UNITS 1 & 2

PHYSICAL EDUCATION FOR QUEENSLAND

CRYSTAL HEDE | KATE RUSSELL | RON WEATHERBY | BEN WILLIAMS

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AUSTRALIA & NEW ZEALAND

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Published in Australia by
Oxford University Press
Level 8, 737 Bourke Street, Docklands, Victoria 3008, Australia.

© Crystal Hede, Kate Russell, Ron Weatherby, Ben Williams 2019

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First published 2011
This edition published 2019

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A catalogue record for this
book is available from the
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ISBN 9780190313197

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Typeset by Newgen KnowledgeWorks Pvt. Ltd., Chennai, India
Edited by Rebecca Hill
Proofread by Jane Fitzpatrick
Indexed by Neil Daly
Printed in China by Golden Cup Printing Co. Ltd.

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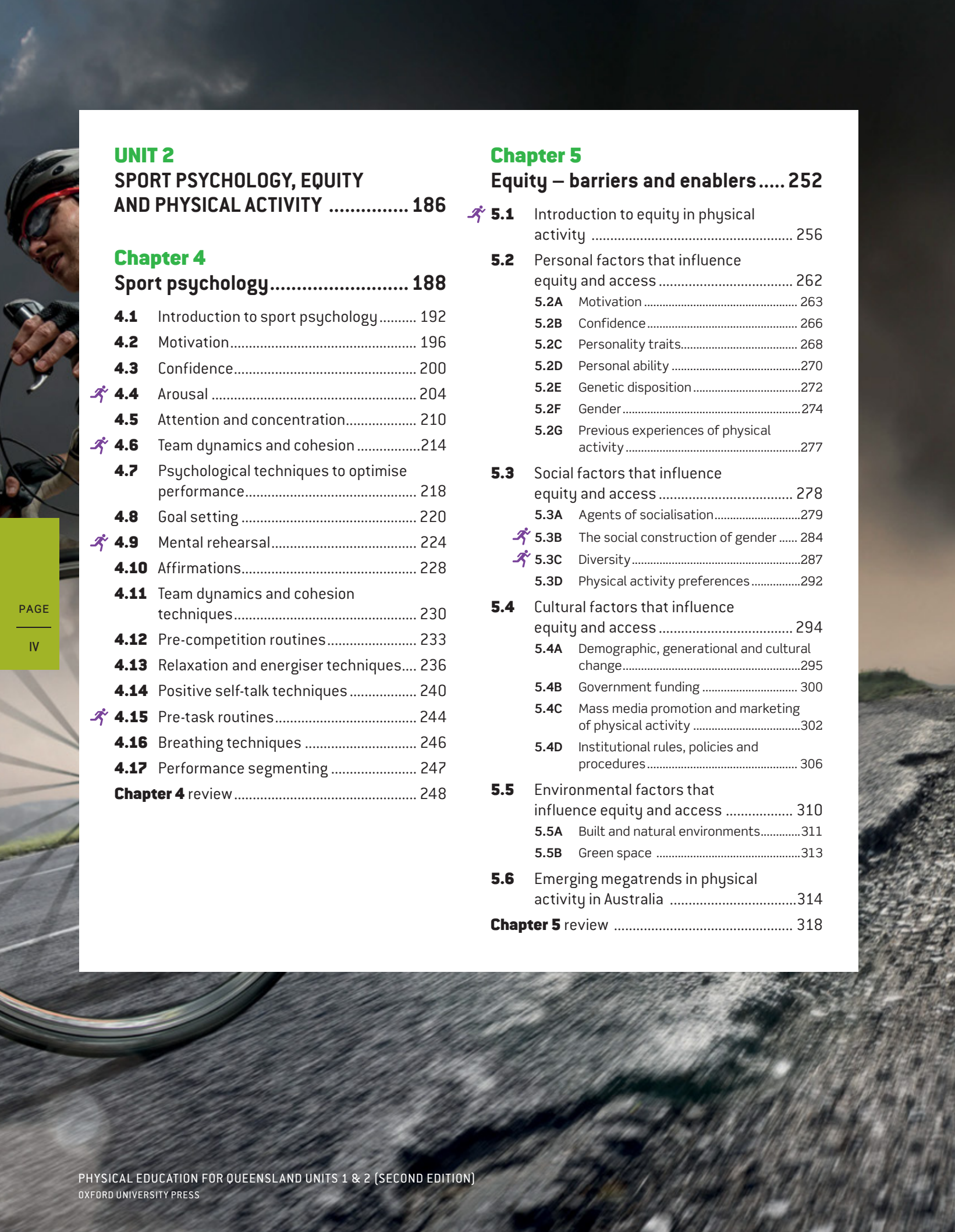

