental effects of training sessions or matches on the body, and maximise the training benefits experienced

principles of training a set of eight guidelines that should be considered when designing effective training activities

problem-solving practice an activity that requires the player to use some decision-making to find a movement solution in completing the task or scenario

process goals goals associated with improving essential processes that will lead to performance enhancement

progressive overload the planned, gradual increase in training load to ensure that fitness continues to be optimised

projectile an object that is propelled into the air

projectile motion the flight path of an object propelled into the air

pronation rotation of the palm of the hand so the palm faces down

properties of force four characteristics that a force possesses: magnitude, direction, point of application and line of action

proprioceptive neuromuscular facilitation (PNF) advanced flexibility training that involves both stretching and contracting the muscle

psychological rate limiter a restraint to motor learning that relates to the mental and emotional state of the person and how this may be affecting learning progress negatively

psychology the study of how thought influences behaviour

qualitative analysis examination of events by recording observations that cannot be measured using numeric values

quality of movement how the body moves, assessed using biomechanical principles

quantitative analysis examination of events through measurement and assigning numeric values

random practice the repetition of several skills simultaneously within the same activity

rate limiter a constraint that holds back or slows the emergence of a motor skill

rate of perceived exertion (RPE) the level of intensity an athlete believes they are experiencing

reaction time the time it takes to respond to a stimulus

ISBN 978-1-009-31125-0 Stewart et al.

reciprocal inhibition the process of muscles on one side of a joint relaxing to accommodate muscle contraction on the other side of the joint

rectilinear motion movement of an object from one place to another in a straight line

relatedness where social acceptance reinforces the motivation for participation

relationships (body and movement concept) an aspect of the body and movement concepts that refers to the performer's interaction and connection with opponents, other players and/or implements and objects

repetition maximum (RM) the maximum weight an athlete can lift over a prescribed number of repetitions

repetitions the number of times an exercise is completed

resistance training exercise that incorporates specific muscle contractions to move or hold weight

response execution occurs when the decision is passed to the relevant body parts and the selected motor plan is enacted

resting heart rate (RHR) the number of times the heart beats per minute when at rest

reversibility the reversal of adaptations due to discontinuation of training or training load

rotation the turning of a limb or the spine along its axis

rules (team) the explicit regulations to follow, as established by the team or leaders within the group

school context the circumstances that form within your school that provide a setting for an event, situation or idea

self-belief a person's trust in their own abilities

self-concept the mental self-image a person has; it includes physical attributes and abilities as well as personality and intellectual ability

self-efficacy a person's belief that they can be successful when carrying out a particular task

self-esteem the way an individual feels about their own abilities, as demonstrated through their self-worth and self-respect

self-fulfilling prophecy something you cause to happen by saying and expecting that it will happen

self-organisation a dynamic systems view that humans will instinctively formulate a physical response when confronted with their environment and that, given practice, this response will be modified to be more successful

serial motor skills those where a number of discrete motor skills are linked together

skeletal muscles muscles that are attached to the skeleton in order to produce movement

skill acquisition the voluntary control over movements of joints and body segments in an effort to solve a motor skill problem and achieve a task goal

social cohesion how much individual team members like each other and enjoy each other's company

social support the assistance provided by others to an individual; in team dynamics, it is the support provided by a team and its members to individuals within the group

socialisation the process by which an individual acquires knowledge, language, social skills and values from their surroundings

somatic anxiety the physical symptoms of anxiety

space awareness where the body can move

specialised movement sequence a combination of specialised fundamental movement skills and movement elements particular to a position or an event to enable a body and/or objects to move in response to a stimulus; a planned order of movements

specificity (practice) representative activities that replicate the performance environment demands with regard to attunement and perception–action coupling

specificity (principle) training that is relevant to the energy systems, position-specific movements and fitness requirements of an activity

speed the ability of muscles to contract quickly and repeatedly, resulting in fast body motion

ISBN 978-1-009-31125-0 Stewart et al.

sport psychology the study of the human mind and how it relates specifically to physical performance

sprint interval training a form of HIIT that involves bursts of sprinting interspersed with rest

stability the state of being stable and resistant to change

stable pattern (of movement) a preferred method of movement that emerges for a performer through self-organisation

stakeholder any person or group affected by the way something is organised or managed

static balance the ability to maintain a stationary balanced position

steady state where the oxygen demands of the working muscles are being met by the body's oxygen uptake

strength the ability of muscles to exert a force against a resistance in one maximal effort

striking and fielding games games in which one team can score points when a player strikes a ball (or similar object) and runs to designated playing areas while the other team attempts to retrieve the ball and return it to prevent their opponents from scoring

stroke volume the volume of blood expelled from the left ventricle of the heart per beat of the heart

summation of forces the total force produced by the coordinated actions of a group of muscles contracting in sequence

supination rotation of the palm of the hand so the palm faces up

synovial joints freely moveable joints, designed to drastically reduce the amount of friction between bones, and are responsible for allowing movement of the skeleton

tactical awareness a personal response to the interaction of constraints of environment, task and player during goal-directed behaviour in a physical activity

tactical rate limiter a restraint to motor learning that relates to the decisions and actions of players in the contest to gain an advantage over the opposing team or players

tactical strategy the variety of approaches that assist a player or team to successfully optimise performance through the application of specialised movement sequences, movement strategies from principles of play, and body and movement concepts

task cohesion the team's ability to work towards a specific goal

task constraints the rules, equipment and goal or purpose of an activity that limit the decision-making and movement patterns that can be displayed by an individual during performance

team cohesion how well a group can work together and remain united in pursuit of its goals and objectives

team dynamics the unconscious, psychological forces that influence the direction of a team's behaviour and performance

technical proficiency the level to which a specialised movement sequence has been refined in order to produce consistently successful outcomes, and the level to which the performer can adapt the sequence to effectively suit the situation

technical rate limiter a restraint to motor learning that relates to the motor programs and movement sequences required for the activity

temperament a person's nature, their natural propensity and innate behavioural and personality traits; temperament is shown in how people behave or react to others or situations

tempo training a type of aerobic training at or just below the anaerobic threshold

training methods a set of different training types, each having its own focus or way of training in order to achieve different training benefits or goals in relation to the fitness component(s) to be developed

training phases the different segments of an annual training plan, each with its own specific purpose in relation to the competition or time when the athlete must peak

training program an organised plan for long-term athlete/team development, based on training objectives, game analysis, required adaptations, tapering and recovery

ISBN 978-1-009-31125-0 Stewart et al.

training session an individual period of time, consisting of different activities designed to improve performance in relation to the goal of the individual or team

training zone specific intensity range that identifies the dominant energy system used

transition phase the phase of an annual training plan that is focused on post-competition recovery, both physically and mentally in readiness for the next annual training cycle

under-aroused when arousal levels are too low for an athlete to produce optimal performance

under-confident a low level of confidence that is detrimental to performance

unethical behaviours actions that are outside, or against, the ethical standards set by the group for expected conduct

variability of practice practice activities that encourage different options to complete a specific task or goal

varied practice the repetition of a skill with the activity requiring minor variations to the motor program

variety (as a training principle) training in different ways, incorporating different training methods, utilising different training principles, as well as venues and equipment; all aid to increase training benefits

velocity how fast and in what direction an object is moving

vicarious experiences knowledge or information about a skill or behaviour derived from viewing the performance

visualisation creating and focusing on a range of positive mental images and experiences

VO_2 max the maximum rate of oxygen consumption attainable during physical exertion

volume the number of repetitions or sets completed

whole practice practice that involves the repetition of a skill in its entirety

ISBN 978-1-009-31125-0 Stewart et al.

Permissions acknowledgements

The author and publisher wish to thank the following sources for permission to reproduce material:

Cover: © Getty Images / Edwin Tan.

Images: © Getty Images / Roz Bannan, Unit 1 Opener / SolStock, Unit 1: Topic 1, Chapter 1 Opener / Pete Saloutos, 1.2 / CasarsaGuru, 1.3 / Matthew Lewis-ICC, 1.4 / Thomas Barwick, Chapter 2 Opener / RichVintage, 2.2 / Edwin Tan, 2.3 / BananaStock, Chapter 3 Opener / South_agency, 3.2 / Imaginima, Chapter 4 Opener / Mark Dadswell, 4.1 / Roz Bannan, 4.2 / Edwin Tan, 4.4 / Chris Ryan, Chapter 5 Opener / Victor Fraile, 5.1 / Icon Sportswire, 5.9 / kirstypargeter, 5.12 / Lauren Devon, 5.21 / Ciricvelibor, 5.24 / Christopher Morris, Chapter 6 Opener / Jacob Wackerhausen, 6.1 / Jasmin Merdan, 6.4 / Cameron Spencer, 6.6 / John Gichigi, 6.8 / Technotr, 6.9 / Patrik Giardino, 6.10 / John Gichigi, 6.14 / Ryan McVay, 6.21 / Maskot, 6.22 / Jeff Pachoud, 6.28 / GeorgeRudy, Chapter 7 Opener / Pixdeluxe, Unit 2 Opener / Kupicoo, 7.1 / Mark Brown, 7.5 / John Giustina, 7.7 / Justin Setterfield, 7.13 / Paul Bradbury, Chapter 8 Opener / Bob Martin, 8.4 / Lachlan Cunningham, 8.6 / Matt Roberts, 8.7 / Francois-Xavier Marit, 8.8 / Rudi Silva, 8.9 / Stephen McCarthy, 8.10 / FluxFactory, Chapter 9 Opener / PeopleImages, 9.2 / Albert Perez, 9.5(1) / Vgajic, 9.5(2) / AleksandarNakic, 9.5(3) / Witthaya Prasongsin, Chapter 10 Opener / Patrick Hamilton, 10.1(1) / Wayne Taylor, 10.1(2) / Don Arnold, 10.1(3) / Michael Willson, 10.2 / Bob Thomas, 10.4(2) / PeopleImages, 10.4(3) / Image Source, 10.4(4) / Pavlyukv, 11.3 / Vgajic, 11.4 / FatCamera, 11.6 / Zeljkosantrac, 11.8 / SolStock, p.218 / Peter Cade, Chapter 12 Opener / Lisa5201, 12.3 / FatCamera, 12.4 / Andresr, 12.9(1) / Searsie, 12.9(2) / Bradley Kanaris, 12.10 / FatCamera, 12.15 / Patrik Giardino, 13.8(1) / Zoranm, 13.8(2) / Khosrork, 13.8(3) / Jamie Schwaberow, 13.8(4) / FatCamera, 13.10 / JohnnyGreig, 13.11 / Pixdeluxe, 13.12 / Roz Bannan, 13.13 / Valentinrussanov, 13.14 / 4FR, 13.15 / Pawel Kajak, Chapter 14 Opener / AlexSava, 14.1 / Isaac Lane Koval/Corbis/VCG, 14.2 / Vgajic, 14.3(1) / Andrew Merry, 14.3(2) / Thomas Barwick, 14.4 / jondpatton, 14.5 / Ian Hitchcock, 14.6 / Mayur Kakade, Chapter 15 Opener / Kali9, 15.1 / Soccrates Images, 15.2(1) / Soccrates Images, 15.2(2) / Soccrates Images, 15.2(3) / Brett Hemmings, 15.3 / Luis Alvarez, Chapter 16 Opener / Keystone, 16.3 / Tempura, 16.4(1) / South_agency, 16.4(2) / Roz Bannan, 16.5 / Chris Hyde, 16.8(1) / Chris Hyde, 16.8(2) / Chris Hyde, 16.8(3) / Westend61, 16.9 / Simonkr, 17.1 / StockPlanets, 17.3 / Cameron Spencer, 17.7 / STR, 17.9 / Westend61, p. 342 / Thomas Barwick, p.353 / Emily Barker, 18.3(1) / Quinn Rooney, 18.3(2) / Francois Nel, 18.3(3) / FG Trade, p.364 / Skynesher, Chapter 19 Opener / 19.2, Kevin Light / SolStock, Chapter 20 Opener / AleksandarNakic, Unit 4 Opener / Akacin Phonsawat, 20.1 / BSIP, 20.7 / Michael Kappeler, 20.11 / David Rogers, 20.12 / NurPhoto, 20.16 / Simonkr, 20.17 / Cameron Spencer, 20.23 / AndreyPopov, 20.24 / Skynesher, 20.25 / Simonkr, 21.2 / Jacob Wackerhausen, 21.3 / FatCamera, 21.4 / Adam Pretty, 21.5 / Martin Keep Photos, 21.6 / Boston Globe, Chapter 22 Opener / James Gill-Danehouse, 22.2 / BraunS, 22.3 / Drazen, 22.4 / Skynesher, 22.5 / Solskin, 22.7 / Timothy A. Clary, Table 22.7(1) / Blanaru, Table 22.7(2) / Kupicoo, 22.9 / Michael Dodge, 22.10 / Kanawa_Studio, 22.11 / Brian B. Bettencourt, 22.18 / Caia Image, Chapter 23 Opener / Alexander Hassenstein, p. 519(1) / Tobias Titz, p. 520(1), p. 520(2), p. 520(3); Remix of the Equality/Equity/Liberation image, a collaboration between Center for Story-based Strategy & Interaction Institute for Social Change. Creative Commons Non-commercial Share alike 4.0 license, 10.6; Reproduced by permission of Australian Sports Commission — www.ausport.gov.au, 12.8; Australian Bureau of Statistics (2022). Physical activity. ABS, 12.14; Reproduced by permission of Play by the Rules, 18.4; Wu, Jialing & Song, Weixin & Lai, Xiaoying & Li, Xiao. (2020). Upper Arm Action Recognition for Self Training with a Smartphone. Journal of Physics: Conference Series. 1616. 012102. 10.1088/1742-6596/1616/1/012102, p.554.

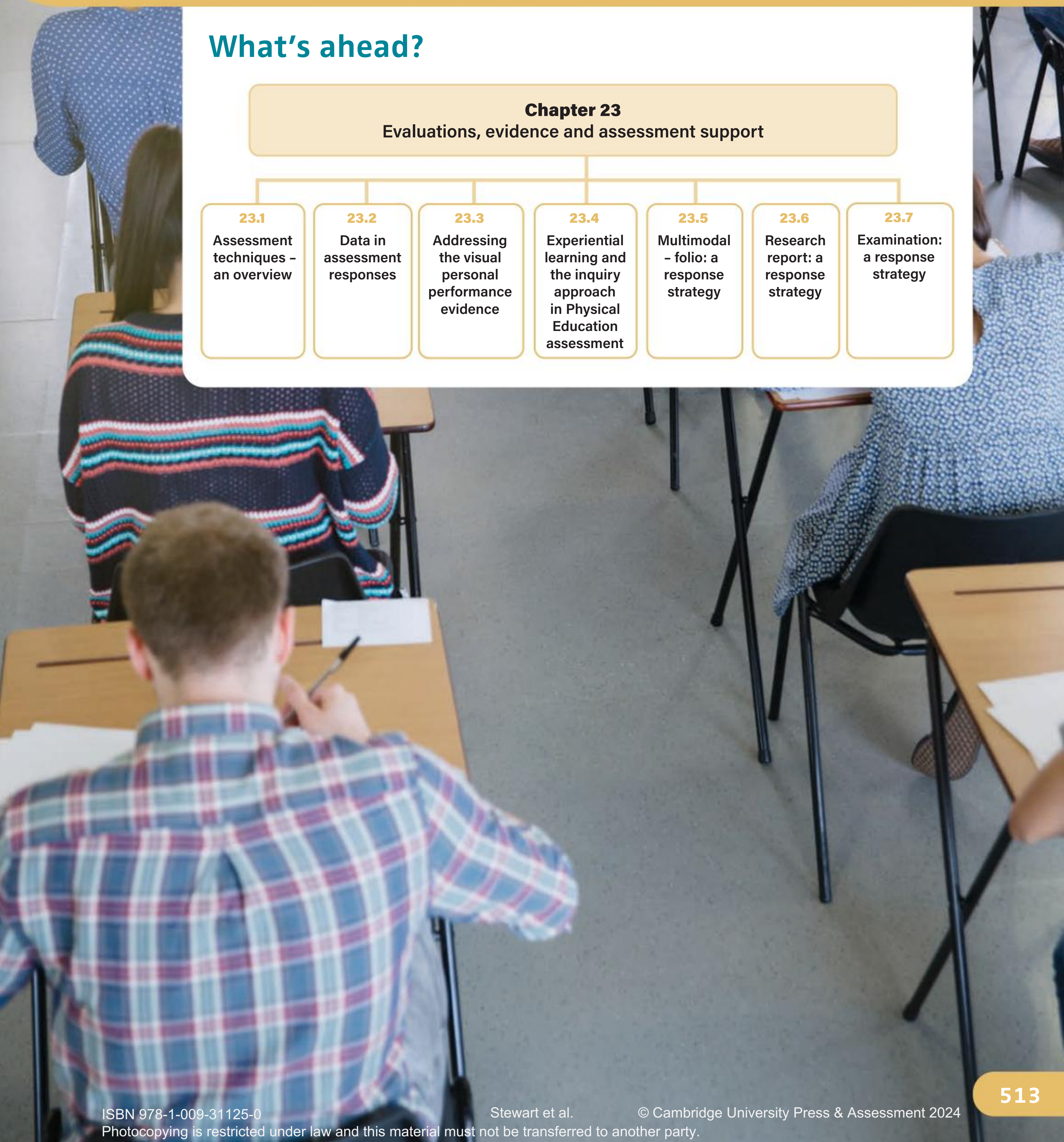
Text: Used from Medical Dictionary for the Health Professions and Nursing (2012), p.6; Reproduced by permission of Human Kinetics, 'Dynamics of skill acquisition', Davids et al. (2008), p.18, p.20(1), p.20(2); Reproduced by permission of Renshaw, Ian, Davids, Keith, Shuttleworth, Richard, & Chow, Jia (2009) 'Insights from ecological psychology and dynamical systems theory can underpin a philosophy of coaching'. *International Journal of Sport Psychology,* 40(4), pp. 580–602, p.25, p.26; Reproduced by permission of Renshaw, Ian, Davids, Keith, Shuttleworth, Richard, & Chow, Jia (2009) 'Insights from ecological psychology and dynamical systems theory can underpin a philosophy of coaching'. *International Journal of Sport Psychology,* 40(4), pp. 580–602, p.34, p.41, p.44; Used from Russell Westbrook, p.164; United Nations Educational, Scientific and Cultural Organization (UNESCO), p.188; Australian Bureau of Statistics (2022). *Physical activity*. ABS., 12.4; Reproduced by permission of Australian Sports Commission — www.ausport.gov.au, 12.8; Reproduced by permission of Australian Sports Commission — www.ausport.gov.au, *AusPlay 2022–23 survey*, Table 12.2, Table 12.3, Table 12.4, 12.13; Reproduced by permission of Australian Sports Commission — www.ausport.gov.au, AusPlay Data Portal, Table 13.1; Reproduced by permission of Australian Sports Commission — www.ausport.gov.au, *AusPlay 2022–23 survey*, 13.2; Reproduced by permission of Australian Sports Commission — www.ausport.gov.au, *AusPlay Participation Data 2023*, Table 13.2, Table 13.3, 13.4, Table 13.4, Table 13.5, Table 13.6; Reproduced by permission of Renshaw, Ian, Davids, Keith, Shuttleworth, Richard, & Chow, Jia (2009) 'Insights from ecological psychology and dynamical systems theory can underpin a philosophy of coaching'. *International Journal of Sport Psychology,* 40(4), pp. 580–602, p.284; Reproduced with permission, *Developing intelligent games performers*, Active Australia, Renshaw and Clancy (2008), p.285; Reproduced by permission of Human Kinetics, 'Dynamics of skill acquisition', Davids et al. (2006), p.287(1); Reproduced with permission, 'What exactly is acquired during skill acquisition?' *Journal of Consciousness Studies*, Araújo and Davids (2011), p.287(2); Reproduced with permission, 'Reflecting on practice: an exploration of NLP in games teaching', *Research Quarterly for Exercise & Sport*, Renshaw and Clancy (2016), p.296; Reproduced by permission of Renshaw, Ian, Davids, Keith, Shuttleworth, Richard, & Chow, Jia (2009) 'Insights from ecological psychology and dynamical systems theory can underpin a philosophy of coaching'. *International Journal of Sport Psychology,* 40(4), pp. 580–602, p.301; Reproduced by permission of Human Kinetics, 'The Game Performance Assessment Instrument (GPAI): Development and Preliminary Validation', Oslin and Mitchell (1998), p.320–1; Used from Magill, R. A. (1993). Modeling and verbal feedback influences on skill learning. *International Journal of Sport Psychology, 24*(4), 358–369, p.304(1); Reproduced with permission, 'Decision-Making in Team Sports', by Richard Shuttleworth, p.304(1), p.304(2), p.305–6; Reproduced by permission of the International Fair Play Commitee, p.348, p.351.

Every effort has been made to trace and acknowledge copyright. The publisher apologises for any accidental infringement and welcomes information that would redress this situation.

ISBN 978-1-009-31125-0 Stewart et al.

CHAPTER 23

Evaluations, evidence and assessment support



What's ahead?

Chapter 23
Evaluations, evidence and assessment support

- **23.1** Assessment techniques – an overview
- **23.2** Data in assessment responses
- **23.3** Addressing the visual personal performance evidence
- **23.4** Experiential learning and the inquiry approach in Physical Education assessment
- **23.5** Multimodal – folio: a response strategy
- **23.6** Research report: a response strategy
- **23.7** Examination: a response strategy

ISBN 978-1-009-31125-0 Stewart et al.

23.1 Assessment techniques – an overview

The senior Physical Education syllabus prescribes three summative assessment techniques used during Units 3 and 4:

- project – folio
- investigation – report
- examination (external assessment).

It is expected that formative assessment used during Units 1 and 2 would replicate the summative assessment techniques above. Knowing how to address these techniques with appropriate generic structure, language and communication conventions is essential for assessment success.

Project – folio

The project – folio assessment technique is required for both summative internal assessment items 1 and 3, each worth 25 per cent of the overall result. Assessment for Units 1 and 2 should also require two project – folios. Overall, 50 per cent of a Physical Education result is based on the success within the project – folio technique.

This assessment technique includes two components:

- a multimodal
- visual personal performance evidence.

The multimodal component

Response requirements

Length: up to 11 minutes

Mode: multimodal

A multimodal uses a combination of at least two modes (e.g. spoken, written), delivered at the same time, to communicate ideas and information to a live or virtual audience, for a particular purpose; the selected modes are integrated so that each mode contributes significantly to the response.

Multimodal presentations may include a:

- pre-recorded presentation submitted electronically
- presentation conducted in front of an audience (class or teacher)
- digital portfolio of video, images and diagrams with annotations or commentary
- multimedia movie or slideshow that may combine images, video, sound, text and a narrative voice.

The specific multimodal presentation requirements for the folio will be outlined by the conditions set by each individual school in the assessment instrument.

In both internal assessment 1 (IA1) and internal assessment 3 (IA3), students will need to:

- **analyse** primary and secondary data about elements of personal performance
- **synthesise** primary and secondary data to devise a personal strategy to optimise performance based on the data (a constraints-led learning activity in IA1 or a training strategy in IA3)
- **justify** the development of the personal strategy
- implement the personal strategy and gather primary data
- **evaluate** the personal strategy by appraising the outcomes and limitations experienced
- **justify** modification and maintenance for the personal strategy for one movement strategy to optimise performance, using evidence from primary data and secondary data.

Multimodals used as assessment during Units 1 and 2 may also follow the same basic structure as that outlined above. However, the personal strategy being developed would be in relation to the subject matter being studied.

The visual evidence component

Visual personal performance evidence in the project – folio assessment technique is required for the allocation of physical performance marks in the **demonstrate** and **apply** criterion. The visual evidence must be completely separate from the multimodal component.

ISBN 978-1-009-31125-0 Stewart et al.

In both IA1 and IA3, the demonstrate and apply criterion, which is based on physical performance within the selected physical activity, is worth 6 per cent of the total 25 per cent available. Therefore, 12 per cent overall of the result in senior Physical Education is substantiated using this visual evidence. This may be replicated for multimodal folios when used for assessment in Units 1 and 2.

Response requirements

Length: up to three minutes

Mode: visual (recorded)

Context: authentic performance environments

Conditions: visual evidence must display the:

- demonstration of the specialised movement sequences of two movement strategies, from two different principles of play (when applicable)
- application of quality of movement and one other body and movement concept when demonstrating the specialised movement sequences of two movement strategies, from two different principles of play (when applicable).

Investigation – report

The investigation – report assessment technique is required for summative internal assessment item 2 (IA2), which is worth 25 per cent of the overall Physical Education result. The investigation – report will also be used for assessment during Units 1 and 2.

Assessment specifications – report

Length: up to 2000 words

Mode: written

Generic structure: report (headings for a common structure may include title page, table of contents, introduction, discussion, conclusion and reference list)

In IA2, students will need to:

- select an ethical dilemma in a class, school or community physical activity context *(specific context(s) will be defined by the specific school task)*
- identify the specific class, school or community to frame the investigation
- use the ethical decision-making framework to conduct a context analysis
- **define** and investigate an ethical dilemma from the context analysis by **analysing** and **synthesising** primary and secondary data concerning significant factors influencing the dilemma
- **analyse** and **synthesise** primary data and secondary data to devise and justify an ethics strategy that provides a course of action in response to the ethical dilemma
- **evaluate** the effectiveness of the ethics strategy to optimise integrity and positive engagement in the class, school or community physical activity context by appraising the potential outcome and limitations.

Examination – combination response

The examination assessment technique is used for the summative external assessment (EA) item. The EA is worth 25 per cent of the overall Physical Education result. Schools may also use an examination during Units 1 or 2.

Assessment specifications – examination

Length:

- two hours, plus five minutes perusal
- 800–1000 words in total, including:
  - short paragraph response items of 150–250 words per item
  - an extended response to stimulus of 400 words or more

Mode: written

Question types:

- multiple choice
- short responses (single words, sentences, paragraphs, images, labels or diagrams)
- extended responses.

Marks allocated for short-response and extended-response items will vary based on the number and complexity of the question(s). Mark allocation will be identified on the exam paper.

ISBN 978-1-009-31125-0 Stewart et al.

23.2 Data in assessment responses

The senior Physical Education syllabus identifies that students are to learn experientially through an inquiry process. This means students explore subject matter and are assessed through a process of research and investigation. As a result, all school-based internal assessment items (IA1, IA2 and IA3) involve gathering personalised **primary data** through physical activity; and analysing the information with reference to associated **secondary data** in order to devise, evaluate and justify a movement or engagement **strategy**.

As a result, both primary and secondary data play an essential role in effective assessment responses for all assessment techniques. The use of both data types is a characteristic of the highest performance-level descriptors in two criteria (**analyse** and **justify**) and therefore is required to receive the highest mark.

Using data – primary

Primary data is raw data that has never been manipulated. It may have been gathered through engagement, observation, interview, questionnaire or experiment. In Physical Education, assessment involves devising strategies in response to primary data gathered about self and/or others to enhance performance or engagement. Therefore, primary data forms the basis from which all assessment responses are constructed.

It is essential the primary data collected is credible and reliable if it is to be used convincingly in responses. The gathering of primary data through physical activity should employ the same methodical approach as a scientific experiment, and planning for effective primary data collection is essential.

Primary data is typically used for two purposes in Physical Education assessment and is collected at two junctures during the inquiry process when undertaking assessment.

1. Initial primary data is collected and analysed to ascertain current aspects of performance or engagement levels. This primary data analysis is then used to devise and justify a strategy that optimises the aspect that is the focus for the specific assessment task.
2. Primary data is then gathered to evaluate and justify the effectiveness of the devised strategy after a period of implementation (in IA1 and IA3 – folios) or to predict the effectiveness of the devised strategy (IA2 – report).

Understanding these purposes will assist in planning appropriate primary data collection methods in response to the assessment task.

Primary data collection methods

Points to consider in primary data collection are outlined in Table 23.1.

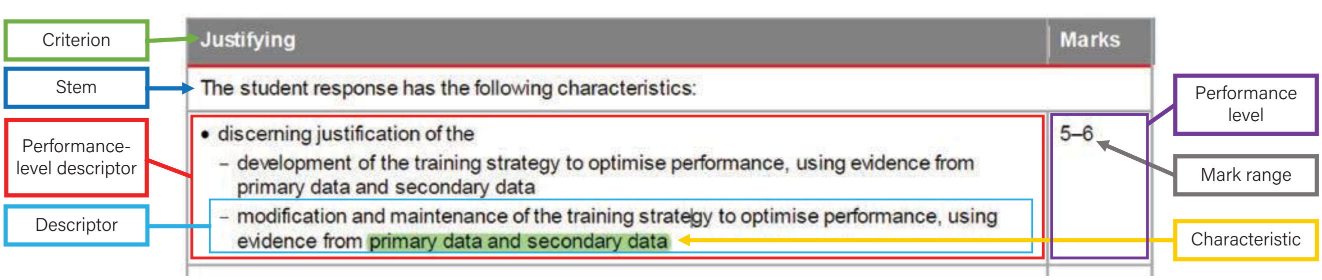


FIGURE 23.1 Justify criterion, syllabus p. 44

Source: Adapted from Physical Education 2025 v1.0 General Senior Syllabus © Queensland Curriculum & Assessment Authority

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 23.1 Primary data collection

	Purpose	Action and methods
Pre-strategy development		
Gather initial or 'control' data The gathering of data on performance or engagement pre-strategy development	Used to justify the **development** of your strategy	Relevant data collection method(s) will vary based on the task (select from Table 23.2).
During strategy implementation – during each session *Note: This section is not relevant to report for IA2, as the strategy developed is not implemented.*		
Account for variables What is happening on this specific day that may affect the data or results gathered?	Used to account for validity of data or data anomalies	This may require some relevant anecdotal notes at the start of the lesson.
Gather session control data If relevant to the task or strategy, first gather data without the use of the strategy to provide a 'baseline' for the lesson.	Used to assess outcomes, implications or limitations of the strategy – that is, how effective was the strategy based on where I started today's session	Relevant data collection method(s) will vary based on task (select from Table 23.2).
Gather data when your strategy is in use Gathering of data with the use of the strategy	Used to assess the outcomes, implications or limitations of the strategy Also note, **maintenance** and **modifications** of the strategy – that is, what is working? What about the strategy was adjusted, and why?	Data collection method/s will match that selected above for consistency of and reliability of data. Relevant anecdotal notes.
Post-strategy implementation	**Purpose**	**Action and methods**
Gather data at the end or after the trial period of your strategy After the strategy, what has changed about your performance?	Used to evaluate the effectiveness of the strategy – outcomes, implications or limitations – and then justify your evaluation in your response	Relevant data collection method(s) will vary based on task (select from Table 23.2).

TABLE 23.2 Data collection methods table

It is essential to use the right data collection method in order to gather information that will best assist you in formulating an effective response.
In Physical Education, the primary data collection methods to consider include: • video footage of performances • still shots of techniques or performances • acute physical responses during performance (e.g. heart rate or breathing rate data) • GPS tracking data (including distance, speed and/or elevation) • personal reflections or journaling of physical, mental or emotional state • GPAI data (such as court movement tracking, technique or strategy) uses tallies or error tallies. These can be simple tables created to record or tally any aspect of performance and can be populated with accuracy while reviewing video footage. • game analysis data (such as general intensities or durations experienced or technique/strategy counts) • results data (e.g. scores or win–loss count) • fitness testing data • surveys, questionnaires or interviews.

ISBN 978-1-009-31125-0 Stewart et al.

When constructing your assessment response – multimodal or report – it is important to consider how to visually represent your primary data. Will it be in the form of footage, stills, graphs, tables, pictograms or other ways that represent data visually? Not only does the way you represent data in your final response contribute to your communication mark, but it can also assist your justifications when data trends found during analysis are effectively represented visually.

Capturing quality video evidence as primary data

As two summative assessment tasks are multimodal folios and represent 50 per cent of an overall Physical Education result, gathering effective video evidence as primary data is essential.

In order to gather appropriate digital evidence, it is important to consider a range of factors that will not only benefit the final multimodal product, but will also allow effective analysis of your performance to occur.

First, ensure that the purpose for gathering footage is known. What should the footage show? The answer to this question will be in the task itself. For example, should the footage demonstrate the use of a tactical strategy, or should it show your ongoing movement around the field? Does the footage need to be constantly focused in a close-up of the individual, or should it be a wider shot of their interactions with teammates and opponents?

Once the purpose is established, the following tips will ensure that the footage gathered is effective for use in assessment response.

Film frequently – and from the beginning of the unit

The more footage taken, the more primary data has been collected. It is therefore more likely that the exact piece of footage required to justify a point or to showcase best performance is there to be used.

Ensure file compatibility and be familiar with your video-editing software

Check at the start of the unit that the device on which footage is being recorded allows for easy file download to computers and that these files are compatible with available editing software. Some recording devices (e.g. phone or tablets) can cause issues, which is very stressful if this is discovered only after weeks of gathering video evidence. Having to convert the file format of footage can be a long and confusing task before editing even begins.

Ensure picture quality

High-definition quality is essential. This allows for smooth zooming, cropping or stills to be generated if required in production to highlight that essential moment of play, especially if footage is captured from a distance. *Note: File sizes for high-definition video files may be large and in excess of the 500 MB limit for final submission. However, it is easier to compress the size of your final product, rather than compromise picture quality of your initial raw footage.*

Ensure that the captured footage is steady

The best way to do this is to always use a tripod. Holding the device by hand and following play from the sideline is not effective. Most tripods have fittings to cater for a wide variety of devices. If possible, organise a partner or class member to record.

Always record in landscape, not portrait

The audience will be viewing the multimodal on screens in landscape view; therefore, this profile should be matched when recording. A portrait view also cuts the width of shot and may not show essential action happening around the player that may be relevant to the performance and task.

ISBN 978-1-009-31125-0 Stewart et al.

Avoid filming into light

A bright background makes it difficult to identify characteristics in the performance of those performing in the foreground, as they appear 'in shadow'.

Avoid background disturbances

Angle the camera to avoid having sideline players or spectators in shot (or just ask them to move). They are a distraction to the performance, which should be the main focus of footage used in assessment.

Reduce background noise

Background chatter or wind provides a significant distraction when viewing performance, and in many cases, these issues can be muted in production. However, for some assessment, it may be helpful to use the sound from the footage collected. For example, the tactical talk in defence or attack may be useful, or talking through 'thinking' when engaging in performance activities. In these cases, reducing noise distractions and using an auxiliary microphone will enhance the quality and volume of captured audio.

Carefully consider the angle of the shots required

The correct angle can be one of the most important factors in producing the credible evidence required. For example, shooting side on and focusing on one end in a tennis match may be counter-productive, as it shows very little of the important aspects of the game. An 'over the shoulder' shot showing serves and game play from behind will not only demonstrate technique, but also the application of the skills, as the opponent's movement and outcome of the rally can be seen. Remember the purpose for your footage; is the camera angle showing all the required aspects of your performance?

Consider the height, depth and width of shots

Invasion and striking and fielding activities may require footage captured from behind the goals or scoreline to see the movements of all players on and off the ball when setting up attacking or defending strategies. Where a defence line is required, in activities such as touch football, then some side-on shots may also be helpful, with the camera panning and zooming as required. In activities played on a small court, such as badminton, volleyball or tennis, it may be advantageous to gain shots from an elevated position behind the court, rather than tracking the ball from end to end from the side of the court.

ISBN 978-1-009-31125-0

Long shots are fine to use when players can easily be identified.

Zooming can be used to highlight specific skills or tactics.

Zooming too close restricts what the footage can demonstrate.

Use the zoom function

When taking long shots of an entire game (e.g. from behind the line in a touch game), zoom should be used to gain a closer perspective, focusing on fewer players at some stages. However, do not zoom to a close shot of a single player, as this does not allow the interplay between players and opponents to be viewed. With these types of activities, this interplay (and the associated decision-making and skill modification) may be essential to the assessment task.

Tips for editing primary data footage

To make a multimodal project from raw footage typically requires elements such as trimming clips, voice-overs, titles, creating stills and the ability to draw diagrams and titles over footage to highlight features. At times, a completed multimodal project may require the use of three or four different programs in its construction, from video editing to Excel graphs or screen capturing, screenshots or PowerPoint. Knowing these programs is vital to maximising assessment results.

For the multimodal tasks, it is *highly* recommended that a *full* script be written *before* delving too deep into editing footage. Knowing what you will be saying will clearly be essential in knowing exactly what footage and other visual features are required to support statements. It will assist in finding the right shots, number of examples or length of clips required – particularly if the script is recorded to give an accurate indication of duration first.

When editing primary data footage, consider the following tips.

Only use quality footage that supports answering the assessment task

Trim footage to the essential section that needs to be shown for analysing or justifying, removing irrelevant footage. No matter the task, taking 15 seconds to set up an activity or retrieve a dropped ball only serves as a distraction in your response.

Use meaningful 'chunks' of footage

If your physical activity allows, use a number of different clips that are at least 15–20 seconds long, particularly when trying to highlight performance, as this demonstrates consistency. If analysing a specific movement sequence or strategy, clips may be shorter with just 1–3 relevant examples that are discussed in the voice-over. In this case, consider looping the footage to allow time to fully articulate the required points from the script.

ISBN 978-1-009-31125-0 Stewart et al.

Use slow motion for emphasis

It may be beneficial to slow down elements or even 'freeze' performances to showcase technical or tactical aspects and allow time for commentary to explain the evidence. The section slowed might then be replayed in real time to demonstrate performance.

Speed up footage to reduce time

Consider the relevance of the footage being displayed in relation to the task. When completing some activities, it may be vital to show the entire performance (such as a timed 800 m race) or to show successive performances (e.g. consecutive tennis points). However, it may be beneficial to speed up much of the performance so relevant aspects can be highlighted in more detail as they appear.

Use the sound of performance

The sounds of 'play' (calls and player communication) may be beneficial to the task and, if relevant, need to be amplified at some stages and then lowered during the voice-over. However, if the sound from the footage is simply distracting and irrelevant to the purpose, then muting it altogether may be entirely appropriate.

Use footage from different times if appropriate to the task

Placing moving footage of high-jump attempts – one from early in the unit and the other from later in the unit – may assist in highlighting performance gains over time. Side-by-side still shots of techniques can produce the same effect.

Clearly label and identify the footage through the use of titles

Appropriate titles may:

- include an initial title highlighting the purpose of the task
- include additional titles to introduce subsections if appropriate
- be overlaid on footage to highlight specific points for the audience
- pose inquiry questions that are answered through the pictures or voice-overs.

Combine various modes of delivery in footage to enhance the primary data

While this may not be required for the visual personal performance evidence, the information on screen that supports footage is very relevant in effective communication for the multimodal. As well as titles, using your editing software to add a variety of information helps the multimodal deliver essential points. A single shot may include:

- video footage
- a photo or screenshot
- a table, graph or diagram
- a GPAI
- relevant titles to label different elements.

If you are unable to do this with your editing software, then a program such as PowerPoint could be used. Each element on screen must work together to highlight the primary data and support the points in your script. However, *never* put parts of the script on screen; keep words on screen to a minimum.

ISBN 978-1-009-31125-0

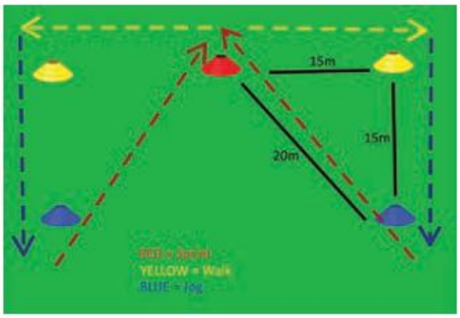
Training and Touch

Training Strategy: Bowtie Lactic Burn Run

Targeted Fitness Components: aerobic capacity and muscular endurance

Targeted Energy System: lactic energy system

Movement Strategy to Enhance: moving quickly in defence (higher intensity general field movement)



Bowtie Lactic Burn Run Set-up

Intensity: as per set-up diagram

Duration: 1 min 30s work – 30s activity recovery

Work:Rest Ratio: 3:1 **Sets:** 5 **Total Duration:** 10 min

FIGURE 23.2 An example of how a variety of information displayed on a PowerPoint slide or video frame can aid a response when evaluating a fitness strategy for touch

Tactical Awareness in Badminton

Movement Strategy:
Driving or smashing the shuttle into the opponent's open court to win a rally

Principle of Play:
Attacking opponent's court and scoring

Strategy Evaluation:
Somewhat effective to optimise performance

Principle of Play:	Attacking opponents court and scoring		Movement Strategy:	Driving or smashing the shuttle into the opponent's court to score and win a rally.	
Date:	14-11-19 (Game 1)	Opponent:	Georgia	Final Score: 8-11	Win / Loss
No. of shots per game	Successful	Unsuccessful	Total Attempts	% Success Rate	
30	5	6	11	45%	
Date:	14-11-19 (Game 2)	Opponent:	Georgia	Final Score: 6-11	Win / Loss
No. of shots per game	Successful	Unsuccessful	Total Attempts	% Success Rate	
24	1	5	6	16%	

FIGURE 23.3 An example of how a variety of information can aid a response when evaluating a tactical strategy in badminton

ISBN 978-1-009-31125-0 Stewart et al.

Using surveys to collect primary data

Another effective way to gather primary data is through the use of surveys, particularly when undertaking the report for IA2. When undertaking surveys, remember:

- **What is the purpose of the survey?** Are you finding opinions and feelings about a situation? Are you finding information about the real cause of a problem? Are you gauging the feelings towards a solution you have devised?
- **Give careful consideration to the questions asked.** What information do you really require for the task?
- **Include basic questions about who is answering the survey.** Surveys can remain anonymous, but including a variety of questions that establishes basic demographics, such as age, gender or sporting ability, may help to later identify trends in the data.
- **Who will be targeted in your survey and how will you target them?** Ensure that all relevant people or groups will have access to your survey. In IA2, this will mean surveying all the key stakeholders with reference to the issue or dilemma.
- **Consider your method of survey delivery.** How will the survey get to respondents and how will you collate answers? Will this be face-to-face, by paper or on a web-based platform?
- **Ensure that you maximise your survey size.** A key consideration when deciding on a method of delivery is to ensure that you get as many respondents as possible. This increases the validity of your data. However, outliers may skew the data if the survey respondents are not in the required demographic.
- **When will you need to collect data?** In Physical Education assessment, data may need to be collected twice – once early on to establish an issue and then again once a strategy has been devised. How will these surveys be different? What information is needed to compare pre- and post-strategy?
- **Consider the structure of questions.** Keep open questions to a minimum, as responses can be hard to analyse if the survey size is large. Closed questions with a variety of answer options can be easier to analyse.
- **Keep the survey as short as possible.** Ensure that you ask all the questions that are essential, but the longer a survey is, the more likely it is that respondents will not fully complete it.
- **Can your survey be useful to others?** While assessment tasks are individual, the data and data collection in many cases can be a group effort. By working with others to construct a survey, your questions may be better, and when it comes to distribution and result collation, there will be a larger data set.

Using data – secondary

Secondary data is any information gathered from other sources. Sources include published data (e.g. books, magazines, newspapers, journal articles, reports and periodicals), electronic and online data, and government records. This data will have already been analysed by another researcher with conclusions presented. In most cases, the data and conclusions presented will have been scrutinised for validity and reliability by others.

The importance of secondary sources for credible justifying

In Physical Education, assessment tasks are research-based and follow an inquiry process. In order to enhance the quality of your responses, it is essential to utilise secondary sources to research and devise strategies for assessment tasks, as well as to justify the evaluations made about the effectiveness of the strategies devised.

Making links between primary research and established thinking in the field is an important aspect of inquiry. The effective use of secondary data is required to reach the highest performance level in both the **analyse** and **justify** criteria of the instrument-specific marking guide (ISMG) for all three internal assessment items. Effective use of secondary data in Physical Education assessment could:

- justify the development of a strategy
- verify and support primary data
- justify inferences or conclusions drawn from primary data
- justify decision-making undertaken throughout the inquiry process
- justify recommendations made
- justify the evaluation of a strategy.

Look to use secondary data in assessment whenever undertaking one of the above in a response.

ISBN 978-1-009-31125-0 Stewart et al.

What are credible secondary sources?

A credible source is a person or an organisation that supplies information or data that can be trusted or believed. In Physical Education research tasks, using secondary data is essential to provide valid justification for the statements made in the response, particularly when analysing or evaluating primary data. Providing the source of this secondary data is essential, as referencing credible sources gives more authority and influence on statements.

Credible sources are more likely to provide credible data. Credible data occurs when there is a level of certitude that the information is real and has been obtained and scrutinised by proper research and acquisition methods – that it is accurate with no intention to misrepresent or mislead.

Using unreliable or unknown secondary sources will negatively affect your assessment response, as justification statements may be seen as unreliable, untrustworthy or based in opinion, not fact.

Five criteria (authority, currency, content, accuracy and bias) can be used to ascertain the credibility of any secondary source, explored in the following table.

Unreliable sources	Criteria	Credible sources
	Authority	
No or don't know	Who is the author? Are they an expert in the field and the topic?	Yes
No	Have they been cited by other authors?	Yes
No	Have they written other articles/ books in this field?	Yes
Self-published	Who is the publisher?	Well-known publisher
	Currency	
Outdated (or not aligned with historical period required)	Do you need current or historical information? How old is the information cited in the article?	Recent (or suitable age for historical information)
	Content	
No, or links to topic are tenuous	Is the information relevant to your topic?	Yes – the same or very similar topic
No	Is the target audience appropriate?	Yes
No	Is it written in academic or scholarly language?	Yes
No – not that influential on topic	How valuable is the information to your topic?	Yes – significant influence or relationship to topic
	Accuracy	
No	Does it adequately explain the research methodology?	Yes
No	Can you verify the accuracy in other sources?	Yes – multiple

ISBN 978-1-009-31125-0 Stewart et al.

Unreliable sources	Criteria	Credible sources
No	Do you recognise authors in the bibliography?	Yes
No	Is it peer-reviewed?	Yes
	Bias	
Yes	Is the research sponsored by an organisation?	No
Yes	Is the author trying to sell or push a product or service?	No
No or unknown	Do other authors agree with the author's point of view?	Yes

To use these criteria, ask the following questions when reviewing if a source is credible.

When evaluating **print** sources:	When evaluating **electronic** sources:
• Is the author reputable (e.g. university-based or a research institution)? • Does the reference list or bibliography appear comprehensive in its coverage? • Does the author present relevant background/context information? • Is the research methodology carefully presented to the reader? • Is the information presented still valid and applicable today?	• Does your teacher or lecturer recommend the site? • Who is responsible for the site? Is it associated with a respected organisation or institution? • Is the organisation responsible for the site clearly identified (e.g. with an official logo) and are contact details provided? • Is there obvious bias in the site? • Does the source use correct grammar and spelling? • Was the site recently updated?

Internet sources

As websites can be produced by any individual or organisation, it is especially important to consider the credibility of web-based sources before using them in academic assignments. In general, it is best not to trust information found on the internet until you can determine who wrote it. Sites or pages that lack key information, such as author's name, organisational information, referencing conventions or updated information, should be avoided.

Domain names can provide some insight into credibility:

Wikipedia (and other similar sites) has a wide range of information that can be useful to read when first trying to understand a topic. However, Wikipedia was designed to be a collaborative and constantly developing encyclopedia, where any person can create, edit or change content. As a result, information directly sourced from Wikipedia is generally not considered acceptable in academic assignments. Despite this, Wikipedia pages may sometimes list references and provide links to external sources, and these sites may be credible and can be cited and referenced directly.

.gov (government) .edu (education) .ac (academic)	.com (commercial) .org (organisation) .net (network)
The domains .gov, .edu and .ac can only be registered by government and educational institutions. For this reason, they reflect a higher order of authority and credibility than .com, .org or .net sites.	

ISBN 978-1-009-31125-0 Stewart et al.

Scholarly and non-scholarly sources

Scholarly sources	Non-scholarly sources
When academics write about their research and ideas for other academics to read	When somebody writes some interesting ideas about a topic for anybody who might be interested to read, and does not necessarily base those ideas on research
Ways to identify scholarly sources: • They are not usually published as often as daily or weekly magazines or popular sources. • They use discipline-specific rather than everyday language. • They do not usually include commercial advertisements or excessively flashy graphics. • They are written by people who are experts in their area(s). • They include specifically detailed information that is interesting to specialists in their area(s). • They acknowledge sources in sufficient detail for you to check the information or read more. • They use an academic style of referencing (e.g. a footnote, endnote or author–date style).	Ways to identify non-scholarly sources: • They are often not written by experts. • They are usually published weekly or monthly. • They usually give broader rather than more detailed information. • They are written in a language style that anybody could understand. • They look visually exciting with lots of colour and pictures. • They usually include advertisements. • They often do not include any references, or include only a few references in an informal style.

Source acknowledgement

Proper source acknowledgement is required to avoid issues of plagiarism, for the authentication of student work and to properly acknowledge the work of others. It also appropriately associates the secondary source to the statement or justification that the source is supporting. There are three components of source acknowledgement to consider:

- in-text citations
- a reference list
- a bibliography.

In-text citations

In-text citations acknowledge in the written passage where another person's idea, data or work is being used. Whether using a direct quote or paraphrasing, an in-text citation must be included. In the case of a multimodal, an in-text citation might be included as part of the script, onscreen or a combination of both.

How to include in-text citations in written reports

Please note that individual schools may have their own specific requirements for source acknowledgement, and that these requirements should be followed if they differ from the advice given in Table 23.3. While the following guidelines outline a recognised referencing process, different schools may adopt different referencing conventions; therefore, ensure that a response meets the requirements of your school. It is also an essential academic skill to learn how to cite and reference sources correctly. Automatically generated computerised referencing may not always be accurate, and may not meet the requirements or conventions as set by the school or university.

ISBN 978-1-009-31125-0 Stewart et al.

The following rules apply when writing **in-text citations** using APA style.

<table>
<tr><td colspan="2">When citing a direct quote, or paraphrasing a specific sentence or passage:</td></tr>
<tr><td>the author surname(s) in the order they appear on the publication
the year of publication
the page number (if available)
If there are two or more authors, the symbol ‘&’ can be used in the citation</td><td>For example:
(Patel, 2017, p. 45)
Or, for more than one author:
(Dartnell, Schilf & Lamper, 2009, p. 165)</td></tr>
<tr><td colspan="2">When paraphrasing (summarising a concept from a paragraph or text section):</td></tr>
<tr><td>the author surname(s) in the order they appear on the publication
the year of publication</td><td>For example:
(Brown, 2015)
Or, for more than one author:
(Dekens, Hester & Pearce, 2019)</td></tr>
<tr><td colspan="2">When citing work that is cited within another source:</td></tr>
<tr><td>you must cite the original source and the source where you found the information</td><td>For example:
(Kling, 2014, cited in Davis, 2018, p. 45)</td></tr>
</table>

Using ‘et al.’

<table>
<tr><td>only used if there are three or more authors
three to five authors must have full citation (all authors listed) the first time, then can use et al.
six or more authors can use et al. from the first time they are cited</td><td>For example:
(Kiss et al., 2021, p. 42)</td></tr>
</table>

Placement of in-text citations

<table>
<tr><td colspan="2">When quoting or paraphrasing a secondary data source, the placement of the citation depends on whether emphasis of the information or emphasis of the author is important.</td></tr>
<tr><td>To emphasise the information, use an information-prominent citation where the citation is placed at the end, allowing the information to be the only focus of the sentence.</td><td>To emphasise the author, use an author-prominent citation where the author(s) are part of the sentence’s structure. This can add credibility when the author is a recognised expert in the field.</td></tr>
<tr><td>For example:
… with data demonstrating a constraints-led approach has 28 per cent better transference of tactics from training into game play (Karlsson, 2018, p. 18).</td><td>For example:
Newell’s (2009, p. 8) research demonstrates a constraints-led approach has 28 per cent better transference of tactics from training into game play.</td></tr>
<tr><td></td><td>When more than one author forms part of the sentence, ‘and’ must be used; not ‘&’.
For example: ‘According to Newell and Clancy (2018), many people …’</td></tr>
</table>

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 23.3 Examples of various in-text citations

Condition	Citation example
One author	This trend has been identified in various studies (Fisher, 2013) OR Fisher (2013) identified … OR In 2013, Fisher identified …
Two authors	… (Petran & Ivanov, 2008) OR Petran and Ivanov (2008) conclude that …
Three to five authors	First time cited in the work: … (Alexiou, Fourie & Mahmoud, 1999) thereafter: … (Alexiou et al., 1999) OR As observed by Alexiou et al. (1999) …
Six or more authors	… (Brodie et al., 2010). OR Brodie et al. (2010) contend that …
Anonymous author	Only use an information-prominent citation: … (Anonymous, 2000).
Corporate author	First time cited in the work: … (Australian Sports Commission [ASC], 2012). Thereafter: … (ASC, 2012). OR if the abbreviation could be confused or is uncommon, give the full name every time. … (National Rowing League, 2003).
A number of authors who support the same idea	… (Nathan, 2001; Bianchi, 2005; Ricci, 2007).
Direct quotation	Bisset (2014, p. 213) claims that 'many Australians are now …' OR 'Many Australians are now …' (Bisset, 2014, p. 213).
Direct quotation from an electronic source without page numbers	If page numbers are not used, use paragraph number: 'Distributed practice tends to be more effective …' (Abumohor & Berkowitz, 2008, para. 2) OR Abumohor and Berkowitz (2008, para. 2) note that 'distributed practice tends to be more effective …'

ISBN 978-1-009-31125-0 Stewart et al.