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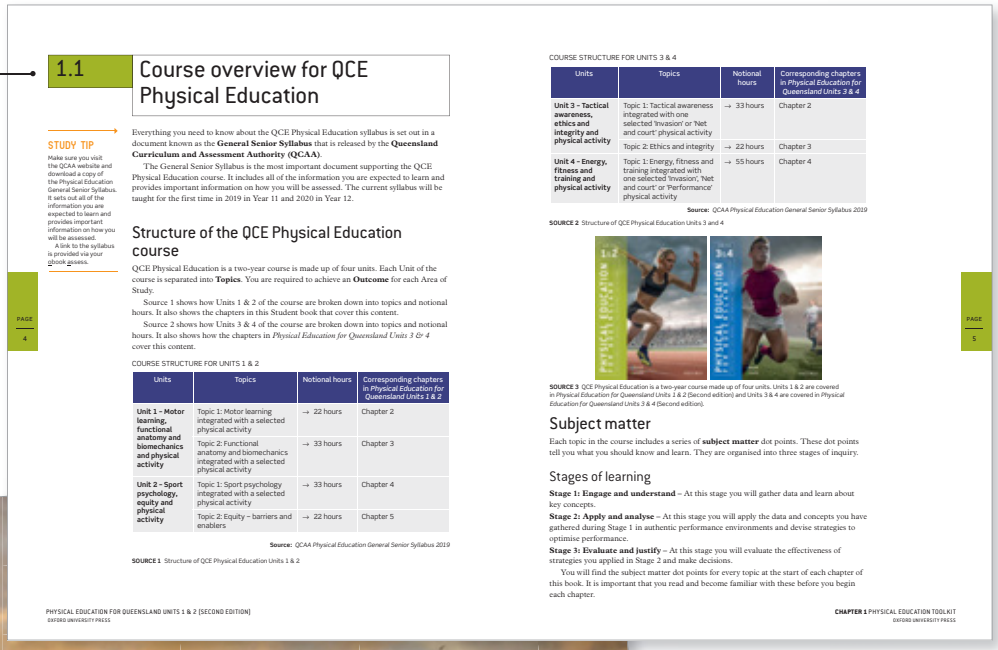
Using *Physical Education for Queensland Units 1 & 2*

Physical Education for Queensland has been purpose-written to meet the requirements of the QCAA Physical Education General Senior Syllabus.

Key features of the Student book

Physical Education toolkit
The Student book begins with a stand-alone reference chapter that includes:

- an overview of the QCAA Physical Education syllabus
- tips for success on assessment tasks
- advice on understanding cognitive verbs
- a summary of the importance of data in the QCE Physical Education course.



1.1 Course overview for QCE Physical Education

STUDY TIP
Make sure you visit the QCAA website and download a copy of the Physical Education General Senior Syllabus. It sets out all of the information you are expected to learn and provides important information on how you will be assessed.
A link to the syllabus is provided via your obook assess.

Everything you need to know about the QCE Physical Education syllabus is set out in a document known as the **General Senior Syllabus** that is released by the **Queensland Curriculum and Assessment Authority (QCAA)**.

The General Senior Syllabus is the most important document supporting the QCE Physical Education course. It includes all of the information you are expected to learn and provides important information on how you will be assessed. The current syllabus will be taught for the first time in 2019 in Year 11 and 2020 in Year 12.

Structure of the QCE Physical Education course

QCE Physical Education is a two-year course is made up of four units. Each Unit of the course is separated into **Topics**. You are required to achieve an **Outcome** for each Area of Study.

Source 1 shows how Units 1 & 2 of the course are broken down into topics and notional hours. It also shows the chapters in this Student book that cover this content.

Source 2 shows how Units 3 & 4 of the course are broken down into topics and notional hours. It also shows how the chapters in *Physical Education for Queensland Units 3 & 4* cover this content.