How to include in-text citations in multimodals

A multimodal must still adequately acknowledge sources, and the same conventions must be applied. When citing, consider the interaction between the spoken and visual components of the multimodal, and if it is necessary to emphasise the author(s).

	Script	Visual
Emphasis on information	Addresses the information only. For example: 'Agility can be defined as a rapid whole-body movement with change in velocity or direction in response to a stimulus.'	Citation is presented as a title on screen either within a dot point or with associated data, quote, image or video. For example: **Agility in Netball**  **Agility** – 'a rapid whole body movement with change in velocity or direction in response to a stimulus' (Stewart, Clancy, Naughtin, & Southey, 2019, p. 398)
	The script could be refined by highlighting only information directly necessary to the task, while allowing visuals to add additional citations or details. For example: 'Agility has been identified as the most essential fitness component to train in order to be successful on court.'	**Agility in Netball**  **Agility** – 'a rapid whole body movement with change in velocity or direction in response to a stimulus' (Stewart, Clancy, Naughtin, & Southey, 2019, p. 398) **Ranked Netball Physical Capacities** 1 Agility 2 Reaction time 3 Speed 4 Balance and coordination 5 Aerobic endurance 6 Power (TopEndSports, 2018)
Emphasis on author(s)	Uses the author(s) names in the script. For example: 'Former Head Australian Netball coach, Lisa Alexander, sees agility as the most essential fitness component to train in order to be successful on court.'	Citation is presented as a title on screen either within a dot point or with the data, quote, image or video. For example: **Agility in Netball** This box might include class footage on a loop of players being agile during performance.  (Alexander, 2013) **Agility** – 'a rapid whole body movement with change in velocity or direction in response to a stimulus' (Stewart, Clancy, Naughtin, & Southey, 2019, p.398) **Ranked Netball Physical Capacities** 1 Agility 2 Reaction time 3 Speed 4 Balance and coordination 5 Aerobic endurance 6 Power (TopEndSports, 2018)

ISBN 978-1-009-31125-0

Reference lists

A reference list is found at the end of the response and is an ordered list of all sources that have been cited during the assessment response – that is, all in-text citations should have a corresponding entry in the reference list.

The in-text citation and the reference list work together to acknowledge the source. The in-text citation is provided during the work to identify the specific idea or data being incorporated and who is responsible for that work; the reference list provides all the details to trace the origin of that work. This allows a reader to scrutinise or investigate further if desired. The ability to acknowledge, review and scrutinise academic writing is an essential component of validating the claims made in the work.

Any information that is cited in the assessment response (written or multimodal) must be included in a reference list at the end of the work. Conversely, any sources included in a reference list must have a corresponding in-text citation.

A reference list is not included in the word count for senior Physical Education tasks.

Referencing sources correctly is also an essential academic skill to learn. Automatically generated computerised referencing may not always be accurate, and may not meet the requirements or conventions as set by the school or university.

Reference list entries include:

- author
- year of publication
- title of book, article or web page (in italics)
- publisher
- *web-based references may include a date viewed here*
- city/country of publication, or website address (URL) if web-based.

If any of this information is unavailable, then 'Unknown' should be written. However, if information is unknown, then thought should be given as to the credibility of your source.

Example reference list entries:

Book (single author)	Jewel, G, 2009, *Integrity in Sport,* Cambridge University Press, Melbourne, Victoria.
Book (two authors)	Jewel, G & Michaels, W, 2009, *Integrity in Sport,* Cambridge University Press, Melbourne, Victoria.
Book (three or more authors)	Jewel, G, Michaels, W, & York, K, 2009, *Integrity in Sport,* Cambridge University Press, Melbourne, Victoria.
Book (missing information)	Jewel, G Unknown, *Integrity in Sport,* Unknown, Victoria.
Website	Harrison, M & Garret, JG, 2011, *Exercise done right,* viewed 9/1/2022, <http://www.exercisedoneright.com.uk>.
Journal	Ferguson, G, Stepford, J, & Jones, B, 2013, 'Getting the best from your team in Australia', *Coaching Journal*, vol. 23, no. 4, pp. 21–34.
Magazine article	Rick, TC & Erlandson, JM, 2019, 'Working out', *Fitness Freaks*, 21 August, pp. 952–3.
Newspaper	Norris, T, (2021), 'Players unite to stamp out doping', *The Australian*, 23 February, p. 26.
Online magazine or newspaper	Kling, D, 2021, 'Inclusion in modern sport', *Sports Illustrated*, 30 March, viewed 29 April 2021, <http://www./illustrated/inclusion-in-modern-sport.com>.
Online audio casts or videos	Bragg, S, 2014, *Tactical Awareness in Football*, podcast, accessed 8 March 2015.

ISBN 978-1-009-31125-0 Stewart et al.

Reference list entries are organised alphabetically initially, then by year, if more than one source from the same author has been cited, then oldest first. A letter reference may be included if more than one source from the same year is cited from the same author – for example, ‘2020a’ and ‘2020b’. This letter reference must also be added to the in-text citation.

Helpful hint – referencing

When researching and collecting secondary data, create a reference table to collate the sources of information. This will save considerable time in creating the reference list, particularly if you are sourcing web-based research.

How to include reference lists in multimodals

A reference list must be supplied with your multimodal, and can be simply added at the end of your video.

- It can be added using titles in your editing software.
- It can be created in Word or PowerPoint, before taking a screenshot to add to your video.

The reference list may only appear for 3–5 seconds, as the viewer can pause the screen to review these if required; however, the on-screen time of the reference list is not included in the overall time for the response.

Bibliographies

A bibliography goes beyond a reference list to acknowledge all sources that may have been accessed or read during the construction of the work, even if they were not specifically cited during the work. This list is usually much broader than a reference list as many sources are typically accessed during research. Bibliographies are not required in senior Physical Education assessment.

Reference List

Jones, L, 2018, *Perception-Action Coupling – The Science Between What You See and What You Do*, viewed 27/11/2021, <https://goalkeepingcentral.wordpress.com/2018/03/30/perception-action-coupling-the-science-between-what-you-see-and-what-you-do/>

Mitchell, S, 1994, *Tactical Awareness as a Developmentally Appropriate Focus for the Teaching of Games in Elementary and Secondary Physical Education*, viewed 15/3/2021, <https://search.proquest.com/openview/c9a18304e2515a72f42931e25186306e/1?pqorigsite=gscholar&cbl=2030480>.

Morris, A 2019, *Developing confidence in sport - Believe Perform*, viewed 16/9/2022, <https://believeperform.com/developing-confidence-in sport/#:%7E:text=Everyone%20believed%20that%20self%20confidence,they%20can%20achieve%20their%20goals>

Queensland Curriculum & Assessment Authority, 2018, *Physical Education General Senior Syllabus 2019*, Queensland Curriculum & Assessment Authority, Brisbane, Queensland.

Renshaw, I, & Holder, D, 2010, *A Constraint-Led Approach to Coaching Cricket*, cited on TopEndSports 24/6/2022, <https://www.community.cricket.com.au/coach/acamembers/~/ media/7CCDFDD582FA4C0396AC20AB00810B8F.ashx>.

Stewart, R, Clancy, J, Naughtin, G, & Southey, A, 2018, *Senior Physical Education for Queensland*, Cambridge University Press, Melbourne, Victoria.

Takuya, S, 2018, ‘Relationship between agility and lower limb muscle strength, targeting university badminton players’, *Journal of Physical Therapy Science*, vol. 2, pp. 320–23.

Tee, D, 2016, *How to Play the Forehand Badminton Smash*, viewed 27/11/2021, <https://www.masterbadminton.com/badminton-smash.html>.

Unknown, 2017, ‘Make Them Change Direction’, *The Badminton Bible*, viewed 20 March 2021, <https://www.badmintonbible.com/tactics/singles/corners/direction-changes#:~:text=Moving%20your%20opponent%20along%20the,force%20him%20to%20change%20direction>.

FIGURE 23.4 An example of how a reference list may appear on screen at the end of a digital presentation for a multimodal

ISBN 978-1-009-31125-0

Information that does require source acknowledgement	Information that does not require source acknowledgement
• books • journal articles • newspapers and magazines • films, documentaries, TV shows • advertising in any media • online videos • websites and other electronic sources • emails, blogs, forums, discussions • personal interviews • any diagrams, graphs, pictures, drawings reprinted in your work	• personal observations or results from primary data collection • your personal experiences • your personal opinions, thoughts or conclusions • your analysis or evaluation of data • original plans, ideas or strategies • generally accepted facts in the field of study • facts that are considered to be 'common knowledge' and likely to be known by many people

Although bibliographies are not used in Physical Education assessment, it is worth noting that the referencing conventions for making an entry in a bibliography are the same as those listed above for creating a reference list. A bibliography simply lists all sources accessed and reviewed during your research process, rather than just those cited in the assessment response.

23.3 Addressing the visual personal performance evidence

Visual evidence of personal performance is required to confirm the school's judgements when awarding results for criterion 2 (demonstrate and apply) in the assessment folios for internal assessment 1 (tactical awareness) and internal assessment 3 (energy, fitness and training). It will also be required for assessment items in Units 1 and 2 as outlined by the school.

Criterion 2 relates to individual student **performance** in **authentic performance environments** in the physical activity of study. It assesses assessment objectives 2 (demonstrate) and 3 (apply):

- **demonstrate** specialised movement sequences and movement strategies for the selected physical activity in authentic performance environments
- **apply** concepts to specialised movement sequences and movement strategies for the selected physical activity in authentic performance environments.

Providing effective visual evidence to showcase performance within the physical activity studied is essential as it is worth six marks in IA1 and IA3 – 12 per cent of an overall result for Physical Education.

What to produce – what must evidence validate?

Visual evidence should showcase best performances across the duration of the unit. The requirements for visual evidence outline that a selection of up to three minutes of footage can be utilised to represent overall capability. It will not display all aspects of performance given the time limitations, but through targeting specific aspects of performance the footage provides a brief summary of the ability to demonstrate and apply.

In order to refine visual evidence, the syllabus requires up to three minutes of footage to display:

- **demonstration** of **specialised movement sequences** for the studied physical activity
- **demonstration** of two **movement strategies** for the studied physical activity (from two different **principles of play** if the activity is classified as net and court or an invasion game)*
- application of **quality of movement** and one other **body and movement concept** during the performance of **specialised movement sequences**.

*Note: Performance activities do not align movement strategies with the principles of play in the syllabus; therefore, any two movement strategies can be evident in the footage submitted.

ISBN 978-1-009-31125-0 Stewart et al.

An outline of the movement sequences, movement strategies and body and movement concepts required for each specific physical activity can be found as supporting material with the syllabus. These concepts are fully explained in Chapter 4 of this textbook.

What to produce – what must be included?

When compiling the visual evidence for personal performance, consider the relevant points from section 23.2 regarding capturing quality video evidence as primary data and tips for editing primary data footage. In addition, ensure that you include footage from authentic performance environments that showcases:

- two different movement strategies

  These strategies must be from two different **principles of play** if the physical activity being studied is classified as a net and court or an invasion game. If undertaking any other syllabus category of activity, any two movement strategies are appropriate. Example movement strategies can be identified from syllabus support materials supplied by the QCAA.

- the **specialised movement sequences** required to enact the movement strategies

  Enacting a specific movement strategy must incorporate one or more specialised movement sequences associated with the physical activity. Therefore, by showing a number of examples for each of the two movement strategies, the associated movement sequences will also be demonstrated within the footage. If the movement strategy can be performed using different movement sequences (that is, different movements and techniques), then it will be helpful to show a variety of these sequences, not simply repeating the same technique. For example, if one of the movement strategies for badminton is to force the opponent to the back court to set up attack, then this could be achieved by using the specialised movement sequences of a lift, an overhand clear or a long forehand serve. Showing different footage snippets where all of these movement sequences are demonstrated may be more beneficial than repetitive footage of a clear being used to enact the strategy. Example specialised movement sequences can be identified from syllabus support materials supplied by the QCAA.

- quality of movement and one other body and movement concept

  The effectiveness of these qualities will be evident to the audience when viewing the onscreen application of the specialised movement sequences and the movement strategies of the physical activity. For example, does the footage show an effective standard of accuracy, efficiency and flow (quality of movement) and interaction with the opponents (relationships)? Therefore, select footage to include where these qualities are being displayed – that is, where the footage clearly demonstrates qualities such as accuracy, efficiency or flow to the best of the performer's ability. Body and movement concepts are explained in Chapter 4 of this textbook.

Tips on producing visual evidence of personal performance

The video evidence gathered is a form of primary data, and as such there is additional advice on how to collect appropriate footage during class under the heading 'Capturing quality video evidence as primary data' in section 23.2.

Remember, footage gathered for **visual personal performance evidence** serves a different purpose to that gathered for the **multimodal** component of a folio. To justify a point during the multimodal, it might be very relevant to use footage from different stages of the unit where demonstrating best performance is not the purpose. However, footage used in visual personal performance evidence must always showcase best performance to maximise results. Planning for this part of the assessment response will ensure that the three-minute time limit is used effectively for greatest reward.

Planning and collating visual evidence

1. Select the two strategies that will be showcased

While it is easy to collect lots of footage, it can be difficult and time-consuming later in the unit to find the exact footage you wish to use. Too much time can be spent searching footage for exactly what you need, or deciding what you are trying to demonstrate.

ISBN 978-1-009-31125-0 Stewart et al.

Decide as early in the unit as possible on the two **movement strategies** that you wish to include in your supporting evidence. Remember, these strategies should:

- be ones where you perform at your best. So, it might take some lessons to work out what strategies you are using and which are most beneficial to your performance. You might have 3–4 strategies in mind early on, and then refine as the unit progresses.
- allow for a range of **specialised movement sequences** to be used when they are being demonstrated. Some physical activities have a wide range of specialised movement sequences associated with them, and therefore movement strategies that allow three or four of these to be shown may be better than selecting a strategy that only requires one or two. However, remember to showcase your strengths. It is not sensible to select a movement strategy that may require a technique that you are not able to perform well. Therefore, if possible, select two strategies that use a range of movement sequences you perform well, or strategies that are limited to your best techniques if you struggle to perform them all well. For example, using three hits to set up attack in volleyball may be a fine strategy, but it requires you to be at your best when digging, setting and spiking. However, directing the first touch to an allocated setter to set up attack might only require showcasing digging and setting ability, and being the setter in a setting system to set up attack may only require you to demonstrate your ability to set.

When deciding on movement strategies:

- research strategies that are provided as examples in the syllabus resource materials. Not only will this focus your footage collection, but it might also provide you with a better understanding of what to develop during your physical performance lessons.
- performance activities typically have fewer strategies with limited specialised movement sequences involved. Be aware of the strategies available, and ensure that these are being used during class. For example, developing a pacing strategy or attempting to negative split a 1500 m race might be the focus during specific lessons, rather than just running.
- in net and court or invasion activities, your two strategies must help to achieve two different principles of play. While these could be any of the four principles of play, it might be helpful to consider selecting an attacking principle and a defensive principle. This may allow for a wider variety of specialised movement sequences to be demonstrated, as in many of these activities the attacking and defending techniques are different. For example, in basketball dribbling is only used when in possession of the ball when attacking or creating space, while blocking shots is only used in defence. By considering strategies from attacking and defending principles, your footage can incorporate both these specialised movement sequences. Remember, however, that selecting an attacking and defensive strategy is not a requirement for visual evidence, so still select strategies and movement sequences that promote your best performance.
- remember that visual personal performance evidence is part of the project – folio assessment technique, which also requires a multimodal component up to 11 minutes long. Both of these elements require investigation and footage of movement strategies. While there is no requirement that the movement strategy in the multimodal matches those in the visual evidence, it would make sense for them to match where possible. This would mean when reviewing footage, look for examples of just two strategies in your game play and this may be easier to identify and less time-consuming. While the footage is used for different purposes in the visual evidence and the multimodal, and will be submitted as two different files, both can utilise the same footage if relevant.

2. Record at every opportunity

Take every opportunity during performance lessons to gather footage. While three minutes of footage gathered across the whole unit does not seem much, there is also huge potential to gather absolute greatest performances. Don't miss the best point you've ever played because your camera was not recording.

Consider a method of identification, such as a bib, sash or numbered shirt, and try to keep this consistent for the unit. For most physical activities, you will not be the

ISBN 978-1-009-31125-0 Stewart et al.

only person on screen when in authentic performance environments. Having an easy way to identify yourself for the audience is essential.

Ensure that footage is clear and suitable. Whether footage is gathered individually, in groups or by the teacher, ensure that you are getting the quality of footage required. Is the footage of appropriate clarity, from appropriate angles and of the best shot length to showcase your performance? More tips regarding these elements were outlined earlier in this chapter.

3. Organise and store your files

At the start of footage collection, ensure that you are able to access the footage being recorded. This might mean checking that you:

- can export from your own device easily and that files work in your editing software
- can get footage from others easily in an appropriate file format. Can you get footage from others who might be recording your performances through a online file sharing, AirDrop or USB? Ensure that this is an easy process and is done after every lesson where footage is taken.

Develop a file storage system to categorise footage so files are easy to save and locate when needed. You might create folders using the name of your strategies or the principles of play.

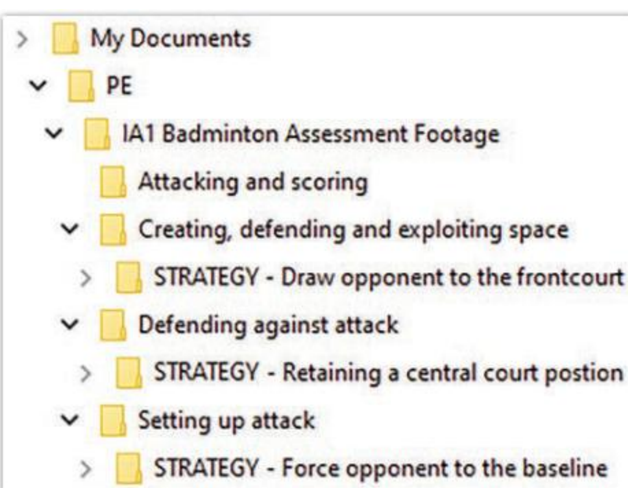


FIGURE 23.5 Using explanatory titles throughout video footage to clarify what is being shown

Develop a file naming system for raw and trimmed files:

- for footage of whole games or lessons, consider date – for example, Badminton 16-04-25a *(add a letter to the file name when more than one file exists for that date)*
- for trimmed footage of specific examples, consider the strategy and date – for example, Draw opponent to front court 16-4-25a.

Remove and review footage after each lesson. This will save having to do large-scale reviews of mass footage later in the unit when assessment deadlines place added pressure on time.

Ensure that you use a method of backing up footage and file snippets so you don't lose weeks of work. Do your files automatically sync to a cloud or OneDrive? If files are too large for an online backup option, save a copy after every session to a USB or an external hard drive.

4. Trim your files

After each performance lesson, review your footage, looking for examples of the strategies you have selected as your focus. When you find suitable examples, crop the footage and save it using the naming and storage system you have developed. For absolute best performance footage, you might find a way to save or rank these as they occur. Putting your visual evidence together then becomes an easy task of simply editing the best clips one after the other, which have already been trimmed and ranked as the unit progressed.

To assist in reviewing footage, it may be very helpful during class to make notes of when your performance is particularly good. Having a way to quickly note when you use your selected strategies with high success will make finding that particular piece of footage easier when reviewing that night. It might mean you can go straight to specific events rather than viewing the whole match, or if your performance produced nothing particularly noteworthy, then it might save you time as a review may not be needed. This might be as easy as creating a table to quickly make a note during class of the time, strategy used and outcome when something noteworthy happens in your performance.

ISBN 978-1-009-31125-0 Stewart et al.

5. Create a shot list – what evidence is important to still get?

Knowing the purpose of visual evidence will help you understand what footage to collect – it is basically, your best performances of two strategies using the associated specialised movement sequences effectively. However, as the assessment deadline approaches you might consider reviewing the evidence you have to determine if there are any gaps. For example, you might find that you only have 2–3 high-quality examples of one of your strategies and this may not be enough footage. Knowing this, you might focus on using that strategy specifically during subsequent performance lessons in order to get more footage and better examples of your level of performance.

Constructing supporting evidence

1. Footage selection

If you have followed all of the tips listed previously, then footage selection is easy and essentially already done. You should have two folders, one for each movement strategy, with trimmed videos of your best performances from the unit.

However, remember the requirements and purpose of visual personal performance evidence:

- two movement strategies must be seen (from two different principles of play for net and court or invasion activities)
- a range of specialised movement sequences are evident
- highlights your best performances (this will show your application of body and movement concepts at your highest standard).

Note: When selecting specific trimmed video files to include, you might also prioritise those that provide clear footage, where you are easily identifiable, and those of longer duration. Longer clips particularly are of benefit, as you might be demonstrating a greater range of movement sequences, across a number of strategies. Longer clips also demonstrate a more sustained high-level performance. A larger number of very short clips can be used if needed, but might give the impression of high-level editing skills rather than performance. Longer clips also mean less to include in order to meet time requirements, and therefore will reduce the time to produce.

2. Video construction

For visual evidence, there is actually very little to do other than collate your footage into a video file that does not exceed three minutes in total. There is no requirement for titles or commentary; a viewer is simply looking at your performances in relation to the demonstrate and apply criterion.

However, your visual evidence should maximise the purpose (showcase your best performance) and minimise distractions (footage when you are not at your best, poor-quality footage, additional irrelevant footage).

While not required, some simple elements that will assist in achieving the purpose of visual evidence might be:

- an introduction screen with your name and, if possible, method of identification for the viewer if this remains consistent throughout your clips. This could be achieved in a title and/or as a voice-over
- clearly breaking your evidence into two sections, one for each movement strategy. These do not need to be allocated the same amount of time, but both sections should make a meaningful contribution to the time. Again, do not exceed three minutes
- including a title screen to start each section that identifies the movement strategy demonstrated in the clips to follow, and the associated principle of play (if required)
- titles over individual clips that remind the viewer of the specific strategy being demonstrated, and also how to identify you if this changes throughout

FIGURE 23.6 Using explanatory titles throughout video footage to clarify what is being shown

ISBN 978-1-009-31125-0 Stewart et al.

- consider video sound; normal game-play sound is applicable and can be left in. However, poor sound, inappropriate background noise or the effect of wind will all serve as distractors and should be lowered or muted altogether on those specific clips.

There is no need to go beyond these simple additions to your visual evidence. Features such as slow motion, transitions or music only serve as distractors to the viewer, take additional time to produce and should not be used.

3. Final checks

Before submitting your visual personal performance evidence, undertake these final checks. Ensure that:

- your evidence plays exactly as you want an audience to see it. Remember, your teacher should see you at your best since this will be all they know about your ability to perform. Take the time to remove glitches, trim clips to the right spots and have the footage play smoothly
- you have exported it from your editing software so that it is a stand-alone file that will play on any device. Your school may require a specific file format on their assessment instrument. Check your task sheet to ensure that you are meeting this condition if set
- video files do not exceed 500 MB.

23.4 Experiential learning and the inquiry approach

What is the inquiry approach?

The senior Physical Education syllabus requires that 'students learn experientially through three stages of an inquiry approach to ascertain relationships between the scientific bases and the physical activity contexts … Through their purposeful and authentic experiences in physical activities, students gather, analyse and synthesise data to devise strategies to optimise engagement and performance. They evaluate and justify strategies about and in movement by drawing on informed, reflective decision-making.'

Physical Education 2025 v1.1 General Senior Syllabus Queensland (c) Curriculum & Assessment Authority, p.1.

Engage and understand

Retrieval and comprehension	Collect primary and secondary data in order to recognise and explain concepts and principles relevant to engagement and/or performance in physical activity contexts

↓

Apply and analyse

Analytical processes	Examine primary and secondary data to determine key relationships influencing engagement and/or performance Develop strategies to optimise engagement and/or performance

↓

Evaluate and justify

Knowledge utilisation	Use primary and secondary data to justify the strategies developed Evaluate the effectiveness of strategies used for optimising engagement and/or performance Use primary and secondary data to justify decisions to maintain and modify strategies

FIGURE 23.7 The three-stage inquiry approach in Physical Education assessment

ISBN 978-1-009-31125-0

The three stages of the inquiry process underpin learning in senior Physical Education, and this process provides a framework for all assessment instruments. To effectively respond to each assessment task, students must progress through each stage of the inquiry process. While the inquiry process remains the same across all Physical Education units, the specific purpose and focus of inquiry changes with each unit and associated physical activity context.

TABLE 23.4 The inquiry stages embedded in summative internal assessments. The same inquiry process will also be incorporated into assessment tasks in Units 1 and 2.

Stage of inquiry	Internal assessment 1	Internal assessment 2	Internal assessment 3
Stage 1: Engage and understand Criterion assessed: Explaining	**Task requirement:** *Recognise* and *explain* constraints, principles of decision-making and body and movement concepts about one specialised movement strategy and associated movement sequencies	**Task requirement:** *Recognise* and *explain* concepts and principles about ethics and integrity relevant to a class, school or community physical activity context	**Task requirement:** *Recognise* and *explain* energy, fitness and training concepts and principles about specialised movement sequences and movement strategies
	Purpose of cognitive process: to accurately: • explain task, learner and environmental constraints and principles of decision-making about one movement strategy • identify personal opportunities for action in relation to the movement strategy • identify personal performance level of one movement strategy and associated movement sequences	**Purpose of cognitive process:** to accurately explain: • the ethical dilemma identified • concepts and principles related to: • ethics and values – integrity and fair play – which are influencing integrity and positive engagement	**Purpose of cognitive process:** to accurately: • explain energy systems, fitness components, training principles, training methods and the phase of training relevant to specialised movement sequences for one movement strategy • identify the energy systems and fitness components necessary for performance of the movement strategy • identify current personal fitness requirements for performance of the movement strategy

ISBN 978-1-009-31125-0 Stewart et al.

<table>
<tr><th>Stage of inquiry</th><th>Internal assessment 1</th><th>Internal assessment 2</th><th>Internal assessment 3</th></tr>
<tr><td rowspan="2">Stage 2: Apply and analyse
Criterion assessed: Analysing</td><td>Task requirement:
Analyse and synthesise data to devise a personal tactical strategy for optimising performance of one movement strategy</td><td>Task requirement:
Analyse and synthesise data to devise an ethics strategy about an ethical dilemma relevant to a class, school or community physical activity context</td><td>Task requirement:
Analyse and synthesise data to devise a personal training strategy for optimising performance of the specialised movement sequences for the selected movement strategy</td></tr>
<tr><td>Purpose of cognitive process:
to ascertain the most significant relationships between the:
• effectiveness of constraints-led learning
• task, learner and environmental constraints that limit or enable personal or team performance
• application of the principles of decision-making based on the presented opportunities for action
to synthesise the most significant relationships to:
• devise a constraints-led learning activity to optimise performance of one tactical strategy</td><td>Purpose of cognitive process:
to ascertain the most significant relationships between:
• the ethical dilemma
• the influence of local and national stakeholders on the ethics and values demonstrated in the class, school or community physical activity context
• the tensions that exist in relation to integrity and fair play
• strategies that have been used in response to similar ethical dilemmas
to synthesise the most significant relationships to:
• devise an ethics strategy that provides a course of action in response to the ethical dilemma</td><td>Purpose of cognitive process:
to ascertain the most significant relationships between the:
• demands of the specialised movement sequences and one movement strategy
• relevant energy systems and fitness components
• personal performance of the specialised movement sequences and one movement strategy
to synthesise the most significant relationships to:
• devise a personal training strategy to optimise performance of the specialised movement sequences for the selected movement strategy</td></tr>
</table>

(continued)

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 23.4 *(continued)*

Stage of inquiry	Internal assessment 1	Internal assessment 2	Internal assessment 3
Stage 3: Evaluate and justify Criterion assessed: Evaluating and justifying	**Task requirement:** *Justify* the development of a constraints-led learning activity to optimise performance of one movement strategy	**Task requirement:** *Justify* an ethics strategy devised for a class, school or community physical activity context	**Task requirement:** *Justify* the development of a training strategy relevant to the selected physical activity
	Purpose of cognitive process: to justify: • how the constraints-led learning activity would help to optimise the use of the movement strategy	**Purpose of cognitive process:** to justify: • how a course of action will optimise ethics and positive engagement for an identified ethical dilemma	**Purpose of cognitive process:** to justify: • how the training strategy would help to optimise performance
	Task requirement: *Evaluate* the effectiveness of the constraints-led learning activity for providing opportunity for the emergence of the selected personal movement strategy	**Task requirement:** *Evaluate* the potential effectiveness of an ethics strategy devised for a class, school or community physical activity context	**Task requirement:** *Evaluate* the effectiveness of the training strategy on performance of specialised movement sequences for the movement strategy
	Purpose of cognitive process: to appraise: • the outcomes, and limitations of performance Criteria for evaluation: • opportunity for the emergence of the personal tactical strategy • the applied principles of decision-making	**Purpose of cognitive process:** to appraise the potential: • outcomes, and limitations of the course of action Criteria for evaluation: • optimise integrity • positive engagement	**Purpose of cognitive process:** to appraise: • the outcomes, and limitations of performance Criteria for evaluation: • principles of training • training methods • energy systems • fitness components

ISBN 978-1-009-31125-0 Stewart et al.

Stage of inquiry	Internal assessment 1	Internal assessment 2	Internal assessment 3
	Task requirement: *Justify* the modification and maintenance of the tactical strategy for the selected movement strategy		**Task requirement:** *Justify* the modification and maintenance of the training strategy to optimise performance of the selected movement strategy
	Purpose of cognitive process: to justify: • what aspects of the tactical strategy have been beneficial to performance and should be maintained • what aspects of the tactical strategy should be modified to further improve performance		**Purpose of cognitive process:** to justify: • what aspects of the training strategy have been beneficial to performance and should be maintained • what aspects of the training strategy should be modified to further improve performance

The inquiry process for assessment success

Assessment instruments administered by your school may include a 'To complete this task you must' section or something similar. QCAA-approved tasks will ensure that this section guides students appropriately through the inquiry process as they formulate a response to the specific task statement. This process should also be scaffolded on assessment tasks in Units 1 and 2.

The following advice on the inquiry process should be used in conjunction with your school's assessment instrument to assist in formulating a successful response in any internal assessment instrument.

Engaging and understanding – Inquiry process: Stage 1

When starting an assessment task, review and refine knowledge of subject matter from the unit and the physical learning experiences to:

- be discerning and educated about the specific subject matter required to respond to the task
- gather a range of **secondary data** to build understanding of the relevant concepts and principles associated with the task and performance in your physical activity context. This would include credible and recent research that:
  - provides definitions of key subject matter
  - explains specific concepts and principles
  - applies concepts and principles in relation to physical activity context
  - indicates optimal performance or engagement as required by the task *(this secondary data can then be weighed against similar primary data for analysis – see Table 23.5)*
- gather **primary data** through authentic learning experiences that explores the concepts further and provides control data or a reference point from which a strategy can be devised, evaluated and modified (the type of strategy will be dictated by the specific task).

The collection of this data allows the identification and explanation of the influential concepts and principles relevant to the physical activity context. Organising this data well will also help when analysing, synthesising, evaluating and justifying.

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 23.5 Data collection table for performance analysis – what to look for

	Notes, details or images	
	My performance (primary data)	**Optimal performance (secondary data)**
Footage: • implementation of specialised movement sequences • implementation of movement strategies		
Movement/physiological data: • movement analysis (distance, speed, acceleration, range, trajectory) • physiological data		
GPAI data: • win/loss records • for and against records • error analysis (forced and unforced) • use of movement sequences and movement strategies • success of movement sequences and movement strategies		

TABLE 23.6 Data collection table for engagement analysis – what to look for

	Notes	
	My physical activity context (primary data)	**Comparable physical activity contexts (secondary data)**
Survey data displaying: • participation rates • enjoyment levels • understanding of rules, policies, and procedures by stakeholders • opinions of rules, policies, and procedures • barriers to engagement • enablers for engagement		

The gathering of initial primary and secondary data as well as the refining of knowledge as required by the task is the first step – engaging and understanding – with the assessment task. More detailed information on gathering and using primary and secondary data effectively is outlined earlier in this chapter. During this stage of inquiry, there is no construction of the multimodal or report. Time is spent to effectively start gathering the required information before responding to the task.

ISBN 978-1-009-31125-0 Stewart et al.

Applying and analysing – Inquiry process: Stage 2

The next phase of the inquiry process requires the analysis and synthesis of the collected data to devise strategies for improved outcomes.

Applying and analysing requires examining the primary and secondary data to identify the most important relationships, patterns, similarities and differences between your level of engagement or performance and that which is identified as optimal. Synthesising this data in a meaningful way is essential for developing justifiable strategies for improvement in the physical activity context.

Effective analysing in Physical Education involves:

- making **comparisons**
  - identifying similarities and differences between primary data results from comparable data sets. This could include:
    - results from different days
    - survey responses from different age groups
  - identifying similarities and differences between the authentic primary data you have collected, and the recommended or optimal data established through secondary research. This could include:
    - comparison of footage
    - comparison of statistical, GPAI or performance data
    - opinions of local and national stakeholders
- identifying **correlations** (relationships between data)
  - applying causal links between primary data sets. This could include:
    - how the number of attempts to apply a certain movement strategy relates to the level of success experienced with that strategy
    - how the fitness level data for a particular component of fitness relates to the number of times a specific movement sequence requiring that fitness component is used during a game
    - how gender and physiological norms are related to geographic location and values in relation to certain physical activities
  - applying accepted concepts and principles from the secondary data to show the influence on primary data. This could include:
    - how the presence of specific constraints has caused errors in performance
    - how mega-trends in physical activity have affected participation for local students
    - how aerobic capacity research data from an elite level also accounts for personal or class-based data recorded from the current physical activity.

Effective representation of data in assessment responses

While analysing and synthesising data to devise a strategy as part of the inquiry process, it is also important to consider how this will be displayed in the final response – the multimodal or written report.

While at this stage of the inquiry process, you have not yet started constructing a response, the analysing and synthesising process will need to be included in your final response to justify the development of the strategy (and to justify the effectiveness of your strategy when you get to the evaluation stage). Constructing appropriate graphs, tables or footage snippets at this point will help to analyse, synthesise and find applicable relationships, trends and patterns in your data. Constructing these elements now using the most appropriate visual representation will also save time later when constructing your final response.

As an example, imagine you have been tasked with analysing your shooting performance in basketball and you have collected the GPAI data, as reported in the table at the top of the next page.

ISBN 978-1-009-31125-0 Stewart et al.

Radial distance from goal	Successful shots	Unsuccessful shots	Total
Less than 2.25 m	10	15	25
Between 2.25 m and 4.50 m	3	7	10
Between 4.51 m and 6.75 m	4	12	16
More than 6.75 m (three-point shot)	2	10	12
Total	19	44	63

The table above is not a good representation of data as it is too hard for a reader to quickly draw conclusions. An easy way to make this data more accessible for a reader and functional for scripting a justification, would be to calculate percentages or fractions from the information. For example, instead of explaining to the reader you were 10 from 25 close range shots (less than 2.25 m), you could instead say that you had a success rate of 40 per cent from under 2.25 metres; or that only two in five shots were successful from within 2.25 metres.

Subsequently, these manipulations would make it easier to make comparisons between data sets when analysing, both when comparing different sets of your own primary data, or when comparing primary data to selected secondary data.

The table below demonstrates a more effective way to represent data visually in your final multimodal or report than the table above. Constructing such tables during this phase of the inquiry process will also greatly assist undertaking effective analysis. The table below makes it easy to see where you have taken the most shots and the range that was most successful.

In this example, it easier to see the volume and effectiveness of your shooting from different distances from the hoop. You can also now compare this to optimal performance using secondary data. For example:

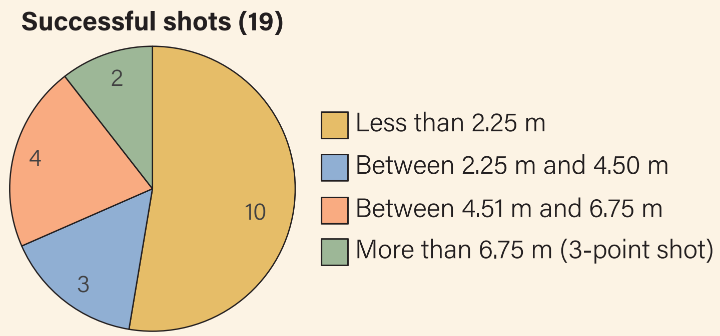
> *My overall shooting success (30%) and my three-point shooting success (20%) are both far below the accuracy of elite basketballers who shoot with success rates of 50% and 40% respectively.*
>
> *– Matange, 2021*

Appropriate graphical representations of data serve to enhance the impact of the data on the audience. On the next page are further examples of how to show relationships between data sets influencing performance. Each of these examples can be effectively used in both the multimodal and the report genres. How you represent your analysed data, or data used when justifying during your response, is very important.

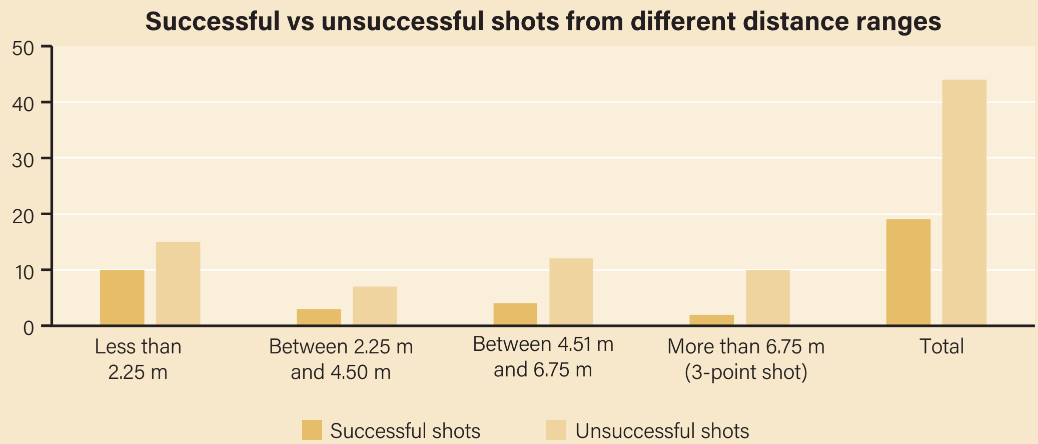
Radial distance from goal	Total shots	Shooting success (%)
Less than 2.25 m	25	40
Between 2.25 m and 4.50 m	10	30
Between 4.51 m and 6.75 m	16	25
More than 6.75 m (three-point shot)	12	20
Total	63	30

ISBN 978-1-009-31125-0 Stewart et al.

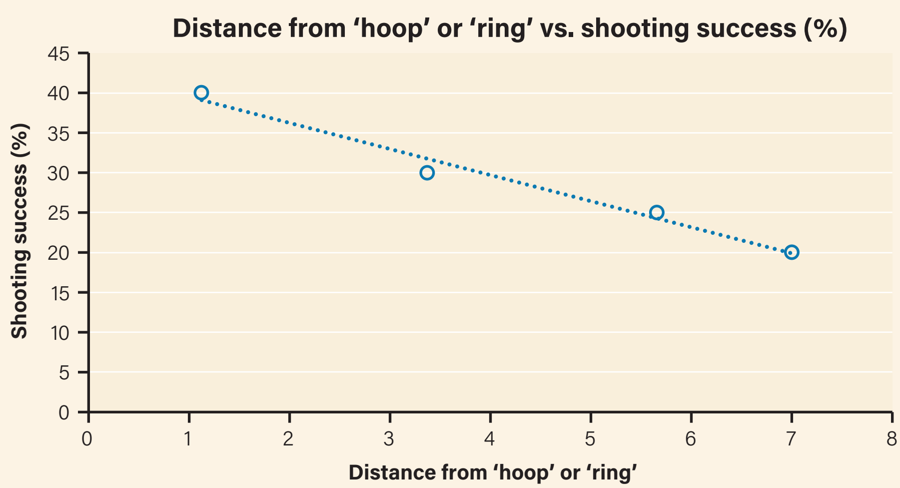
Example 1: Pie charts can be used to compare how many shots were successful from each range as a portion of the total shots made.



Example 2: Column graphs can show the outcomes of comparable data sets. In this case, you can easily see the differences between the amount of successful and unsuccessful shots for each data range.



Example 3: Scatterplots are most useful in demonstrating relationships between data. In this case, you can clearly see that there is a negative correlation between distance away from the hoop and the successful shots – that is, as the distance increases, the shooting success decreases.



ISBN 978-1-009-31125-0 Stewart et al.

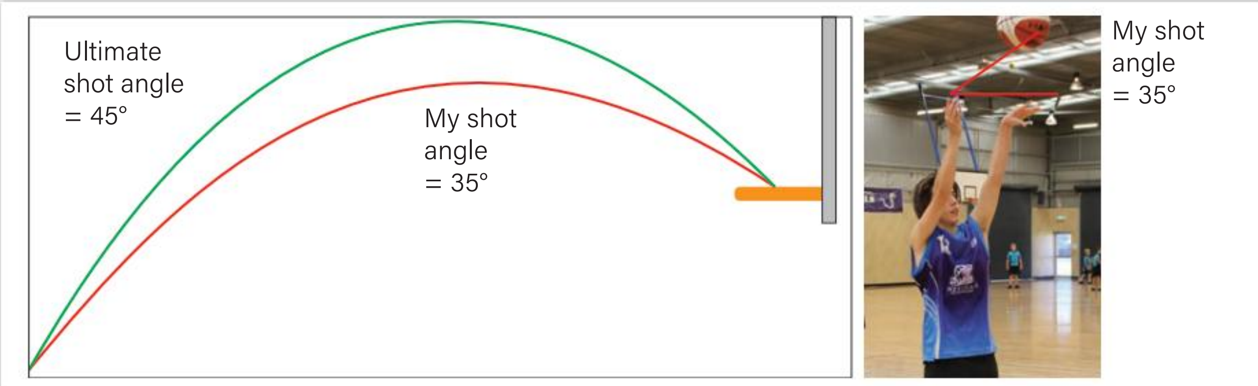


FIGURE 23.8 Combining primary and secondary data linking the research to what is being shown in the footage

Further relationships between data can be represented graphically by combining primary and secondary data. This will assist in clearly showing the key concepts and principles impacting performance.

For example:

> *The image above shows that my shot angle is approximately 35° and research from Austin (2022) suggests that I could be 12% more efficient if I increased this to the optimal angle of 45°.*

Evaluating and justifying – Inquiry process: Stage 3

Evaluation and justification are both considered knowledge utilisation processes. They are used to communicate overarching ideas generated through the initial two stages of the inquiry process.

Evaluation

The process of evaluation requires you to reflect on the primary and secondary data to make judgements or appraisals based on selected criteria. In Physical Education, you are required to appraise outcomes and limitations of your devised strategies for optimising engagement or performance.

Writing an **evaluative statement** requires you to appraise the merit or value of something based on specific criteria. In Physical Education, this appraisal should combine an adverb (value) and an adjective (description) about the level of effectiveness or impact something has had on engagement or performance in the physical activity context.

An example of an evaluative statement regarding personal performance in badminton could be:

> *I am only partially effective at using the movement strategy of pushing my opponent to the back of the court to defend against attack as my ability to use the required specialised movement sequences is limited by the lack of force and accuracy generated by my technique.*

An example of an evaluation statement for the implementation of a strategy to optimise integrity could be:

> *The 'trials event' ethics strategy course of action will be quite effective in optimising integrity and increasing positive engagement for the key stakeholders.*

Justification

Justification involves the effective use of primary and or secondary data to support a claim or an assertion in your response. In Physical Education, the claim or assertion to support within assessment will be either:

- why a strategy was developed in a particular way, or
- the evaluation statement made about the effectiveness of that strategy.

Specifically, it requires the use of data to justify the development of your strategies as well as recommendations for maintenance and modifications.

TABLE 23.7 Common adverbs and adjectives for evaluative statements

Useful adverbs	extremely, very, substantially, especially, quite, partially, fairly, somewhat
Useful adjectives	effective, suitable, relevant, desirable, important, insignificant

ISBN 978-1-009-31125-0 Stewart et al.

Constructing a response to an internal assessment task

After progressing through the inquiry process, the research gathered is used to formulate a well-constructed response to the task. Initially, a thesis that will form the basis of the multimodal or report will need to be developed. The thesis will be an overarching evaluative statement that directly responds to the task statement and addresses the effectiveness of the personal strategy that has been devised for the task. The findings gathered through the inquiry process are then used to support the thesis throughout the response.

As the overarching evaluative statement is written in response to the assessment task, it is essential that this statement be constructed once the inquiry process is complete (all relevant data has been gathered and all relevant research has been conducted), yet before beginning construction of the written or multimodal response. This statement should be presented early in the introduction, and it then provides the backbone of the body. All evidence presented through the response should link back to this statement.

Writing a thesis that responds to a task statement

Your overarching evaluative statement is the thesis. It is what your response is trying to prove in relation to the task that has been set in the assessment instrument.

An effective thesis statement will 'respond to the task', rather than repeat it, and this will also help set the tone for the introduction. In both the thesis statement and the introduction, avoid simply restating the task; good academic writing moves beyond this.

TABLE 23.8 Thesis statements to frame the assessment response

For example:	
Example IA1 task statement: Justify the development of a constraints-led learning activity to provide opportunity for the emergence of a personal tactical strategy, to optimise performance for one movement strategy in water polo. Evaluate the effectiveness of the constraints-led activity in achieving its purpose and justify the maintenance and modifications of the tactical strategy to optimise performance. Example IA1 thesis statement: The 'continuous 6 on 5' constraints-led learning activity is **somewhat effective** for *allowing the emergence of anticipating ball movement to sprint early and intercept the ball* when defending against attack as a centre back in water polo.	Example thesis statement features: • States the constraints-led activity and tactical strategy developed • **States the level of effectiveness** (that's the overall evaluation – the hypothesis that the response will set about justifying) • *States the purpose of the strategy, as defined by the task* • Provides additional details as to the specific context in which this strategy was developed and implemented for evaluation
Example IA2 task statement: Devise an ethics strategy to provide a course of action in response to one identified ethical dilemma present in our school's Sport Excellence Program. Evaluate the effectiveness of the devised ethics strategy to optimise integrity and positive engagement for our students in school sport. Example IA2 thesis statement: The implementation of a minimum grade point average (GPA) for acceptance into our school's Sport Excellence Program would be a **very effective** strategy to *optimise integrity and positive engagement for our athletes.*	Example thesis statement features: • States the ethics strategy devised • **States the level of effectiveness** (that's the overall evaluation – the hypothesis that the response will set about justifying) • *States the purpose of the strategy, as defined by the task*

(continued)

ISBN 978-1-009-31125-0 Stewart et al.

TABLE 23.8 *(continued)*

Example IA3 task statement:	Example thesis statement features:
Devise one personal competition-phase training strategy for a three-session microcycle. The training strategy should optimise personal performance of one movement strategy utilised in a specific basketball position. Evaluate the effectiveness of the devised training strategy in the selected basketball position.	• States the training strategy developed • **States the level of effectiveness** (that's the overall evaluation – the hypothesis that the response will set about justifying) • *States the purpose of the training strategy, as defined by the task* • Provides additional parameters as required in this task – that is, the movement strategy to be optimised and position in which it is used
Example IA3 thesis statement:	
The HIIT interval training strategy, mega mayhem agility runs, is **partially effective** during the competition phase for *optimising my performance* in basketball when implementing a full court press to set up attack as a guard.	

It is essential that evaluative statements are written using appropriate adverbs and adjectives that can be supported throughout the response by the primary and secondary evidence that has been gathered during the inquiry process. For example, if the evaluative statement suggests that the strategy was 'very effective', the majority of the response should show the positive impacts of its implementation and exclude evidence that could be construed as negative. Alternatively, if analysis of the data gathered demonstrates both positive and negative outcomes of the strategy, then making an evaluation using an adverb such as 'fairly' or 'somewhat' would be better to describe its effectiveness, and this evaluation can then be accurately supported by the data collected.

Note: Using effective and concise evaluative statements, such as the examples provided, as your hypothesis that is stated early in the introduction, negates the need for casual language that just restates the task. An effective hypothesis means you do not need to use phrases like 'This report will …', 'The multimodal outlines …', 'Throughout this folio it will be shown …' or 'This task required a strategy be designed …'. There is no need to state the task in your introduction; simply state the well-constructed hypothesis and set about in the introduction previewing the structure and research that will be presented to justify that evaluative statement in the response.

Supporting the thesis throughout the response

Following the development of the thesis, develop a logical structure for the response, ensuring adherence to the genre conventions of the task. Each new section of the task should clearly support the thesis statement from the introduction and commence with its own evaluative statement.

Well-structured writing/scripting allows effective communication of the conclusions, evaluations and recommendations essential for a high-level response.

The PEEL structure is one method used to construct clear and cohesive communication when presenting academic information. PEEL is equally useful when constructing written paragraphs for an essay or a report, or when constructing a script to be used to voice a multimodal folio or oral presentation. The PEEL structure provides an effective way to present and support points as the overall response develops in a logical sequence.

- **P: Point** – make your main point in the first sentence of the paragraph. This is more than just a topic sentence, and in Physical Education, should be written as its own **evaluative statement**. This makes it clear to the audience the purpose for this section of the task.
- **E: Evidence** – support your point with facts, evidence and examples. This evidence may be primary and/or secondary data. You will always be expected to support your point with research from experts in the field of study. Ensure that you have acknowledged the authors of secondary research presented with in-text citations and a corresponding entry in the reference list. When using multiple sources of evidence to support your evaluation, always present the evidence that is most justifiable first.

ISBN 978-1-009-31125-0 Stewart et al.

- **E: Explanation** – your justification of how the evidence supports your point. It is through explaining coherently the links between your evidence and your point that you demonstrate your understanding of the underpinning concepts that form the subject matter of a Physical Education course. Therefore, ensure that your explanation draws on and refers to relevant concepts in relation to the task, and that these are articulated clearly and applied correctly.

  At a senior school level, more comprehensive justifications are required to support evaluations – that is, more evidence and explanation are required to be convincing. This provides great opportunity to link subject matter or research, making paragraphs longer and more comprehensive. This can be achieved with the use of multiple evidence sets to support each point.

  It is recommended at senior level that the combination of Evidence and Explanation is repeated with additional evidence sets that support your evaluation statement. This would form an extended PEEL (or PEEEEEEL) structure.

- **L: Link** – link your point back to your central argument, hypothesis or thesis presented in the introduction – that is, how did the information in this paragraph specifically support the overall contention for your writing? If possible, also provide a logical link to the next paragraph.

The graphic organiser in Figure 23.9 is an effective tool to help structure your response. It assists in going from the data, analysis, evaluation and justification notes you have been collating so far, into a detailed and ordered response structure.

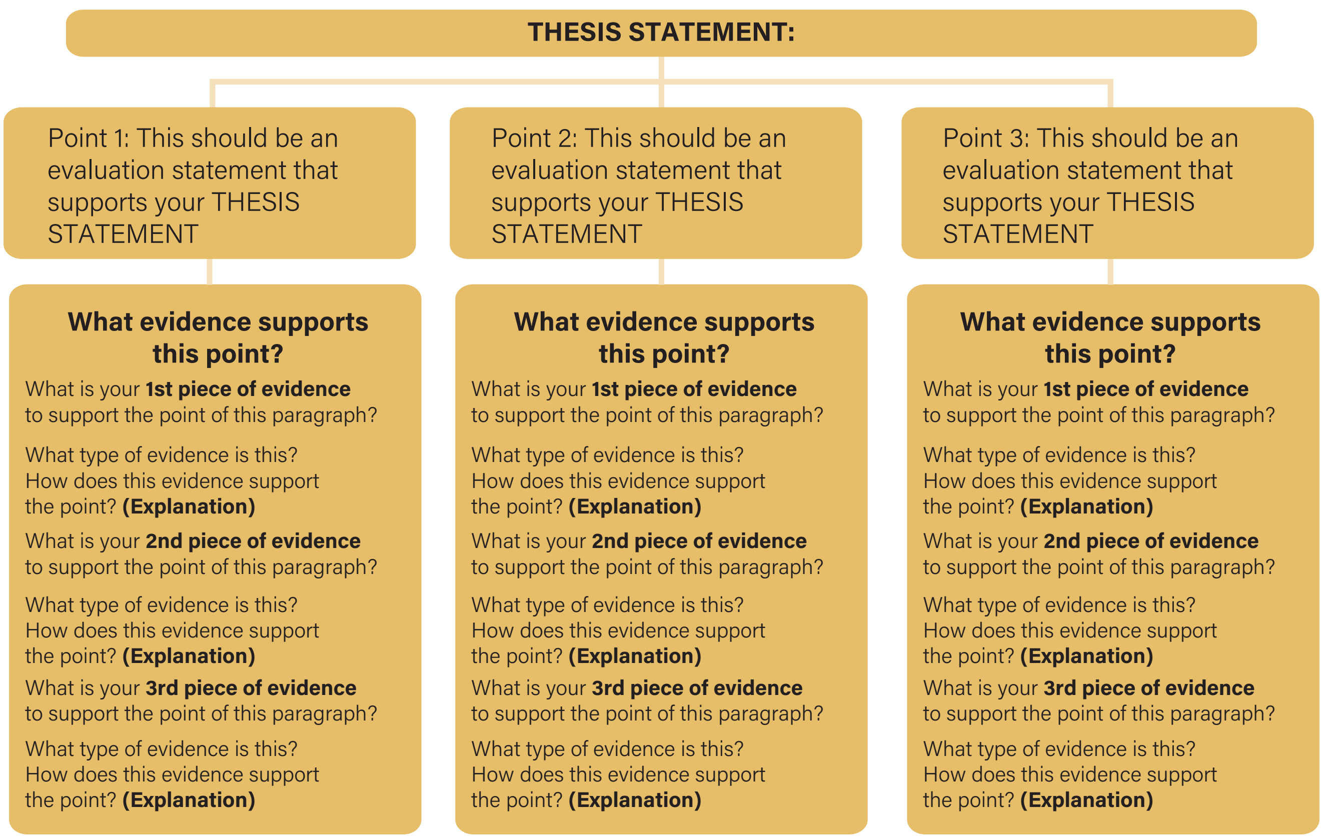


FIGURE 23.9 Developmental scaffold to produce a response that supports the thesis

ISBN 978-1-009-31125-0 Stewart et al.

23.5 Multimodal – folio: a response strategy

Note: While this section highlights summative multimodal responses from Units 3 and 4, and provides an example relevant to Unit 3, Topic 1 (tactical awareness in physical activity), the same learnings are relevant to any multimodal undertaken as assessment items in Units 1 or 2.

The multimodal research tasks undertaken for IA1 and IA3 both require multiple evaluations and justifications. Primary and secondary data is needed to justify the development of a strategy, to evaluate the effectiveness of the strategy developed, and to justify maintenance and modifications of the strategy. It is important to note that following the development of the strategy, further data reflecting the implementation and outcomes of the strategy must be collected through reputable sources.

The following sequence is recommended for developing your multimodal response.

Utilising knowledge gained through the **initial collection and analysis** phase:

1. **Analyse** your performance of one movement strategy in the physical activity being studied. Include references to the associated specialised movement sequences for this movement strategy. You should then synthesise the primary and secondary data about the physical activity requirements and your pre-strategy capabilities for the movement strategy.
2. **Justify the development** of a constraints-led activity (IA1) or training strategy (IA3) that will optimise your performance.

Utilising knowledge gained through the collection and analysis of data **during or following** the implementation:

3. Evaluate the effectiveness of the tactical (IA1) or training (IA3) strategy in optimising your performance by presenting data on the outcomes, implications and limitations.
4. Justify maintenance and modifications of the tactical (IA1) or training (IA3) strategy.

The following is an example of how to address the steps above in a response to IA1 by applying the concepts of tactical awareness to badminton. This same process for producing a multimodal response can be implemented for IA3 with regard to training, or to any multimodal folio undertaken as part of Units 1 or 2.

IA1 example multimodal response

1. Synthesising primary and secondary data to show effectiveness of your performance

Both IA1 and IA3 require you to engage in a specific physical activity to analyse your personal performance of one movement strategy and the associated specialised movement sequences. Below is an example of how to use the inquiry approach to gather data, analyse the key relationships within the data and ultimately make decisions about the effectiveness of your strategy by gauging the improvement in performance.

Engaging and understanding: What data are you looking for?

To make an informed analysis of performance, it is essential that you synthesise the most important data by applying the body and movement concepts when forming judgements. More information on effective primary data collection is found earlier in this chapter.

Data that should have been collected for **performance analysis** includes:

- footage of the select movement strategy being used in authentic performance environments
- footage of the personal techniques of the associated specialised movement sequences
- footage/research of optimal techniques
- GPAI data (use of and success of the movement strategy)
- records of team and/or individual outcomes
- physiological data.

Applying and analysing: What is the data telling us?

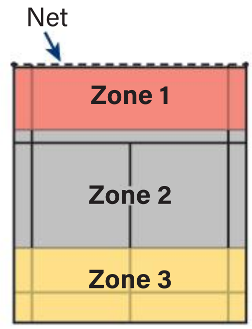
On the following pages are a number of data sets that have been collected during the engage and understand phase of the inquiry process, and where analysis and synthesis have been performed.

ISBN 978-1-009-31125-0 Stewart et al.

Primary data

Data set 1

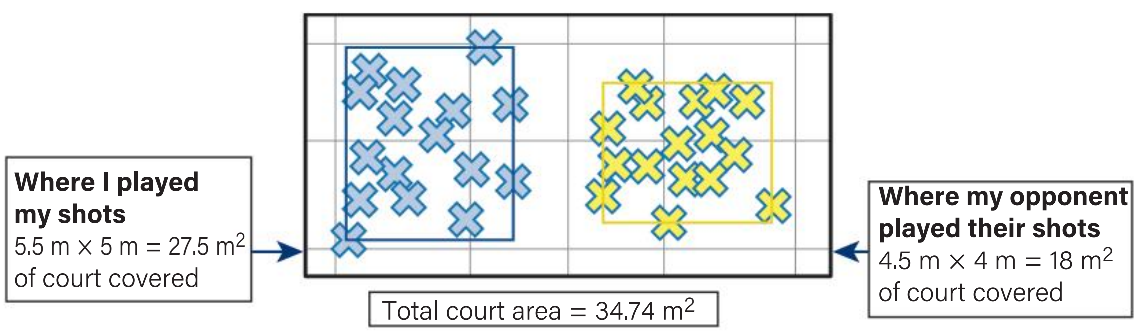
Number of shots landing in each zone	
Zone 1	4
Zone 2	12
Zone 3	2
Total	18



- Two-thirds of my shots land in the middle zone.
- Only 1 in 9 shots made it to the back of the court.
- Less than a quarter of shots were played in the front of the court.

FIGURE 23.10 Data set 1

Data set 2



- I played shots from lots of different areas of the court.
- My opponent played lots of shots from the centre of the court.
- My court coverage = 78%
- Opponent's court coverage = 51%
- I cover over 1.5 times the area that my opponent does (or 50% more).

FIGURE 23.11 Data set 2

Data set 3

- Feet and shoulders are square (not side-on for weight transfer).
- Left arm stays down during shot.
- Leaning back to make contact.

FIGURE 23.12 Data set 3

ISBN 978-1-009-31125-0 Stewart et al.

Data set 4

Analysis of points won during rallies (excluding serves)					
Me			Opposition		
Winners	Forced errors	Unforced errors	Winners	Forced errors	Unforced errors
3	8	4	8	1	4

Only 20% of my shots were winners.

My opponent had more than twice as many winners as me.

I had 8 times more forced errors than my opponent.

My opponent and I had the same number of unforced errors.

Ratios

Forced: unforced errors = 2:1

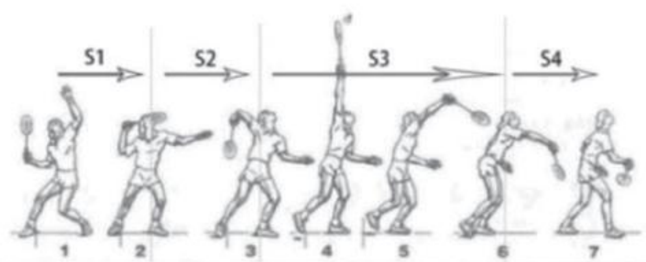
Winners : unforced errors 1:0.75

FIGURE 23.13 Data set 4

Secondary data

The following is secondary performance data that has been collected during the engage and understand phase of the inquiry process, and where analysis and synthesis can be done in relation to primary data of personal performance.

Data set 5

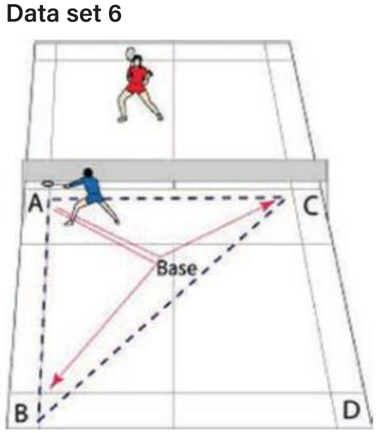


Source: Wu, Song, Lai and Li (2020)

- Player is side-on to target and 'loading' weight on back foot with left arm high.
- Weight is transferred forward.
- Contact is made high as player is leaning forward and bringing left arm down.

FIGURE 23.14 Data set 5

Data set 6



If the shot is hit to 'A,' the next shot should be to the other corners of the triangle – either 'B' or 'C,' forcing the opponent to change directions. Avoid hitting to 'D,' which would allow the opponent to run through the base position without stopping or changing direction.

Source: Moss (Unknown)

FIGURE 23.15 Data set 6

ISBN 978-1-009-31125-0 Stewart et al.

Data set 7

All matches	N	%
Winner	855	19.1
Forced error	617	13.8
Unforced error	747	16.7

Source: Gomez, Rivas and Leicht (2019)

- Winner: unforced error ratio = 1.14:1
- Forced error: unforced errors = 0.82:1

FIGURE 23.16 Data set 7

Evaluating and justifying: Making and defending judgements

Figure 23.17 is an example of how to evaluate performance in the physical activity. Undertaking a structured process such as this to synthesise your analysis of initial data sets and arrive at an evaluation, provides all the information required to justify during your script or to present as on-screen data.

<table>
<tr><td>Physical activity</td><td colspan="2">Badminton</td></tr>
<tr><td>Principle of play</td><td colspan="2">Defending against attack</td></tr>
<tr><td>Movement strategy</td><td colspan="2">Move the opponent to the back court and create space in the front court</td></tr>
<tr><td>Body and movement concepts</td><td colspan="2">Quality of movement – speed, accuracy, force, and flow of movement
Space awareness – use of space, direction of movement, planes of movement and movement</td></tr>
<tr><td></td><td colspan="2">Application of body and movement concepts</td></tr>
<tr><td>Appraisals</td><td>Outcomes</td><td>Limitations</td></tr>
<tr><td>Technical:
Inaccurate technique for overhead clear – no weight transfer, not using core muscles in by rotating, not pulling down with left arm.
(Data set 3 and Data set 5)
(Quality of movement – slow swing speed and low force)
Tactical:
I am not moving my opponent around the court enough.
(Data set 2 and Data set 6)
(Space awareness – not enough use of space, not making the opponent change direction)</td><td>I am not generating as much force as needed and rarely hit to the back of the court. (Data set 1 and Data set 2)
Easier for the opponent to hit forceful attacking shots from the centre of the court.
• They have twice as many winning shots. (Data set 4)
The opponent is playing a lot of shots from the centre of the court rather than from corners. (Data set 2)
Easier for the opponent to push me to the back of the court.
• I have 8 times more unforced errors. (Data set 4)</td><td>Constantly defending attack would mean that it is harder to control a rally.
My ability to win points through winners is reduced (low ratio of winners and forced errors against my opponent and compared to professionals. (Data set 4 and Data set 7)</td></tr>
<tr><td colspan="3">Evaluations: My ability to use the specialised movement sequence overhead is poor. My ability to push my opponent to the back of the court to create space at the front of the court is limited by my technique. I am therefore ineffective at using this movement strategy to defend against attack.</td></tr>
</table>

FIGURE 23.17 Example of how to evaluate performance in the physical activity

ISBN 978-1-009-31125-0

Example of evaluative response: Using PEEEEEEL structure in multimodal

Effective multimodals are those where the visual and spoken modes complement each other to successfully relay the message to the audience. It is highly recommended that the script be formulated first, where timing and length can be adjusted and adapted, before assembling the visual evidence to support the script.

Visuals should:

- be easily interpreted
- have limited text (dot points preferred)
- be aligned with what is being said in the voice-over.

The following is an example of how to structure a multimodal PEEEEEEL response when evaluating performance.

Visual

Notes:

Video involves montage of clear shots.

Some successful and most not.

Analysis of Performance

Principle of Play: *Defending against attack*

Movement Strategy: Move the opponent to the back court and create space in the front court

Synthesis

The movement strategy is:

- limited by technique
- lacking force and accuracy

Spoken

Point

Using the movement strategy of pushing my opponent to the back of the court to defend against attack as my ability to use the required specialised movement sequences is limited by the lack of force and accuracy generated by my technique.

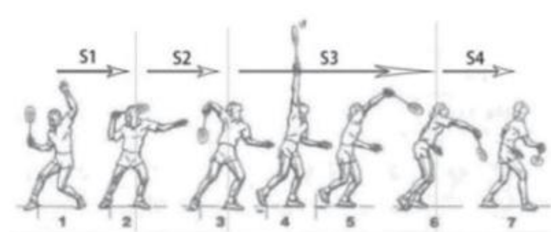
Visual

Notes:

Data from secondary source cited.

Personal image highlights key errors mentioned in text.

Analysis of Performance



Source: Wu et al. (2020)

Errors in technique resulting in low force:

- No weight transfer
- Not twisting, less core muscle use
- Not using non-racquet arm

ISBN 978-1-009-31125-0 Stewart et al.

Spoken

Evidence

Comparisons between footage of my technique and the recommended motor program provided by Wu et al. (2020) show poor technique resulting in a lack of force development when executing an overhead clear shot.

Explanation

Specifically, without weight transfer forward, the lack of core muscle use through the abdominals when twisting and not using my non-racquet arm in my action resulted in me not developing enough force to hit clears into the back of the court.

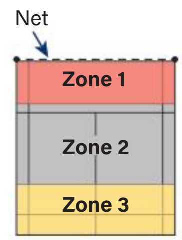
Visual

Notes:

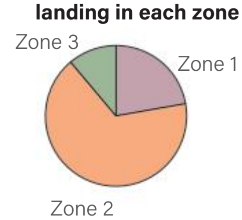
Video montage of clears landing in the middle of the court with opponent playing smashes.

Analysis of Performance

- Only 11% of shots in Zone 3
- Most shots land in Zone 2
- Opponent can play more effective attacking shots



Percentage of shots landing in each zone



Spoken

Evidence

Furthermore, GPAI data shows that I am rarely (only 11% of the time) hitting the shuttle to the back of the court and my opponents are playing most of their shots in the centre of the court.

Explanation

This allows my opponent to play a high number of attacking shots as they are in position to hit with downward trajectory into a larger area of my court, making it harder for me to defend and stay in a rally.

Visual

Notes:

Analysis of Performance

Number of Forced Errors for every Unforced Error	
ME	2
OPPONENT	0.25
EXPERT	0.82

(Gomez et al., 2019)

- Opponent is making me play difficult shots
- I am not making my opponent play difficult shots

(continued)

ISBN 978-1-009-31125-0

Evidence

Finally, analysis of my forced and unforced errors shows that the ratio between the two is significantly higher for me (2:1) than both my opponent (0.25:1) and the standards of professional badminton players (0.82:1).

Explanation

This indicates that I am losing a lot of points due to my opponent's attacking shots because I am not making them hit from the back of the court (Gomez et al., 2019).

Link

My inability to push my opponent to the back of the court is severely hindering my defence during rallies and therefore reducing the quality of my performance.

FIGURE 23.18 Example of script structure for a multimodal PEEEEEEL response when evaluating performance

2. Justifying the development of a constraints-led learning activity and personal strategy

The purpose of developing and implementing a strategy in IA1 is to optimise performance in the physical activity you are studying. It is important that the strategy meets your personal needs and can realistically be implemented in an authentic performance environment. A constraints-led activity will help the athlete self-organise their movements and facilitate the emergence of affordances that will prove successful when performing the targeted movement strategy.

Engaging and understanding: What data are you looking for?

To devise and justify the development of a strategy, you can incorporate the data you have identified as being most important in your performance evaluation.

You may look to develop a strategy that is currently a strength so that it is used as often as possible. You may work on a strategy that is a weakness, so that fewer errors in performance are made. Or you may work on a strategy that is underutilised and has not developed for you, so that you have a broader range of options during performance. Each of these options should result in improved performance if an effective constraints-led activity is implemented. The constraints-led activity should help you to improve your self-organisation skills and the perception–action coupling of the movement strategy.

Applying and analysing: What is the data telling us?

For this section, subject matter associated with tactical awareness should be included when synthesising the data and devising an effective strategy. In IA3, subject matter related to energy systems, fitness and training would be required.

TABLE 23.9 Data synthesis to develop a strategy

Physical activity	Badminton
Principle of play	Defend against attack.
Movement strategy	Move the opponent to the back court and create space in the front court.
Demands of specialised movement sequences and movement strategy	Power is needed to hit a shuttle the full distance of the court when trying to push the opponent back (up to 14 m). Footwork and speed are needed to reach the opponent's shot and return to the centre of the court to prepare for the next shot. Hand–eye coordination is needed to hit the moving shuttle with the racquet.

ISBN 978-1-009-31125-0 Stewart et al.

	Synthesis of data	Impact on performance
Constraints	My technique of an overhead clear results in a lack of power (learner constraint). The back of the opponent's court is too far away (task constraint) if I am making contact from the middle or back of my court. I am playing a lot of shots from the back half of the court. (Data set 2) My opponent's strengths include playing effective smash shots from high shots in the centre of the court (environmental constraints).	If I hit a clear to the centre of the court, my opponent will likely attack the shuttle with a smash. This means it will be difficult for me to play an effective shot and remain in the rally. Data set 4 showed that my opponent won most points through winners and unforced errors.
Decision-making	I focus most of my attention on the flight of the shuttle during a rally and not on the position of myself or the opponent (lack of perception). I am mostly playing high overhead clear shots and rarely playing drop shots or smashes to the front of the court.	Only reacting to each of my opponent's shots limits my affordances throughout the rally. My opponent can comfortably return to the centre of the court to prepare for another attacking shot.

Devising a constraints-led activity tactical strategy

The lack of power accompanied by the predictability of using overhead clears is resulting in an ineffective use of the defensive strategy of moving the opposition to the back of the court and creating space at the front of the court.

Movement strategy	Move the opponent to the back court and create space in the front court. *(Principle of play: defending against attack)*
Tactical strategy	Vary my defensive shots according to where my opponent and I are positioned on the court. • *Only use overhead clears if the opponent is in front of the service line.*
Constraints-led activity	Play rallies against my opponents where Zone 2 is out of play. This task-based constraint should allow the emergence of affordances that do not include high shots to the middle of the court when defending against attack.

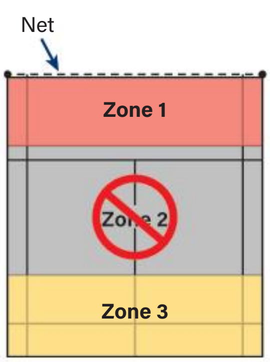


FIGURE 23.19 Example of tactical strategy for a constraints-led activity

(continued)

ISBN 978-1-009-31125-0

Example of justifying the development of tactical strategy

Visual

Notes:

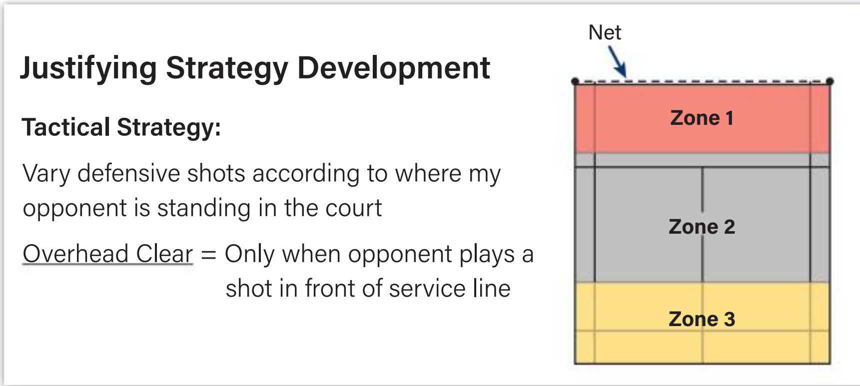


FIGURE 23.20 Example of how to justify the tactical strategy for a constraints-led activity

Spoken

Point:

A tactical strategy that will help me optimise my performance is to vary my defensive shots according to where my opponent is positioned on the court.

Evidence:

This would involve making decisions to only use an overhead clear shot when my opponent is in front of the service line.

Explanation:

This strategy is intended to make my opponent hit their next shot when running backwards and open the court up for my next attack.

Visual

Notes:

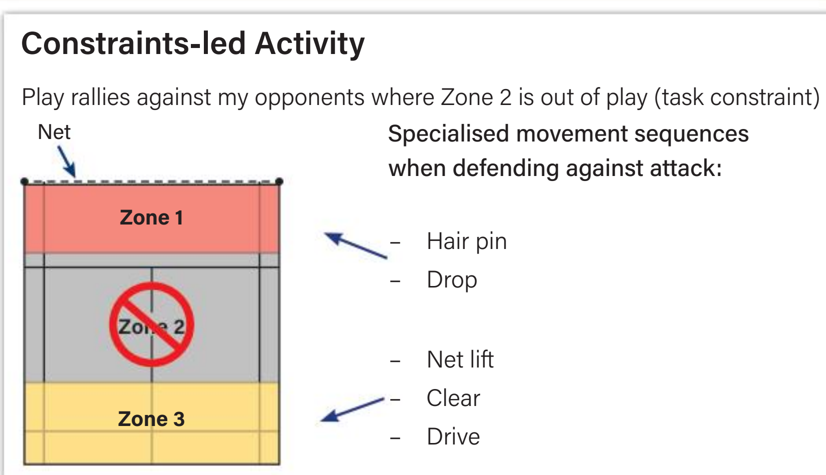


FIGURE 23.21 Example of how to justify the tactical strategy for a constraints-led activity

Spoken

Evidence:

This strategy would be supported by the implementation of task constraints-led learning activity that prevents the use of the middle of the court (Zone 2) during practice rallies against opponents.

Explanation:

This would allow for the emergence of other affordances to use when playing defensively. Specifically, I would be required to respond with a specialised movement sequence based on the position of myself, the opponent and the shuttle.

ISBN 978-1-009-31125-0 Stewart et al.

Visual

Notes:

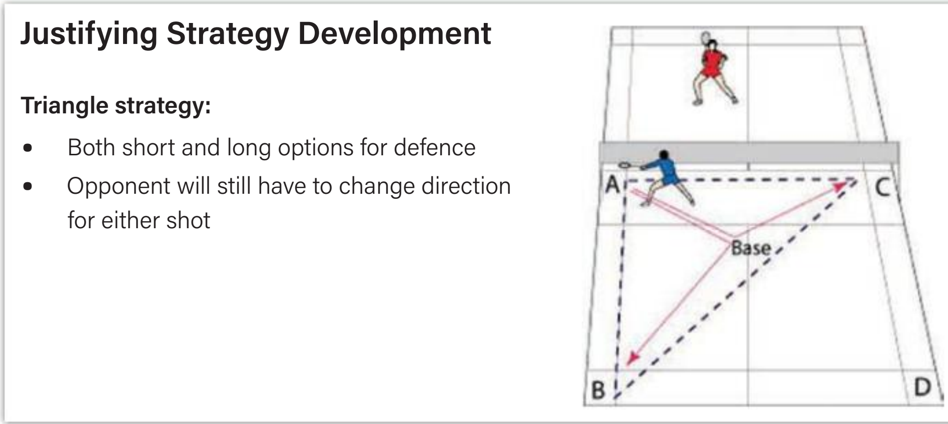


FIGURE 23.22 Example of how to justify the tactical strategy for a constraints-led activity

Spoken

Evidence:

I could then focus on implementing triangle strategy in badminton, which involves hitting consecutive shots to adjacent corners and is an effective way of making your opponent change direction after returning to centre court. (Data set 6)

Explanation:

This would mean that I would have both a short and long option when playing a defensive shot, regardless of where my opponent hit the shuttle.

Visual

Notes:

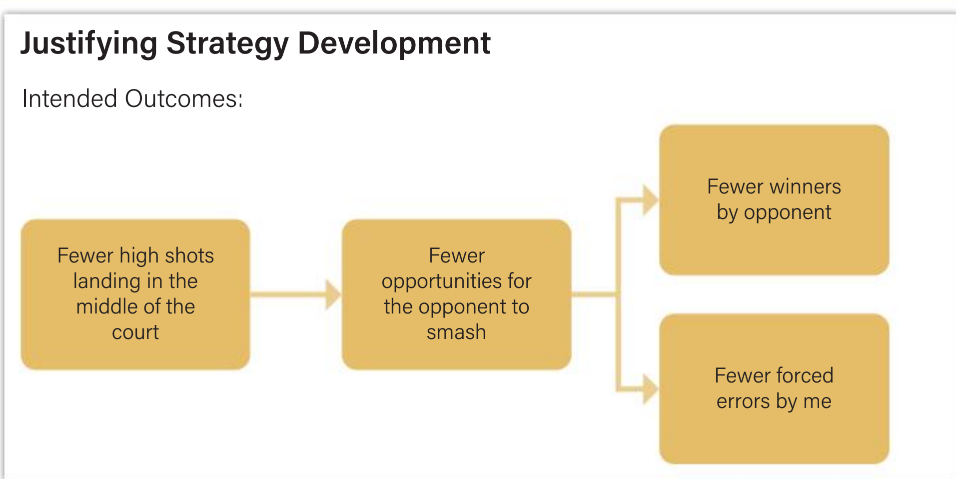


FIGURE 23.23 Example of how to justify the tactical strategy for a constraints-led activity

Spoken

Evidence:

Playing a combination of short and long defensive shots should limit the number of winners from my opponent and forced errors from me.

Explanation:

Because I am only using the overhead clear when they are in front of the service line, if I do hit a clear without enough power, it is hoped that they will not be in as good a position to play a hard attacking shot.

Link:

If this strategy is successful, I will reduce the number of easy attacking shots my opponent will play.

ISBN 978-1-009-31125-0

3. Evaluating the effectiveness of constraints-led activity and personal tactical strategy

The following is an example of how to use the inquiry approach to gather further data, analyse the key relationships within the data and ultimately make decisions about the effectiveness of your constraints-led activity and the impact on your movement strategy performance *following implementation*.

Engaging and understanding: What data are you looking for?

To make an informed evaluation on the effectiveness of your strategy, it is essential that you identify the most important data and that you apply the body and movement concepts when forming judgements. Further information on the body and movement concepts, as well as primary data collection types, is found earlier in this chapter.

Data to collect for performance evaluation:

- footage demonstrating implementation of the constraints-led activity
- performance footage demonstrating the movement strategy and associated specialised movement sequences in use during authentic badminton environments
- GPAI data (comparisons to performance before the implementation of strategy)
- records of changes in team and/or individual outcomes.

Applying and analysing: What is the data telling us?

Primary data

Data set 8

Number of shots landing in each zone		
	Before strategy	After strategy
Zone 1	4	8
Zone 2	12	8
Zone 3	2	4
Total	18	20

- Twice as many shots are landing in Zones 1 and 3
- Two-thirds as many shots are landing in Zone 2

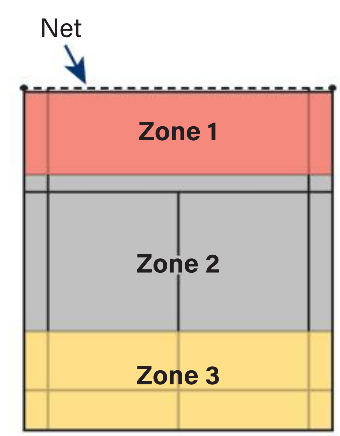


FIGURE 23.24 Data set 8

Data set 9

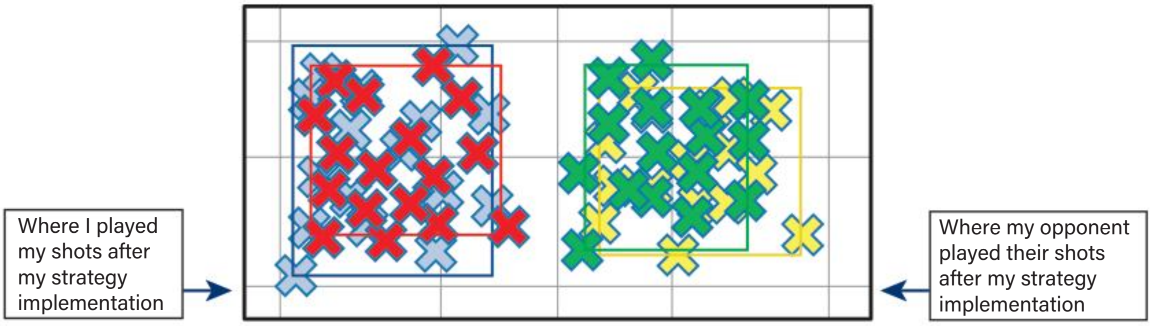
	Analysis of points won during rallies (excluding serves)					
	Me			Opposition		
	Winners	**Forced errors**	**Unforced errors**	**Winners**	**Forced errors**	**Unforced errors**
Before strategy implementation	3	8	4	8	1	4
After strategy implementation	4	6	5	5	3	4

- I hit more winners and fewer unforced errors.
- I had 25% fewer forced errors.
- My opponents hit 37.5% fewer winners.

FIGURE 23.25 Data set 9

ISBN 978-1-009-31125-0 Stewart et al.

Data set 10



- I covered a lot less of the court to return shots.
- My opponent covered similar amount of data.
- My opponent played shots closer to the front of the court and less from the centre of the court.

FIGURE 23.26 Data set 10

Data set 11

Shot selection						
	Underarm clear	Overarm clear	Drive	Net lift/ hair pin	Drop shot	Smash/ net kill
Before strategy	4	9	4	2	3	2
After strategy	4	5	5	5	6	6

- I am staying in the rallies longer and playing more shots.
- I have more opportunity to play smashes and net kills (300% increase).
- I have almost halved the number of overhead clears I am using.

FIGURE 23.27 Data set 11

Data set 12

Effectiveness of decision-making

Use of overarm clear shot				
	Appropriate decision	Inappropriate decision	Effective shot	Ineffective shot
Before strategy	3	5	1	7
After strategy	4	1	3	2

- My appropriate to inappropriate decision ratio has increased from 3:5 to 4:1.
- I am playing less than a third of the ineffective shots that I was before strategy.
- I am still not hitting many effective overhead clears.

FIGURE 23.28 Data set 12

ISBN 978-1-009-31125-0 Stewart et al.

Evaluating and justifying: Making and defending judgements

Figure 23.29 is an example of how to evaluate the effectiveness of tactical strategy.

Physical activity	Badminton	
Principle of play	Defend against attack.	
Movement strategy	Move the opponent to the back court and create space in the front court.	
Tactical strategy	Vary my defensive shots according to where my opponent and I are positioned on the court.	
Constraints-led activity	Make the middle of the court out of play during practice rallies.	
	Application of body and movement concepts	
Appraisals	**Outcomes**	**Limitation**
Principles of decision-making: I am more effectively using perception–action coupling by varying my shot selection based on the position of the opponent. (Data set 11) (Learner constraint)	I am playing half as many overhead clears. I am choosing more appropriate times to hit clears and they are more effective. (Data set 12) I am playing more smashes/attacking shots. (Data set 11) My percentage of winners has increased by 37.5%. (Data set 9)	My ability to play long clear shots has still not improved. Shot selection will be limited/ predictable if my opponent plays a net lift to the back of my court (only be able to play drop to the other side of their front court).
Constraints: I am not hitting as many high shots to the centre of the court where my opponent can smash. (Data set 10) (Environmental constraint) My technique of my overhead smash has not improved, and I am still hitting the same distance.	I reduced ineffective clears by more than a third. Opponent has reduced opportunity to hit an attacking smash to win the rally. My percentage of unforced errors has reduced by 25%. I am not having to cover as much court. (Data set 10)	
Evaluation statement: The strategy of only hitting overhead clears when my opponent is in the front court was somewhat successful at allowing me to defend against attack and improve performance.		

FIGURE 23.29 Example of evaluating the effectiveness of a tactical strategy

ISBN 978-1-009-31125-0 Stewart et al.

Example of evaluative response: Multimodal PEEEEEEL structure

An evaluative response has been formulated from the inquiry approach on the previous pages. For IA1 and IA3, this would form the script that you would build your multimodal from.

Visual

Notes:

Video showing rally using triangle strategy.

Varying level of success.

Evaluation of Strategy

Strategy was somewhat successful

Spoken

Point:

The constraints-led activity supporting the strategy of only hitting overhead clears when my opponent is in the front court was somewhat successful at allowing me to defend against attack and improve performance.

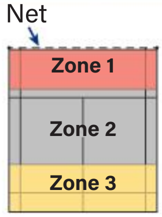
Visual

Notes:

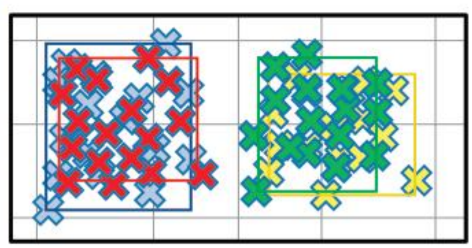
Evaluation of Strategy

Number of shots landing in each zone		
	Before strategy	After strategy
Zone 1	4	8
Zone 2	12	8
Zone 3	2	4
TOTAL	18	20

Net



Me before and after



Opponent before and after

Spoken

Evidence:

It can be clearly seen from my before and after data that I have replaced a lot of my shots that would have landed in the centre court with shots into my opponent's front court (Zone 1).

Explanation:

This is reflective of my strategy of hitting to the shorter option of the triangle strategy if my opponent was in the middle or back of their court and only using the long defensive clear if they were at the front.

(continued)

ISBN 978-1-009-31125-0 Stewart et al.

Visual

Notes:

Evaluation of Strategy

Spoken

Evidence:

The success of this strategy is evident from the reduction in my opponent's ability to hit winners (37.5% less) and force errors from me (25% less).

Explanation:

This is largely because more effective decision-making was overcoming my environmental constraint of hitting a high volume of clears high into the middle of the court. I was more than a third less likely to hit an ineffective clear to a space where my opponent could return the shuttle using one of their strongest attacking shots, the smash. (Data set 12)

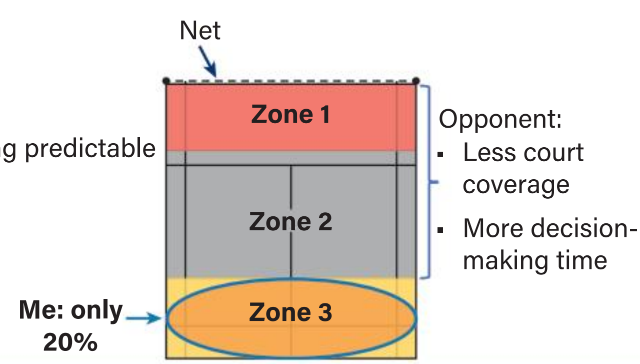
Visual

Notes:

Evaluation of Strategy

Limitations:

Play becoming predictable



ISBN 978-1-009-31125-0 Stewart et al.

Spoken

Evidence:

Unfortunately, the limitations of implementing the triangle strategy include that I am still only landing about 20% of my shots in the back of the court due to my lack of power (learner constraint) when using the overhead clear.

Explanation:

Without effectively being able to push my opponent to the back of the court, my short shots would become more predictable, and my opponent would be able to set their base (point of return after each shot) closer to the net and negate the effectiveness of my short defence.

Link:

Although some success was seen by implementing the triangle principle, it is predicted that it would be easy for my opponent to adapt and negate this strategy.

FIGURE 23.30 Example of script structure for an evaluative response using a multimodal PEEEEEEL structure

4. Justifying the maintenance and modifications of a strategy

The final section of the multimodal requires you to justify the aspects of the strategy that you will continue to use (maintenance) and the aspects that you will change (modifications).

Physical activity	Badminton	
Principle of play	Defend against attack.	
Movement strategy	Move the opponent to the back court and create space in the front court.	
Constraints-led activity	Make the middle of the court out of play during practice rallies.	
	Synthesis of data	**Impact on performance**
Constraints	The learner constraint of not generating enough power to hit to the back of the opponent's court is still present. I have minimised the number of times my overhead clears are falling to an area my opponent is able to attack. (Data set 8 and Data set 10) There was a pattern that the least effective clears occurred when I was hitting diagonally to the back of the court when using the triangle strategy. (This was the greatest distance – environmental constraints.)	Fewer points through winners and forced errors were won by my opponent. There were times when my only option was to try to hit diagonally into their back court.
Decision-making	There was more effective decision-making when using overhead clear based on opponent's position (perception–action coupling). (Data set 12) There was reduction in affordances available.	I was avoiding playing to my opponent's strengths. Fewer affordances would make my play more predictable.

FIGURE 23.31 Example of how to justify the maintenance and modifications of the strategy implemented

ISBN 978-1-009-31125-0

Example of justifying the maintenance and modification of a tactical strategy: Multimodal PEEEEEEL structure

Visual

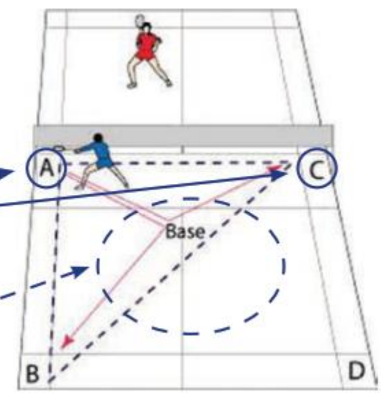
Notes:

Justifying Strategy Maintenance & Modification

Maintenance

Persist in using triangle principle:

- Short defensive shots are effective
- Less ineffective clears to middle of court



Spoken

Point:

The strategy of only using the forehand clear if my opponent is in the front of the court was somewhat successful and therefore has some areas to maintain and some to modify.

Evidence:

First, I would continue to implement the triangle principle – play short shots if the opponent is in the middle of the court – as this has seen a reduction in the amount of attacking shots that my opponent plays.

Explanation:

This tactic should remain as it does not require me to attempt long clears in defence that often fall to the middle of the court.

Evidence:

According to *The Badminton Guide* (2020), flat short shots are effective in defence as they remove the ability to play aggressive forehand shots.

Explanation:

Making an opponent play a shot below their waist, especially when close to the net, would remove their ability to play a forceful overhead shot.

FIGURE 23.32 Example of how to justify the maintenance and modifications of the strategy implemented

ISBN 978-1-009-31125-0 Stewart et al.

Visual

Notes:

Justifying Strategy Maintenance & Modification

Modification

All long clears to backhand of opponent

Generally weaker attacking shots (*The Badminton Guide*, 2020)

Spoken

Evidence:

The main modification I would make to this strategy would be to direct all my long clears to the opponent's backhand as this is generally considered weaker than forehands (*Badminton Bible*, Unknown).

Explanation:

It is believed that this modification would be more beneficial than making them change direction when pushing the opponent to the back of the court in defence as it would further reduce the number of forehand smashes that they could play during the game.

Link:

By continuing to select short and long shots based on the position of my opponent but only hitting long shots to the backhand side, I will be able to remain in and control more rallies and ultimately improve performance. However, to further optimise performance, I should engage in a specific strategy to improve my technique in overhead clears to increase the number of effective affordances I have when playing defensive shots.

FIGURE 23.33 Example of script structure justifying the maintenance and modifications of the strategy using a multimodal PEEEEEEL structure

23.6 Research report: a response strategy

Note: While the example used in this section is relevant to Unit 3, Topic 2 (ethics and integrity in physical activity), the same learnings are relevant to any reports undertaken as assessment items in Units 1 or 2.

The research report requires the collection of primary and secondary data through the same three-step inquiry process as undertaken for the multimodal folios. However, there are a number of key differences about this assessment instrument that must be noted.

- There is no requirement to collect video footage as primary data. Physical performance is not assessed as part of Unit 3, Topic 2, and therefore the assessment task does not require any evidence of performance.
- IA2 will be in relation to a class, school or community context. Therefore, the task is about the integrity and positive engagement created for a group; while IA1 and IA3 are about strategies to optimise personal performance. Data gathering therefore needs to engage all stakeholders and a variety of respondents.
- The ethics strategy in IA2 is not implemented; therefore, the inquiry process for assessment does not include a period of implementation where data is collected. The evaluation of the strategy is based on the 'potential' effectiveness, and not in actual

ISBN 978-1-009-31125-0 Stewart et al.

primary data collected. This also means the task does not ask for modifications or the maintenance of the strategy, just the development in response to the ethical dilemma.

The following sequence is recommended for developing your multimodal response.

Section 1 – Utilising knowledge gained through the **initial collection and analysis** phase:

1. **Synthesise** primary and secondary data to show the impact of the ethical dilemma.
2. **Justify** the development of a devised ethics strategy.

Section 2 – Utilising knowledge gained through further collection (if applicable) and analysis of data **following strategy** development:

3. **Evaluate** the *potential effectiveness* of an ethics strategy devised for a class, school or community physical activity context.

The following is an example of how to address the sections above in a response to IA2 by applying the concepts of ethics and integrity to a community context. This process integrates the ethical decision-making framework and could be implemented for class or school contexts as well.

IA2 example written response

1. Synthesising primary and secondary data to show the impact of the ethical dilemma

Unlike the assessment items for IA1 and IA3, the research report for IA2 provides a framework around which the inquiry process and the written response must be based. The use of the ethical decision-making framework requires in-depth analysis of primary and secondary data to devise an ethics strategy specific to the ethical dilemma that has been identified. The following is an example of how to use the inquiry approach to gather data, analyse the key relationships within the data and ultimately make decisions about the effectiveness of the ethics strategy developed.

Engaging and understanding: What data are you looking for?

To devise a justifiable ethics strategy, it is important to identify an ethical dilemma relevant to the class, school or community context and identify the most important data related to ethics, integrity and fair play. More information on effective primary data collection methods, such as survey construction, is found earlier in this chapter.

This stage of the inquiry approach requires engagement with a physical activity context to identify and collect data on an ethical dilemma. This would involve:

a. **Review the physical activity context associated with the task and identify areas where dilemmas may exist**

   Specifically, looking more closely at issues raised by concerned stakeholders through:

   - formal processes (meetings, letters of complaint, annual reports, policy reviews)
   - informal processes (discussions, direct emails, social media posts).

   The purpose of this review is to identify areas of concern or trends that may impact the integrity and positive engagement associated with this physical activity context.

b. **Collect primary data about the context that establishes the issues for stakeholders, and their tensions**

   Survey construction specific to ethics and integrity should target all relevant local stakeholders to gauge their values, attitudes and beliefs towards these issues and encompass the principles of fair play.

c. **Review and collect secondary research associated with similar context and associated stakeholders**

   This should include establishing the tensions of national stakeholders, such as world, national or state governing bodies associated with the physical activity context.

Ultimately, the purpose is to identify the tensions that arose from stakeholders (including at a national level) from comparable physical activity contexts. This will help you form a deeper understanding of existing ethics strategies and their effectiveness in different contexts.

ISBN 978-1-009-31125-0 Stewart et al.

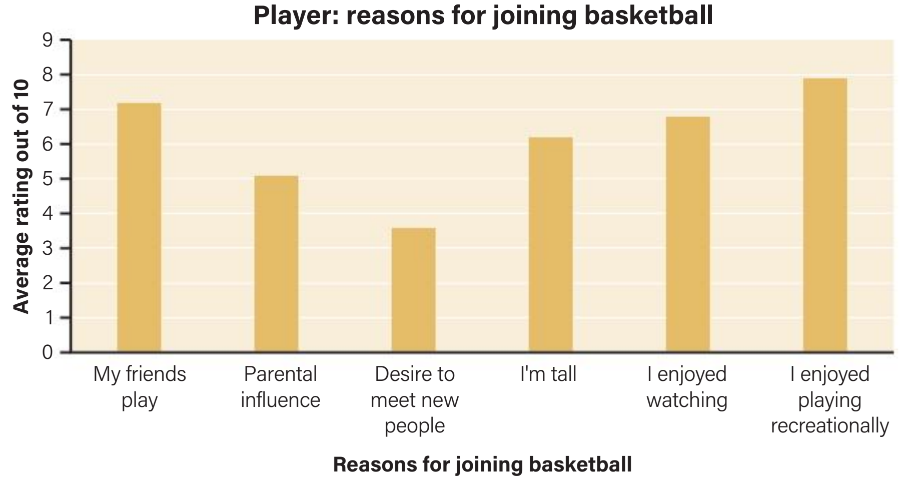
Applying and analysing: What is the data telling us?

Below are several example data sets that may have been collected during the engage and understand phase of the inquiry process, and where analysis and synthesis have been performed.

The primary data was collected using a survey of local stakeholders after identifying issues surrounding the fairness of basketball competitions. Specifically, issues were raised that some teams had unfair advantages due to having slightly older players, players who were much taller than others and players who were more experienced.

Primary data

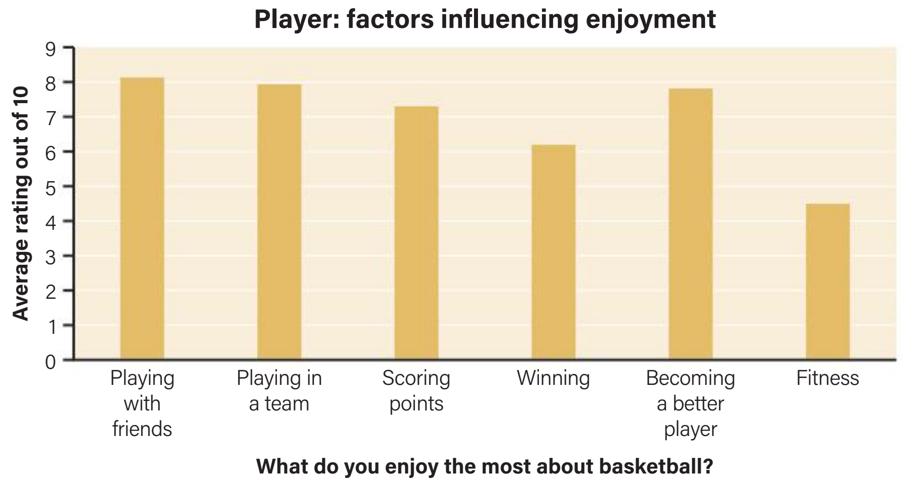
Data set 1



- Enjoyment and playing with friends is most important to players.
- Twice as likely to join to play with friends than meet new people.

FIGURE 23.34 Data set 1

Data set 2



- Social aspects are slightly higher than desire for excellence.
- Playing with friends is more than 25% higher than winning in terms of enjoyment.
- Scoring individual points is close to leading factors influencing enjoyment.

FIGURE 23.35 Data set 2

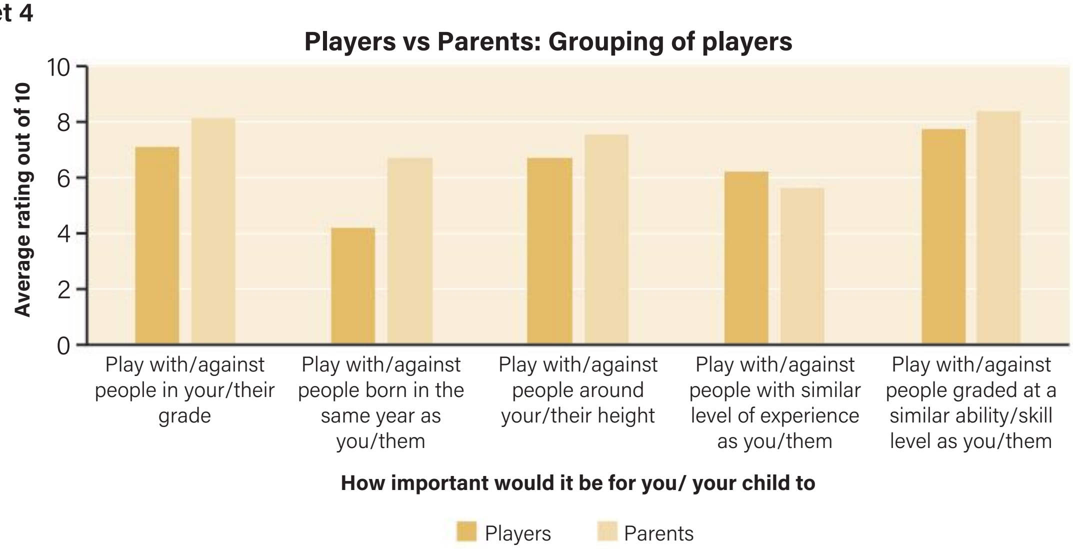
ISBN 978-1-009-31125-0

Data set 3

- Three principles of fair play that these players rate the highest all relate to having the opportunity to compete on a level playing field (fair competition, equality, respect for rules).
- This is closely followed by excellence – playing to win.

FIGURE 23.36 Data set 3

Data set 4

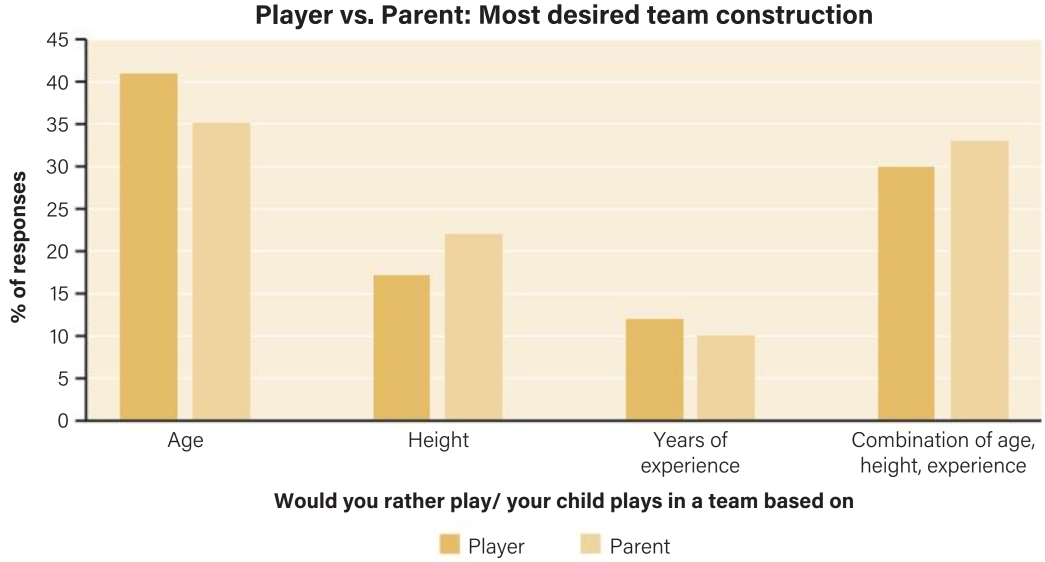


- Both parents and players would prefer grade-based to calendar-year-based competition.
- Parents value similar height competitions more than players (+11%).
- Responses where players' and parents' responses were closest was playing against people with similar levels of experience (players 5.2 – parents 5.6).
- This is closely followed by excellence – playing to win.

FIGURE 23.37 Data set 4

ISBN 978-1-009-31125-0 Stewart et al.

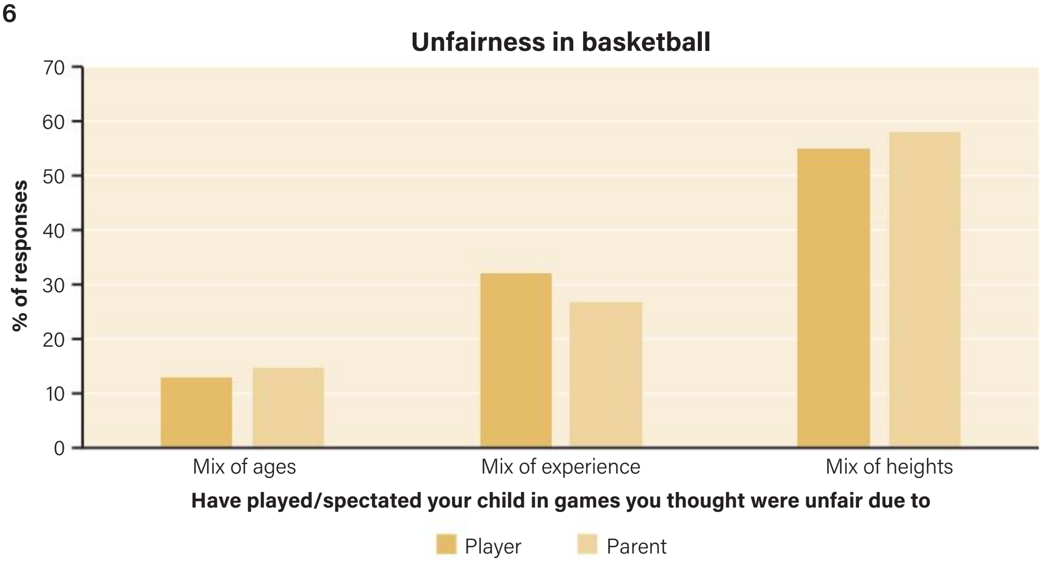
Data set 5



- 41% of players and 35% of parents think that age-based competitions are the best.
- Less than half that number of students would like to play based on their height.
- Almost a third of all respondents believe a combination of age, height and experience would be the best way to organise fair competitions.

FIGURE 23.38 Data set 5

Data set 6



- More than half of all respondents have experienced most unfairness when there is a mix of heights.
- Players are almost 20% more likely to feel mix of experience has led to unfairness than parents.

FIGURE 23.39 Data set 6

ISBN 978-1-009-31125-0

Secondary data

Data set 7

Values and principles of ethical behaviour – Basketball Australia (https://australia.basketball/integrity/)

We are the custodians of the sport of basketball
We manage the game for the benefit of our members and will make decisions that help basketball meet its full potential and that are in the best interests of the sport.

We are ethical, honest and trustworthy
We act with integrity and are committed to fair play both on and off the court. We respect, promote and enforce standards and rules in a consistent manner.

Basketball is a source of national pride
All Australians should be proud of how we play the game and conduct ourselves both on and off the court.

Basketball is for everyone
Basketball is 'everyone's game' and we have a responsibility to remove barriers, make it accessible, provide opportunities and encourage all Australians to enjoy the game.

Basketball provides a sense of community
We will create opportunities for people to get together and engage in a positive and welcoming environment based on a shared sense of purpose, cooperation and respect.

We support excellence at all levels
We will provide opportunities for all our participants to achieve their best. Everyone who is involved in our sport should be encouraged to do their best and make their communities proud. We will acknowledge the efforts and achievements of all participants.

Basketball provides a fun and safe environment
We will provide and promote an environment that is fun, welcoming, supportive and conducive to the safe enjoyment of basketball.

FIGURE 23.40 Data set 7

Data set 8

Basketball

Strategy: Currently competitions are organised in ages until 13, then a transition year as 14-year-olds, then ability-based teams beyond 14.

Research links:
https://youthguidelines.nba.com/guidelines

FIGURE 23.41 Data set 8

ISBN 978-1-009-31125-0 Stewart et al.

Data set 9

Rugby Union/Rugby League – safety and 'fairness'

Strategy: Size-for-age guidelines (height and weight) – introduced 2019

Research links:

Rugby Union

https://www.rugbycoachweekly.net/rugby-coaching/blog/australia-age-grade-size-for-age-guidelines-official-document/articles about

https://www.triplem.com.au/story/rugby-australia-announce-new-size-for-age-guidelines-81695 (article) 2018 for 2019

https://www.smh.com.au/sport/rugby-union/rugby-launches-new-sizeforage-guidelines-and-concussion-blue-card-system-for-juniors-and-seniors-20180215-h0w4v1.html (article) 2018 for 2019

https://www.abc.net.au/news/2018-02-16/rugby-au-to-move-junior-players-between-age-grades/9455436 (article2019)

https://www.theroar.com.au/2019/11/20/size-for-age-is-it-fair-to-have-an-11-year-old-playing-in-an-older-league/ (2019)

Rugby League

https://kingfishers.com.au/wp-content/uploads/2019-NSWRL-Weight-Dispensation-Guidelines.pdf (article)

https://www.smh.com.au/sport/nrl/all-players-great-and-small-the-flip-side-of-the-weightforage-debate-in-rugby-league-20180214-h0w2qp.html

FIGURE 23.42 Data set 9

Data set 10

Hockey – older 'new' players 'stuck' with other young players with much lower ability level.

Strategy: A competition system based on ability, not age (J1, J2, J3) – three groups across ages 10–17 based on skills ability.

Research links:

https://websites.sportstg.com/get_file.cgi?id=85495

https://hockey.org.au/playing/resources/policies-resources-and-inclusion/

FIGURE 23.43 Data set 10

Synthesising your data: Impact of your dilemma

Below is a fully completed ethical decision-making framework for the above ethical dilemma that has been broken into sections. A completed framework, such as this, may be included as an appendix for the report in IA2. Appendices do not form part of the overall word count, but could be referred to during the Discussion section of the report.

Stage 1 of the ethical decision-making framework helps to analyse the tensions that exist between stakeholders and synthesise the impact that the identified dilemma is having on the integrity and fair play of this physical activity context in focus.

ISBN 978-1-009-31125-0 Stewart et al.

The ethical decision-making framework – a 5-step process	
Stage 1 Identify the ethical dilemma	Clearly articulate the problem or situation and identify the tension that exists between the organisation's or player's values. Find information about: • the relevant facts of the problem or situation • individuals and groups who have an important stake in the outcome.
	Research notes and decisions Ethical dilemma: The current organisational structure of the local junior basketball competition bases divisions on age; this can create 'unfair' situations when a youth is unusually tall for their age. **Stakeholders** and the tensions/values they bring to the situation: • Players who are unusually tall – want to play (to develop skills and/or have fun) – want to fit in with peers (may be already socially isolated/self-conscious due to height) – want to play with friends – want to shine and make use of their 'gift' (have the opportunity to feel good and be admired by friends and peers) – want to maximise potential (some might want to make a career from their genetic predisposition) – perhaps want to win • Parents of the unusually tall player – want their child to be socially and emotionally happy and healthy – want their child to feel included – want their child to experience success and shine – want their child to learn life-long lessons like teamwork and resilience – perhaps want their child to win and show excellence • Other players in the team – want to play and be included – want the opportunity to improve and succeed – want a fair competition where they are valued as a team member • Parents of other players in the team – want their child to be socially and emotionally happy and healthy – want their child to feel included – want fair playing time and attention from the coach for their child – want value for the money paid for their child to be part of the competition/program – want their child to experience success and shine – want their child to learn life-long lessons like teamwork and resilience – perhaps want their child to win and show excellence • Players in opposition teams – want a fair competition and an equal chance of winning – want to have fun with teammates – want the joy of winning and being successful • Parents of opposition players – want their child to be socially and emotionally happy and healthy – want a fair competition and an equal chance of winning – want their child to feel included – want their child to experience success and shine – want their child to learn life-long lessons like teamwork and resilience – perhaps want their child to win and show excellence

ISBN 978-1-009-31125-0 Stewart et al.

The ethical decision-making framework – a 5-step process	
	• The coach (and other team officials) – wants their players to grow and be challenged in a fair way – wants to win games and competitions – wants to bring 'glory' to the club – wants to be ethical and equitable – wants to promote life-long learning opportunities or values (e.g. resilience and determination) – wants a fair competition and an equal chance of winning – this area would change depending on the individual coach • The referees – want to apply rules and adjudicate fairly and impartially – want to follow guidelines and protocols accurately – perhaps want players to have fun and experience a well-run and equitable contest • The clubs in the competition – want their players to have fun in their chosen sport – want their players to grow as athletes and people – want a fair competition and an equal chance of winning – want their club to be seen as a successful club (winning and relationships/personal development) – want to bring 'glory' to the club – want to be the 'club of choice' for local people – want to be ethical and equitable – want to remain financially viable – want to promote basketball and increase participation numbers – this area might change depending on the individual club • The local basketball organisation running the competition – wants a fair competition, giving all clubs/teams an equal chance of winning – wants to be seen to run a fair, ethical and equitable competition to continue community participation and confidence – wants basketball to be seen as a 'good' sport for local children to participate in – wants to demonstrate the fair play principles – wants to remain financially viable – wants to promote basketball and increase participation numbers • The Basketball Federation (governing body) – wants individual organisations/competitions to deliver fair competitions, giving all clubs/teams an equal chance of winning; this promotes community confidence in the basketball 'product' – wants individual organisations/competitions to follow set procedures and guidelines – wants to be seen to run a fair, ethical and equitable competition to continue community participation and confidence – wants basketball to be seen as a 'good' sport for children to participate in – wants to remain financially viable – wants to promote basketball and increase participation numbers – wants to demonstrate the fair play principles

(continued)

ISBN 978-1-009-31125-0 Stewart et al.

(continued)

The ethical decision-making framework – a 5-step process	
	Fair play principles affected in the dilemma and in what way: • Fair competition – is the competition fair if one player (and therefore team) has a huge advantage due to height? • Equality – are those competing all on a relatively 'level playing-field'? • Integrity – if one team can be advantaged heavily by one player, does the competition (and the organisations setting competition guidelines) have integrity? • Joy – is the situation promoting joy for all players involved? • Excellence – does the situation promote excellence for the player (and the opposition)? • Tolerance – is there tolerance for the players and differences in general?

Example of analytical response: Report PEEEEEEL structure

An evaluative response has been formulated from the inquiry approach. For IA2, this would form the first section of your discussion.

Point	The current organisational structure of the local junior basketball competition has been identified as an ethical dilemma within our community. This is because it bases divisions on age; this can create 'unfair' situations when a youth is unusually tall for their age.
Evidence	A recent survey of parents and players associated with our basketball club indicated that more than 50% of all respondents felt the greatest unfairness either experienced or witnessed was the result of players who are exceedingly tall for their age disadvantaging others (Appendix 2 – Data set 6).
Explanation	Although taller players are playing within the rules, their height leads to a decreased fairness of the competition as players of average, or below average, height will find it difficult to shoot without getting blocked, defend against their shots and rebounding the ball. This is having a detrimental impact on the integrity of the competition as many lopsided matches have occurred.
Evidence	In addition to this, players have indicated that the fair play principles of fair competition (8.9/10) and equality (8.4/10) are more valuable to them than the principle of excellence (8.0/10) (Appendix 3 – Data set 3).
Explanation	Obviously, the lack of opportunity to compete on equal terms in the game is taken away from the teams opposing those with exceedingly tall players. It is also likely, due to the dominance of the taller players, their teammates would experience unequal opportunities when playing; with more emphasis on excellence, winning and individual success.
Evidence	Furthermore, Basketball Australia's National Integrity Framework (2022) suggests that everyone should be able to enjoy the game of basketball equally and be encouraged to do their best (strive for excellence).
Explanation	This is not happening at our club presently as opposing players and parents are becoming disheartened due to consistently losing in lopsided games. Additionally, players who are dominant because they are tall are not getting the exposure to challenging competition that they require for further development in the sport.
Link	In accordance with Basketball Australia's commitment to their responsibility of removing barriers and providing opportunities for all participants to enjoy the game, an ethics strategy has been developed to increase the integrity and positive engagement on the court.

FIGURE 23.44 Sample Stage 1 of an analytical response using the report PEEEEEEL structure

ISBN 978-1-009-31125-0 Stewart et al.

2. Justify the development of a devised ethics strategy

Stages 2–4 of the ethical decision-making framework support the justification of the devised strategy in response to the ethical dilemma.

The ethical decision-making framework – a 5-step process (continued)	

Stage 2
Identify possible solutions and/or behaviours
	• Are there examples of similar dilemmas previously being addressed?
	• Where previous examples exist, how successful were the strategies implemented (i.e. extent to which behaviour changed or the dilemma solved, amount of people reached or helped, was the outcome permanent change or a band-aid solution, was it cost-effective)
	• How effectively will the identified solutions transfer to your context? How much will it need to be adapted? Will any adaptations affect the success of the strategy?
	• Are there any other possible solutions that have not previously been attempted? Consider:
	  – totally new thinking, or
	  – correcting the flaws in other strategies – where did they go wrong?
	• Formulate a list of potential strategies.
	
	Research notes and decisions
	
	Rugby Union:
	• Dilemma – safety and 'fairness' for all participants when larger players were involved in young age-based competitions.
	• Strategy used – size-for-age guidelines (height and weight) – introduced 2019.
	• Plus, minus, interesting: safety issues/concerns 'averted'; specific players taken away from natural friendship groups, larger players were unable to use their weight effectively when against older players (creates safety issue for the player moving up); skill level might not match size (skills don't get to develop if placed in a harder older age group).
	• Transfer to the basketball dilemma – could transfer, but with the same negative outcomes as found in Rugby Union.
	
	Rugby League:
	• Dilemma – safety and 'fairness' for all participants when larger players were involved in young age-based competitions.
	• Strategy used – size for age guidelines.
	• Plus, minus, interesting: safety issues/concerns 'averted'; specific players taken away from natural friendship groups, larger players still unable to use their weight effectively when against older players (creates safety issue for the player moving up); skill level might not match size (skills don't get to develop if placed in a harder older age group).
	• No longer used – there were more ethical issues created by the new strategy than were solved.
	• Transfer to basketball dilemma – could transfer, but with the same negative outcomes as found in Rugby League.
	
	Hockey:
	• Dilemma – older 'new' players were disadvantaged as teenagers as they did not possess the skills to be competitive when in age-based competitions, and younger players with high-level skills were 'stuck' with other young players with much lower ability level.
	• Strategy used – a competition system based on ability, not age (J1, J2, J3) – three groups across ages 10–17 based on skills ability.

(continued)

ISBN 978-1-009-31125-0 Stewart et al.

(continued)

The ethical decision-making framework – a 5-step process (continued)	
	• Plus, minus, interesting: helped with safety issues in hockey created when different ability levels play together; specific players were taken away from natural friendship groups, younger players in 'older' divisions might be skilful enough but older players can hit the ball harder and faster (safety issue); clubs did not 'grade' players correctly – leaving skilful players 'down' in order to win matches or competitions. • Some areas have reverted back to age-based as this model was creating too much inter-club fighting and issues for the tournament organising bodies. • Flaw – allowing individual teams/clubs to decide player 'ability' in order to place them on appropriate teams. Different interpretation of 'ability structures.' Different coaches/clubs had different understanding of what a 'J1' player could do. • Transfer to basketball dilemma – could transfer to basketball, but who would 'grade ability'? Basketball: • Dilemma – 'fairness' for all participants when abnormally tall players were involved in young age-based competitions. • Strategy – currently competitions are organised in ages until 13, then a transition year as 14-year-olds, then ability-based teams beyond 14. • Plus, minus, interesting: this is the current situation creating the ethical dilemma being discussed. • Modification basketball dilemma – just bring ability-based teams back down into younger age groups. **New thinking** • Could have age groups (e.g. 8, 10, 12), but with maximum height restrictions (like size-for-age strategy); however, they are only required to go up a maximum of one age category, no matter their height. • Potential to maximise positives of the size-for-age strategy, but also reduce the negatives for the individual player affected.
Stage 3 Evaluate alternatives	• Use criteria to evaluate potential strategies. Criteria might include: – level of good produced (Which strategy will produce the most good and do the least harm?) – respect to rights (Which strategy will best respect the rights of all who have a stake?) – level of equality produced (Which strategy will treat people equally or proportionately?) – how many people will benefit (Which strategy will best serve the community as a whole?) – level of behavioural change (Which strategy will lead players to act with integrity, or reflect the values of fair play?) • Select a strategy based on evaluation. **Research notes and decisions** 1. Change to height-based competitions. Criteria: • Good produced – All other players may experience a 'fairer' competition if they are competing against players of similar height. – The players moving 'up' might experience less enjoyment as they are not with the natural friendship groups. – The players moving up may develop better skills as they are more 'challenged.' – Competition and organisers/federations may be seen as equitable and ethical. – Maintains community confidence in basketball.

ISBN 978-1-009-31125-0 Stewart et al.

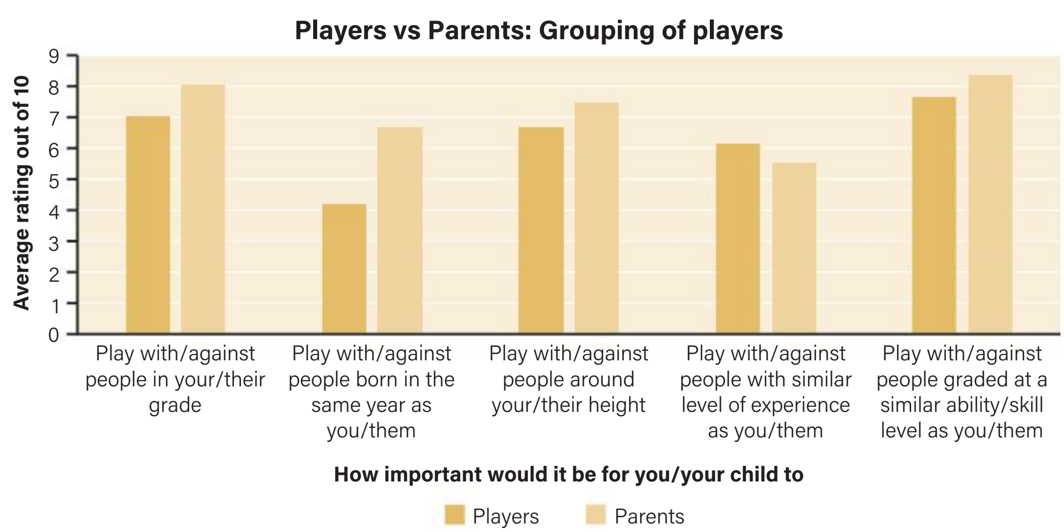
The ethical decision-making framework – a 5-step process (continued)	
	• Respect to rights – All players have rights respected, although the player moving up may experience some dissatisfaction. – Coach/club may have some 'rights' issues if they are not able to access a player that might have won them competitions. • Level of equality – In terms of playing ability on court across the competitions, this is quite high. • People benefited – Potentially all people, except the players and parents of those asked to move up (depending on how they react and respond to the situation). • Behavioural change – As this can be an easily enforceable guideline for competition, it can be a permanent behavioural change as long as the guideline is in place. 2. Use a 'height for age' system, but only moving up one age division if it is applied. Criteria: • Good produced – All other players may experience a 'fairer' competition if they are competing against players of similar height. – The players moving 'up' might experience less enjoyment as they are not with the natural friendship groups, *but limiting to only one age-group higher may help reduce this experience.* – The players moving up may develop better skills as they are more 'challenged.' – Competition and organisers/federations may be seen as equitable and ethical. – Maintains community confidence in basketball. • Respect to rights – All players have rights respected, although the player moving up may experience some dissatisfaction. – By only moving one age division, the player is not overly disadvantaged, and this may limit safety or developmental concerns with a younger player with much older players. • Level of equality – In terms of playing ability on court across the competitions, this is quite high. • People benefited – Potentially all people, except the players and parents of those asked to move up (depending on how they react and respond to the situation). • Behavioural change – As this can be an easily enforceable guideline for competition, it can be a permanent behavioural change as long as the guideline is in place.
Stage 4 Provide a course of action	• Refine the selected strategy. – This may include how the strategy can best be delivered to the intended player(s), target group or organisation. • Implement the strategy – strategy *will not* be implemented for this assessment task. **Research notes and decisions** Course of action: A 'height for age' system, but only moving up one age division if it is applied. • Guidelines implemented across all competitions – mandated by the federal governing body. • Advertised prior to competition season. • Enforced by competition organisers and referees at matches.

ISBN 978-1-009-31125-0 Stewart et al.

Example of analytical response: Report PEEEEEEL structure

An evaluative response has been formulated from information synthesised through stages 2–4 of the example ethical decision-making framework on the previous pages. For IA2, this would form the second section of your discussion.

<table>
<tr><td>Point</td><td>To most effectively address the ethical dilemma, the ethics strategy of using a ‘height for age’ system to construct playing divisions will be implemented with the provision that players will only ever have to play up one age division.</td></tr>
<tr><td>Evidence</td><td>Moreover, organising competitions based on height first and then age aligns directly with Basketball Australia’s values and principles of ethical behaviour as it removes barriers and provides more opportunities for all of its players to enjoy the game (Basketball Australia, 2022).</td></tr>
<tr><td>Explanation</td><td>This would directly address the concerns of the players of average and below average height as they will feel they are competing on a more level playing field to compete in an environment they are suited for.</td></tr>
<tr><td>Evidence</td><td>Similar strategies to this have been used by the rugby codes in Australia, which report increases in perceived fairness from the stakeholders by grouping players by physical development, skills and experience (Robinson, 2018).</td></tr>
<tr><td>Explanation</td><td>The provision of only ever having to play one age division above will help maintain fairness for the players who have to play against older teammates. By only playing one year above, there will not be too much disparity between the skill level in a mixed-age team.</td></tr>
<tr><td>Evidence</td><td>Finally, the implementation of this strategy is supported by the main stakeholders in youth sport, players and parents. Both of these groups of stakeholders valued player groupings based on age, height and experience as more desirable than any of those criteria individually (refer to Graph 1).



Graph 1 Importance of player grouping criteria</td></tr>
<tr><td>Explanation</td><td>This would suggest that above all else, both players and parents value a fair environment or level playing field that might not be possible if categorisations are limited to single criteria.</td></tr>
<tr><td>Link</td><td>The multi-levelled approach to this strategy would be effective as it would increase the positive engagement within the sport, while still being inclusive of the physical and social developmental needs of all athletes.</td></tr>
</table>

FIGURE 23.45 Sample of Stages 2-4 of the analytical response using the report PEEEEEEL structure

ISBN 978-1-009-31125-0 Stewart et al.

3. Evaluating the potential effectiveness of strategy

Below is an example of how to use the inquiry approach to gather further data, analyse the key relationships within the data and ultimately make decisions about the effectiveness of your **proposed strategy**.

Engaging and understanding: What data are you looking for?

To make an informed evaluation on the effectiveness of your strategy, it is essential that you identify the most important data and that you use the principles of fair play when forming judgements.

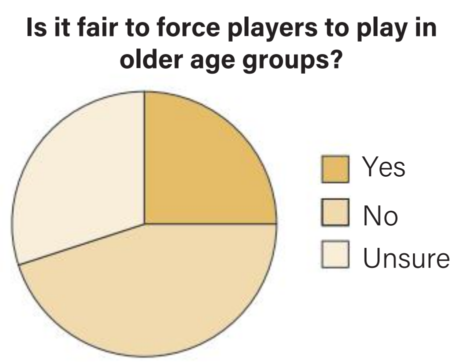
The evaluations you are making will be based on the potential, rather than actual, effectiveness of your ethics strategy as your strategy is not implemented.

Further collection of primary data may be an option by surveying stakeholders for their opinions on your proposed ethics strategy. Questions at this stage would focus on determining if the proposed strategy would influence the perceived integrity and positive engagement regarding the dilemma – that is, do stakeholders believe that your proposed strategy would have a positive or negative effect on the situation, or perhaps no impact at all?

Applying and analysing: What is the data telling us?

Primary data

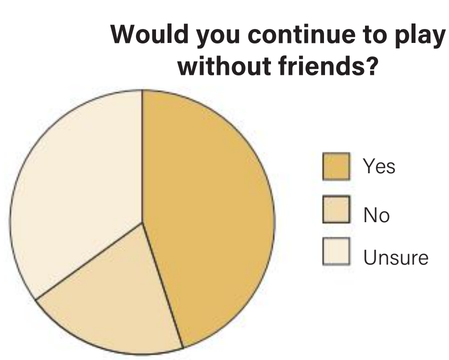
Data set 11



- Almost half of players do not think it would be fair to force players to play in older age groups.
- Only 1 in 4 players think that this would be fair.

FIGURE 23.46 Data set 11

Data set 12



- 1 in 5 players have indicated that they would stop playing if they could not play with their friends.
- Almost half would definitely continue playing.

FIGURE 23.47 Data set 12

ISBN 978-1-009-31125-0 Stewart et al.

Data set 13

- 60% of parents believe that the strategy would make their child happier.
- 4 times more parents believe their child would be happier.
- 2 out of 5 parents either know their child would not be happier or are unsure of how they would respond.

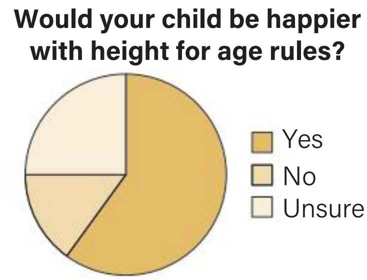


FIGURE 23.48 Data set 13

Figure 23.49 is an example of how to use the inquiry approach to appraise the outcomes, implications and limitations of the proposed strategy.

Physical activity	Basketball		
Physical activity context	Community competition		
Ethical dilemma	The current organisational structure of the local junior basketball competition bases divisions on age; this can create 'unfair' situations when a youth is unusually tall for their age.		
Ethics strategy	Course of action: a 'height for age' system, but only moving up one age division if it is applied.		
	Application principles of fair play		
Appraisals	**Potential outcomes**	**Potential implications**	**Potential limitations**
Integrity: Some players don't think it is fair for players to be forced to play up an age group. (Data set 11)	Without major height disparity, the original perceived fairness would increase. (Data set 6)	Increased feeling of fairness for players in the younger age group as they will not have to play against exceedingly tall players. All players would have more opportunity to develop skills and maintain the integrity of play without relying on height advantage to win.	Some players would not join if they could not play with friends of the same age. Feelings of alienation for younger players forced to play in older grades.
Positive engagement: Most players indicated that playing with friends was the reason they joined and what they enjoy the most. (Data set 1 and Data set 2)	Some players would leave if forced to not play with friends. (Data set 12) More players have opportunity to develop and be challenged. (Data set 2) Parents believe this strategy would bring more joy to their child's experience. (Data Set 13)		
Evaluation statement: The strategy of implementing a 'height for age' system to construct competition divisions would be effective in overcoming tensions associated with this ethical dilemma but may limit the present and future positive engagement.			

FIGURE 23.49 Sample showing use of the inquiry approach to appraise the outcomes, implications and limitations of the proposed strategy

ISBN 978-1-009-31125-0 Stewart et al.

Stage 5 of the ethical decision-making framework might be hard to complete in its entirety as your strategy for assessment is not being implemented; therefore, the need for modifications might not be ascertainable.

You may need to take your strategy to stakeholders and seek their opinion and advice through some follow-up primary data collection regarding the effectiveness of your proposed strategy and modifications that might need to be made.

The ethical decision-making framework – a 5-step process (continued)	
Stage 5 Reflect on the effectiveness of the strategy.	• Determine the effectiveness of the strategy by predicting the potential by: – gauging the degree to which the strategy might affect the dilemma (to what degree might the problem be solved) • What might change, what may not? – gauging the longevity and sustainability of the potential changes displayed • Would a change be permanent or will it revert? • How long could the strategy continue; does it need to continue? – identifying any unforeseen consequences (both positive and negative) for all stakeholders. • Determine if the strategy should continue. • Determine if modifications to the strategy are required.
	Research notes and decisions • Strategy has the potential to 'fix' the dilemma, particularly if enforced correctly and clubs and coaches work with specific players to see this as an opportunity to develop and be challenged. • Unlike the rugby example, there are fewer issues with a younger player moving to an older age group as basketball has less physical contact and is not an 'impact sport.' • This can be a permanent change if it is successful, with guidelines remaining in place once applied.

Example of analytical response: Report PEEEEEEL structure

An evaluative response has been formulated from information synthesised through stages 2–4 of the example ethical decision-making framework above. For IA2, this would form the third section of your discussion.

Point	The strategy of implementing a 'height for age' system to construct competition divisions would be effective in overcoming tensions associated with this ethical dilemma but may limit the present and future positive engagement.
Evidence	If implemented, the proposed ethics strategy would be effective in reducing the perception of unfair competition among players with 4 times as many parents believing their child would be happier under the new system than not (refer to Appendix 3 – Data set 13).
Explanation	An implication of this reduction in height disparities includes that it would give more players the chance to use their skills on the court with success. Both teammates and opponents of an exceedingly tall player would have more opportunities to fairly contest plays and feel they are competing on equal terms.
Evidence	This strategy would also be more beneficial to development of taller players forced to play up an age group. According to Diaz (2016), playing against tougher opponents will challenge your skill level and force you to work harder to improve your game.

(continued)

ISBN 978-1-009-31125-0

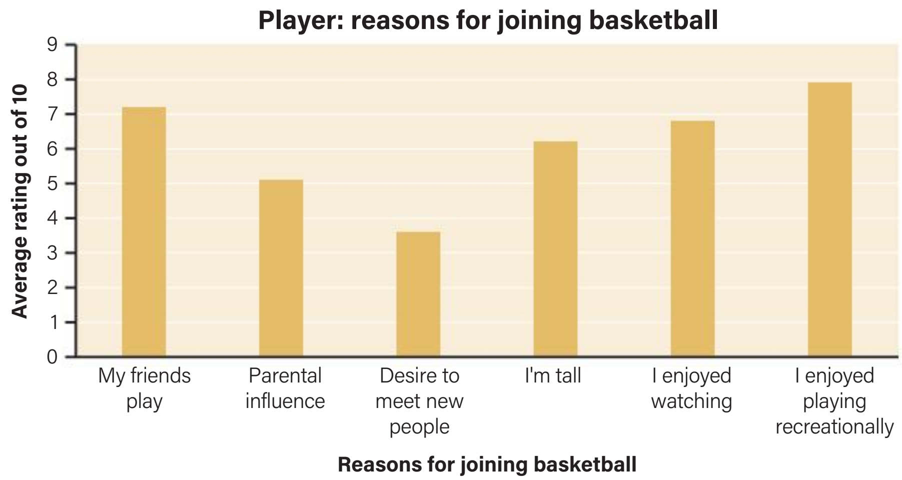
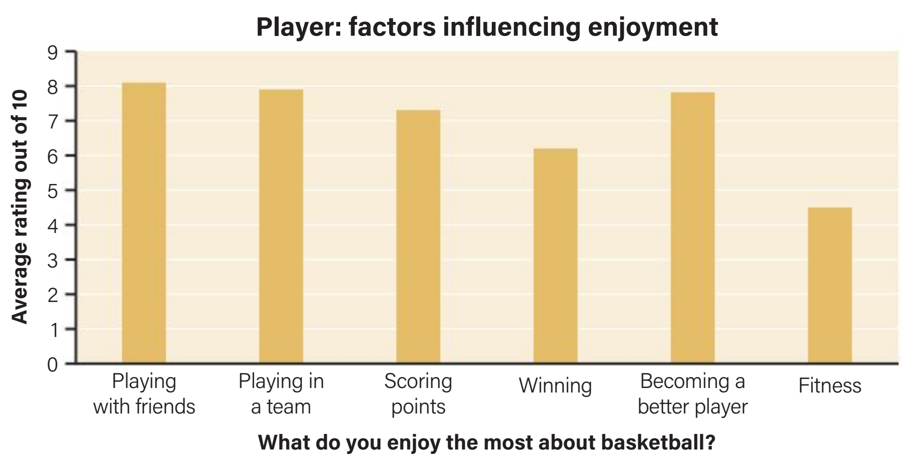
Explanation	This would also improve the integrity of both competitions and promote excellence as teams more evenly matched by height would rely less on using height advantages to succeed and more on the effective use of specialised movement sequences and movement strategies associated with the sport.
Evidence	Alternatively, as can be seen in Graphs 2 and 3, survey results from players indicated that playing alongside friends featured very highly as reasons for joining basketball and factors influencing enjoyment. Values of friendship and team spirit were clearly identified as the most influential factors when joining basketball.  Graph 2  Graph 3 Furthermore, 1 in 5 players indicated that they would cease playing if not allowed to play alongside friends (Data set 12 – see Appendix 5).
Explanation	The loss of ability to play alongside friends would be a limitation of this strategy. For example, if a taller player is forced to play up an age group instead of alongside a friend, they may feel alienated from their friendship group and may drop out or not sign up in the first place.
Link	Although there is a chance that players will choose to quit or not join basketball if forced to play in a higher age group, this strategy would still be effective in increasing both the positive engagement of those involved and the integrity of the competitions.

FIGURE 23.50 Sample of Stage 5 of the analytical response using the report PEEEEEEL structure

ISBN 978-1-009-31125-0 Stewart et al.

23.7 Examination: a response strategy

Exam preparation

There are many study tips and techniques that can be implemented to maximise exam success. Every individual needs to develop their own exam routine that works best for them. However, the following suggestions might help to refine your best plan of attack.

How to prepare for an examination

1. Start preparation early – that is, at the start of the unit.
2. Organise a space to study – enough space for your notes, a place with limited distractions, a comfortable chair and good lighting.
3. Plan a calendar – organise study times and be committed to these.
4. Set study goals – know what you want to achieve in each study session.
5. Study to suit your learning style – know how you learn best and design study activities that suit you.
6. Work in intervals – smaller focused study sessions (30 minutes – 1 hour) may be more productive; or ensure that you schedule breaks in longer sessions to freshen your mind.
7. Do not cram – it tends to make you more anxious and tired for the exam, and very little new information is retained effectively.
8. Ask for help – from teachers, tutors, family, friends. When you know there are gaps in your understanding, seek assistance from those who can help you effectively. Read the syllabus so you know what you'll be assessed on.

What study sessions might include

Where to start

- Review all work from the unit and ensure that all required notes and activities have been fully completed.
- Cull class work to only notes containing information relevant to the exam.
- Collate revision materials – notes and practice questions, if provided.
- Make your own study notes of relevant subject matter in a way that will help you remember, in your own words.
- Make diagrams, graphic organisers, flow charts or concept maps to link subject matter.
- Write down processes that may be required with examples.
- Categorise all relevant subject matter into 'What I know', 'What I think I know' and 'What's still confusing me'.
- Identify and rank the areas that are causing confusion, and seek help to have these clarified.

Time to study – what can I do?

- Complete any practice exam questions given – initially try under exam conditions.
- Check your answers to practice exam questions by reviewing notes for accuracy, and using any marking scheme or criteria that may have been provided.
- Read over your notes and try to recall key concepts.
- Write out concepts, procedures or subject matter in your own words from memory.
- Use the textbook or study guide to clarify concepts by reviewing specific explanations or sections.
- Practise using old exam papers if available; ideally, also reviewing question style, marking criteria and answers.
- Review the marking guide for old short-response and extended-response questions to look at how marks are allocated and what markers will be expecting.
- Look on the internet to find videos or text that help to explain the concepts in different ways *(Note: Ensure that your online research matches the subject matter as it has been taught in class.)*
- Work in study groups to complete study notes.
- Create your own exam questions on relevant subject matter and then answer yourself or share with others in a study group.
- Work with others to correct practice questions and discuss elements included in the best answers.
- In study groups, describe a concept or an answer to another person verbally.
- Teach a specific concept or piece of subject matter to a parent or sibling who does not know the information.

ISBN 978-1-009-31125-0 Stewart et al.

The last 48 hours

Feeling prepared when you walk into the examination room is an essential component of having the right mindset and confidence to achieve your best. What you do in the immediate lead-up to the exam can affect your success.

- One to two days before, check the required/permitted equipment for the exam. Check that you have everything needed and that it functions. Do not leave this until the day of the exam.
- Plan your exam day – when do you need to arrive, where is the exam room, what will you do in the morning/afternoon to help get you ready or relax? Give yourself plenty of time before the exam to wake up, eat and arrive.
- Sleep well. Try not to late-night cram, lie awake thinking of what you know or don't know, or spend half the night distracting yourself with games or online posting. Developing a normal sleep routine will assist with this.
- Drink water. Staying hydrated during the whole exam period is essential for your brain to work at its best. Avoid highly caffeinated drinks to stay awake studying; they interrupt your sleeping patterns and dehydrate you.
- Ensure that you have water in the appropriate container for during the exam if it is allowed.
- Eat nutritious foods. It may be easier to eat junk food when studying, but it can affect your energy and thinking levels. Eat nutritious and well-balanced meals, particularly in the 24 hours prior to the exam.
- Set your alarm. To follow your plan for exam day, ensure that you are up when you need to be. Perhaps organise another person to provide a wake-up call as backup.
- Exercise and zone out. Take time to forget about study. Go for a walk, throw a frisbee or play with your dog. Downtime is important so that you are less stressed and not mentally fatigued prior to the exam. Factor this downtime across your whole study period, but especially the last 48 hours.

In the exam room

Using perusal time

The external exam provides five minutes perusal time, during which you are not permitted to do writing of any kind. So, what can you do to maximise these five minutes?

Formulate a plan of attack

1. Skim through the exam. Look for the number of questions and the marks assigned to each question. *Does it match what was expected? Are there any differences from practice exams you have seen or undertaken?*
2. Allocate time to exam sections (multiple choice, short response and extended response). Ideally, you will already have a timing plan based on practice exams and questions undertaken in class and while studying. *Does your plan work for this exam based on the questions and marks you just skimmed? Adjust your timing plan if needed.*

Example timing plan – 120 minutes	
Multiple choice	20 minutes (for 10 questions)
Short response	40 minutes (for two questions 20 minutes each)
Extended response	45 minutes (15 minutes written planning – 30 minutes writing response)
Check work	15 minutes

Tip: Don't plan to use the full 120 minutes to answer questions. If you start to fall behind, this leaves you no buffer and you can start to get stressed as the finishing time approaches. Better to work on using 105 minutes to complete your responses, and 15 minutes (at least) to check your work. This time becomes important if some questions take a little longer than expected.

ISBN 978-1-009-31125-0 Stewart et al.

3. Peruse the questions – read them in more detail. Your first skim read may have only just glanced at the subject matter in the questions and the type of stimulus provided, as well as the number of questions and mark allocation. With this more in-depth perusal, try to establish which questions you can easily answer, those that will slow you down as they will require more thought, and any that you are going to find difficult.

   Note: Typically, the external exam will offer more than one option for the extended-response task. This means you may get to choose between two questions to answer. At this point, it may be good to decide on which question you will answer.

4. Plan a response order. You don't need to start at the beginning and simply work your way through the exam. Consider which questions you will answer first and which will come later – particularly across the short-response and extended-response sections. Starting with the ones you are confident in answering can get your exam kick-started in the right direction. Some students may like to get the extended response over with first.

Answer what you can with any remaining perusal time

While you cannot write at this stage, you can answer multiple-choice questions mentally, read and analyse the stimulus for any short-response or the extended-response questions that you plan to answer first, or start mentally planning your extended response.

Tip: Just because perusal finished and writing time begins, does not mean you need to grab your pen and head straight to question 1 to start. Take a breath, and finish what you were reading or planning. Perhaps jot down some notes on questions, highlight sections you read or write down some notes on your mental planning for the extended response. It is okay to continue to plan if needed once writing time has begun.

Using time effectively

- Constantly check that you are sticking to the time plan that you formulated in the perusal time.
- Don't get bogged down on a difficult question – move on and return to the question later. When you are bogged down, your anxiousness may prevent clear thinking.
- Take the time to stop, breathe, stretch, wiggle your toes and have a drink – regular micro-breaks will help your brain stay focused until the exam is over.
- Do not panic or rush. Remember, you can use right up to the last second for your response. Be confident, as you have a time plan and a buffer at the end if needed. There are no marks allocated for finishing first (or even in the first five).

Checking your responses

Exams are exhausting, and while you may like to leave early or put your head on the desk, your allocated reviewing time can still gain you valuable marks.

- Check you have answered all questions – particularly the multiple-choice questions (it is sometimes easy to forget that you were going to go back to answer a tricky one).
- For short-response and extended-response questions, ensure that the length of your answer is appropriate to the marks allocated – that is, for a 6-mark question have you included six points, explanations or links?
- Check that all relevant key words from the question or stimulus have been used (and defined). Even on difficult questions that you might have struggled with, you can have a shot at gaining marks by putting down possible key points or defining key words.
- If you wrote a plan for any responses, double-check that everything from your plan was included in your final response.
- Proofread, looking for basic spelling, grammar and sentence structure.

Write neatly, right from the start. Good presentation will enable an assessor to easily identify relevant points mentioned. If you need to undertake some major editing to a response, ensure that this is done neatly and clearly so it is easy for an assessor to understand.

ISBN 978-1-009-31125-0

Multiple-choice questions – a response strategy

Multiple-choice items are designed to assess your knowledge retrieval, comprehension and, when stimulus is provided, ability to analyse.

Multiple-choice questions are made up of the following components:

- stem – this is the question, which may be in the form of a question, problem, incomplete statement or situation
- stimulus – information presented in various forms that must be interpreted in order to find the correct answer. (*Note: Not all multiple-choice questions may have additional stimulus.*)
- options – the answers presented; usually, there will be four possibilities
- key – the correct answer in the list of options
- distractors – the incorrect answers in the list of options.

Sometimes it can be easy to underestimate the complexity and time it will take to answer multiple-choice questions, particularly when each may contain stimulus to interpret. Remember, 10 multiple-choice questions in the external exam is essentially 10 per cent of your exit result for Physical Education, so having a plan will help maximise your result in this section.

- Ensure that you are using a 2B pencil to mark the bubbles.
- Fully colour the bubble you want – but don't colour too firmly (this can make it difficult to erase if you make a mistake).
- Fully erase a mistake – ensure that you have a good eraser. Check you have only erased your error and not other bubbles too.
- If you skip a question to come back to, ensure that you are colouring the bubbles that correspond to the question being answered – use a ruler or edge of the paper to assist.
- At the end, double-check that only one bubble is coloured on each line.

A response plan – multiple-choice questions

1. Read the entire question (the stem) carefully first – not the answers (options) yet.
    - Students often start reading a multiple-choice question and think they know what the question is asking before they completely read it. They pre-empt what it is asking and skip straight to skimming the answers, looking for the one they expect to be there – because it is 'right'. This may be because students think these questions should be answered quickly to allow time for longer responses in the rest of the exam. *Do not skim read the stem or any stimulus* then skip to the options. Take the time to process what the stem is asking.

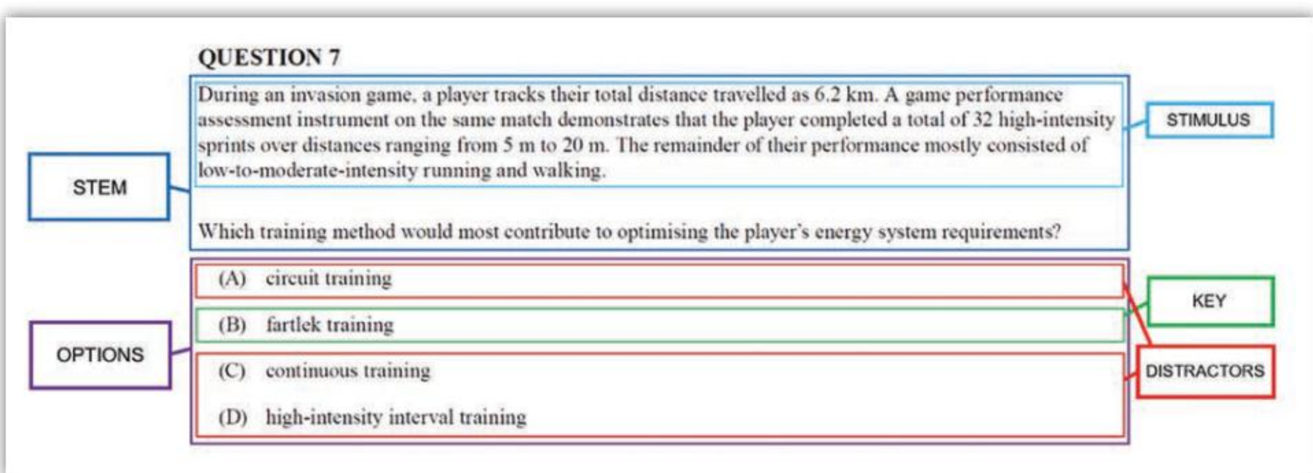


FIGURE 23.51 Sample of multiple-choice questions with written stimulus information

ISBN 978-1-009-31125-0 Stewart et al.

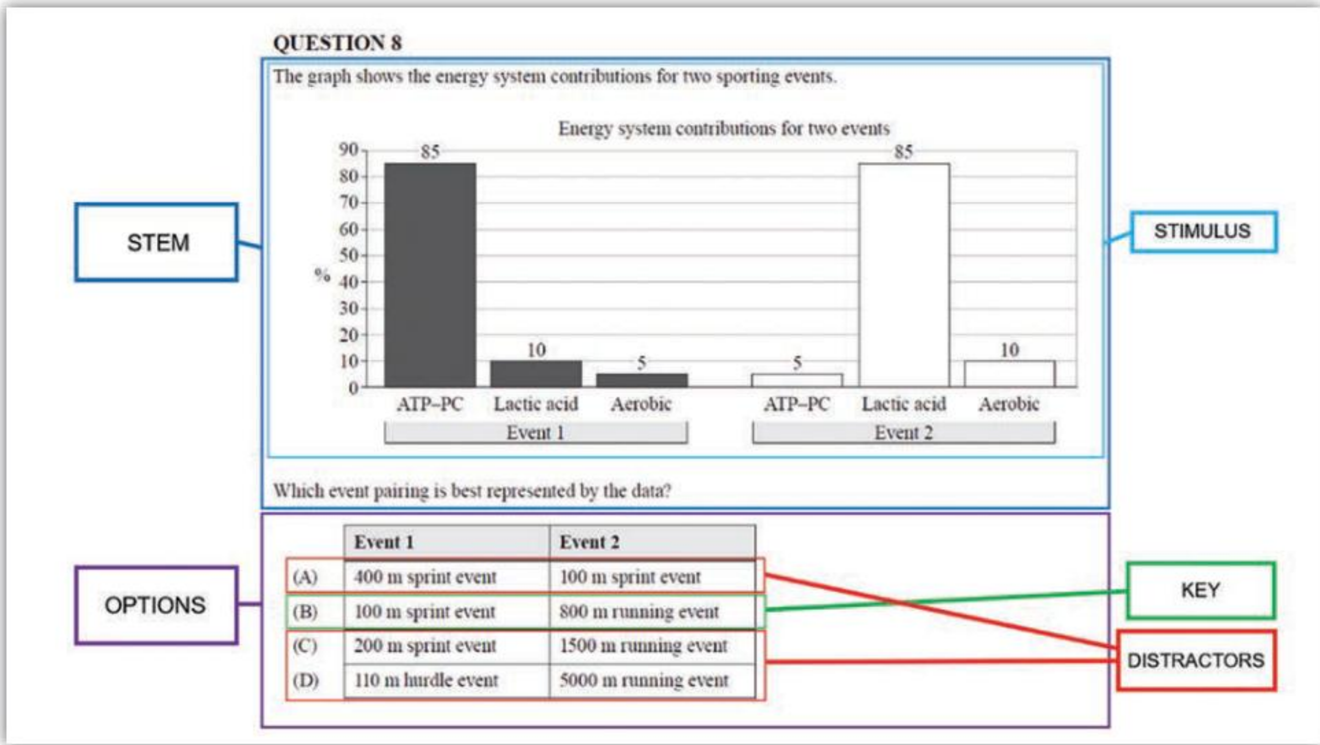


FIGURE 23.52 Sample of multiple-choice questions with graphical stimulus information

2. Analyse any stimulus material. What is it about? What might it be telling you? Are there any obvious trends or links to your knowledge?
   - Where stimulus is provided, check to see if it is familiar, then double-check that nothing about the familiar stimulus has been removed or changed. If the stimulus is new, what is it presenting? How can it be interpreted? Draw on, highlight or make notes on the stimulus if needed to assist in your analysis. This can be helpful before reading the options.
3. Answer the question in your mind first – *before* reading the answer options.
   - After reading the question and looking at any stimulus, answer it in your mind before reviewing the answer options. If you know the subject matter, this can help you identify the key (the correct answer for those listed). It may also help prevent you from talking yourself out of the correct answer once you've read the options. While it won't always work, sometimes your first instinct is the right one (you can overthink the options).
4. Now read and evaluate each option provided – pay attention to key words.
   - Read each option fully and carefully. Let the words sink in – don't just skim read, looking for the answer you want (the one you expect to see because you know it is 'right'). As you read each option, consider: is this answer wrong, plausible or right? Again, do not just glance over any of the options.
   - Pay particularly close attention to words like 'not', 'sometimes', 'always' or 'never' in either the stem or the options. These words may hold clues to a right or wrong option.
5. Eliminate each clearly wrong option as you evaluate each one – you might even cross these out on the question sheet.
   - If you are unsure of the subject matter, all answers may seem 'plausible'. But if you know the subject matter, then distractors that are clearly wrong can be eliminated. Don't just look for the 'right' option – look to eliminate the distractors and think about why they are incorrect.

ISBN 978-1-009-31125-0

- This process has clear benefits if you are not sure which option is the correct answer. Eliminating distractors may mean you have a greater chance of 'guessing correctly', if it comes down to it. You may like to place a line through distractors you have eliminated in the question sheet to help with your thinking – particularly if you still are unsure of the correct option and wish to return to the question later.

6. Select the best answer. At this stage, you may know the answer. However, you may be left with two options that are highly plausible. If necessary, compare the two, look for other clues or reread the question before selecting the most likely response.
   - It is important to select the best answer to the question being asked, not just an answer that seems correct. Remember, the options are meant to all seem plausible, so you might find two or three 'seem' right. Which option best answers the question?
7. Trust your first choice. Sometimes you can over-think the answer, causing doubt. If so, review your initial thinking from steps 1–3 and back yourself.
   - It is best to stick with the answer you first chose after reading the question. It is usually counter-productive to constantly second-guess yourself and change your answer. However, this doesn't mean your first answer choice is necessarily the correct answer choice. While multiple-choice tests aren't usually intentionally designed to trick or confuse students, they are designed to test students' knowledge and ability. To this end, the answer options provided will often include the most common wrong answer among the choices or answers that seem logical but are ultimately incorrect, as well as the best answer.

Remember, in the exam:

- Reading and answering multiple-choice questions in your head can be done during perusal time.
- Consider answering the multiple-choice questions you know first – but don't confuse the bubbles you are colouring, and don't forget to come back and answer all questions.
- Double-check you have answered all multiple-choice questions by colouring one bubble for each one – don't leave any blank. If you need to, *make an educated guess*!
- Take time to check your responses. It can be easy to think this is not required for multiple-choice questions, but they are either right or wrong; there is no part marks. If you misread the question or fill in the wrong bubble, you are 100 per cent wrong. Allow time to check and reflect.

Short-response questions – a response strategy

Short-response questions assess retrieval, comprehension, analysis and knowledge utilisation. Students apply their knowledge and demonstrate skills or processes. Depending on the type of short-response question, expected responses are likely to be up to 250 words long. Short-response questions for the external exam typically involve interpretive short-response items – interpreting graphs, tables and diagrams, analysing stimulus and information, paragraph responses to stimulus or complex unfamiliar operations.

A response plan – short-response questions

1. Break down the question and identify cues. Highlight or underline:
   - the cognitions (e.g. analyse, evaluate, devise). What are you being asked to do?
   - key subject matter words. What do you have to write about?
2. Analyse the stimulus material. What is it about? What is it telling you? What inferences or trends can be made?
3. Review how many marks the question is worth.
4. Draft a plan. Ensure that your response has an appropriate number of points to match the marks (e.g. 6 marks – six points, explanations or links).
5. Write your response. Although this is a short-response answer (50–250 words), following a PEEL structure across 2–3 paragraphs will help ensure that your response is concise and remains focused on answering the question. PEEL writing is explained in section 23.4.

ISBN 978-1-009-31125-0 Stewart et al.

6. Review your response. Although you might have time allocated at the end of the exam for checking and proofreading, while your response is fresh in your mind – stop, take a breath and read through what you have just written. Does it make sense? Does it use all the key words? Does it have everything you planned in there? Has it answered the question?

Extended-response questions – a response strategy

Extended-response questions assess knowledge utilisation, through which comprehension, analysis and synthesis are also required. Answers to extended-response questions require a minimum of 400 words, with no upper limit (markers will read everything you write). However, excessively wordy responses may not be required, nor are they a responsible use of time across the exam. Wordy responses may also demonstrate a lack of concise writing and a response that ventures away from the key elements of the question. Extended-response answers that venture beyond 700–800 words may be excessive.

Typically, the external exam requires a response to one extended-response question. Usually, however, the exam provides a choice from two extended-response questions. Ensure that you select the question you are most confident in answering well and clearly identify that selection in the response booklet as required. You may have selected this question as part of your perusal process at the start of the exam.

A response plan – extended-response questions

1. Break down the question and identify cues. Highlight or underline:
   a. the cognitions (e.g. analyse, evaluate, devise). What are you being asked to do?
   b. key subject matter words. What do you have to write about?
2. Analyse the stimulus material. What is it about? What is it telling you? What inferences or trends can be made?
3. Review how many marks the question is worth.
4. Draft a plan. Take some time to do this well; it will save writing time and ensure that you present all the required elements to gain maximum marks.
   a. Draft a mind map of information you wish to use in your response. Write key points, evidence to use, links between concepts, and key definitions or explanations that will need to be made. Ensure that you include a clear evaluative statement if it needs to be made, or ideas for the response if a training strategy or program needs to be devised.
   b. On the mind map, highlight or underline the essential elements to include in your response, ensuring the appropriate number of points to match the marks (e.g. 15 marks – 15 key points, explanations or links to include as a minimum). Reviewing and applying the marking schemes from previous exams during your lead-up study will assist in this area.
   c. Use the mind map to outline a scaffold for your response. This should include an introduction, the body of the question and a conclusion, as an extended response should follow the general structure of an essay.

To assist in planning and writing an extended response during an exam, review the information in sections 23.4 and 23.5 that reference PEEL structure and constructing evaluative responses. The same information that is relevant to writing effective reports or scripts in IA1, IA2 and IA3 is essential in an extended response.

5. Write your response.
6. Review your response. Although you might have time allocated at the end of the exam for checking and proofreading, while your response is fresh in your mind – stop, take a breath and read through what you have just written. Does it make sense? Does it use all the key words? Does it have everything you planned in there? Has it answered the question?

ISBN 978-1-009-31125-0 Stewart et al.