COURSE STRUCTURE FOR UNITS 1 & 2

Units	Topics	Notional hours	Corresponding chapters in *Physical Education for Queensland Units 1 & 2*
Unit 1 – Motor learning, functional anatomy and biomechanics and physical activity	Topic 1: Motor learning integrated with a selected physical activity	→ 22 hours	Chapter 2
	Topic 2: Functional anatomy and biomechanics integrated with a selected physical activity	→ 33 hours	Chapter 3
Unit 2 – Sport psychology, equity and physical activity	Topic 1: Sport psychology integrated with a selected physical activity	→ 33 hours	Chapter 4
	Topic 2: Equity – barriers and enablers	→ 22 hours	Chapter 5

Source: *QCAA Physical Education General Senior Syllabus 2019*

SOURCE 1 Structure of QCE Physical Education Units 1 & 2

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COURSE STRUCTURE FOR UNITS 3 & 4

Units	Topics	Notional hours	Corresponding chapters in *Physical Education for Queensland Units 3 & 4*
Unit 3 – Tactical awareness, ethics and integrity and physical activity	Topic 1: Tactical awareness integrated with one selected 'invasion' or 'Net and court' physical activity	→ 33 hours	Chapter 2
	Topic 2: Ethics and integrity	→ 22 hours	Chapter 3
Unit 4 – Energy, fitness and training and physical activity	Topic 1: Energy, fitness and training integrated with one selected 'Invasion', 'Net and court' or 'Performance' physical activity	→ 55 hours	Chapter 4

Source: *QCAA Physical Education General Senior Syllabus 2019*

SOURCE 2 Structure of QCE Physical Education Units 3 and 4

SOURCE 3 QCE Physical Education is a two-year course made up of four units. Units 1 & 2 are covered in *Physical Education for Queensland Units 1 & 2* (Second edition) and Units 3 & 4 are covered in *Physical Education for Queensland Units 3 & 4* (Second edition).

Subject matter

Each topic in the course includes a series of **subject matter** dot points. These dot points tell you what you should know and learn. They are organised into three stages of inquiry.

Stages of learning

Stage 1: Engage and understand – At this stage you will gather data and learn about key concepts.
Stage 2: Apply and analyse – At this stage you will apply the data and concepts you have gathered during Stage 1 in authentic performance environments and devise strategies to optimise performance.
Stage 3: Evaluate and justify – At this stage you will evaluate the effectiveness of strategies you applied in Stage 2 and make decisions.

You will find the subject matter dot points for every topic at the start of each chapter of this book. It is important that you read and become familiar with these before you begin each chapter.

CHAPTER 1 PHYSICAL EDUCATION TOOLKIT
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PAGE 5

Unit openers
Each unit begins with a unit opener that includes:

- **unit objectives** from the syllabus
- an **overview of notional hours** and **topics** in the unit.

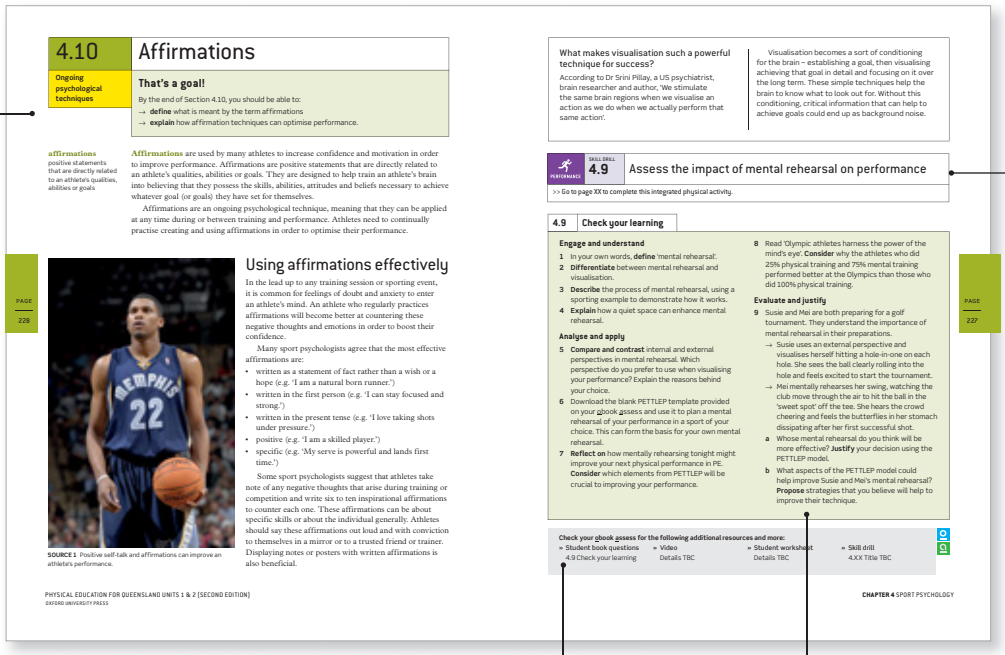
Chapter openers
Each chapter begins with a chapter opener that includes:

- key terms from the syllabus
- an inspirational quote to spark discussion
- links to relevant digital resources provided on the obook
- a content grid that shows the coverage of all subject matter from the syllabus.

Skill Drill links – direct links to practical activities (provided in a handy reference section at the back of the Student book)

Section-based approach
Content throughout the Student book is presented in clearly structured **sections**. Each section:

- is clearly labelled and numbered to help navigation
- ranges in length from 2–10 pages.



4.10 Affirmations

Ongoing psychological techniques

That's a goal!

By the end of Section 4.10, you should be able to:
→ **define** what is meant by the term affirmations
→ **explain** how affirmation techniques can optimise performance.

affirmations positive statements that are directly related to an athlete's qualities, abilities or goals

Affirmations are used by many athletes to increase confidence and motivation in order to improve performance. Affirmations are positive statements that are directly related to an athlete's qualities, abilities or goals. They are designed to help train an athlete's brain into believing that they possess the skills, abilities, attitudes and beliefs necessary to achieve whatever goal (or goals) they have set for themselves.

Affirmations are an ongoing psychological technique, meaning that they can be applied at any time during or between training and performance. Athletes need to continually practise creating and using affirmations in order to optimise their performance.

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SOURCE 1 Positive self-talk and affirmations can improve an athlete's performance.

Using affirmations effectively

In the lead up to any training session or sporting event, it is common for feelings of doubt and anxiety to enter an athlete's mind. An athlete who regularly practices affirmations will become better at countering these negative thoughts and emotions in order to boost their confidence.

Many sport psychologists agree that the most effective affirmations are:

- written as a statement of fact rather than a wish or a hope (e.g. 'I am a natural born runner.')
- written in the first person (e.g. 'I can stay focused and strong.')
- written in the present tense (e.g. 'I love taking shots under pressure.')
- positive (e.g. 'I am a skilled player.')
- specific (e.g. 'My serve is powerful and lands first time.')

Some sport psychologists suggest that athletes take note of any negative thoughts that arise during training or competition and write six to ten inspirational affirmations to counter each one. These affirmations can be about specific skills or about the individual generally. Athletes should say these affirmations out loud and with conviction to themselves in a mirror or to a trusted friend or trainer. Displaying notes or posters with written affirmations is also beneficial.

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What makes visualisation such a powerful technique for success?

According to Dr Srini Pillay, a US psychiatrist, brain researcher and author, 'We stimulate the same brain regions when we visualise an action as we do when we actually perform that same action'.

Visualisation becomes a sort of conditioning for the brain – establishing a goal, then visualising achieving that goal in detail and focusing on it over the long term. These simple techniques help the brain to know what to look out for. Without this conditioning, critical information that can help to achieve goals could end up as background noise.

PERFORMANCE SKILL DRILL 4.9 Assess the impact of mental rehearsal on performance

>> Go to page XX to complete this integrated physical activity.

4.9 Check your learning

Engage and understand

1 In your own words, **define** 'mental rehearsal'.
2 **Differentiate** between mental rehearsal and visualisation.
3 **Describe** the process of mental rehearsal, using a sporting example to demonstrate how it works.
4 **Explain** how a quiet space can enhance mental rehearsal.

Analyse and apply

5 **Compare and contrast** internal and external perspectives in mental rehearsal. Which perspective do you prefer to use when visualising your performance? Explain the reasons behind your choice.
6 Download the blank PETTLEP template provided on your obook assess and use it to plan a mental rehearsal of your performance in a sport of your choice. This can form the basis for your own mental rehearsal.
7 **Reflect on** how mentally rehearsing tonight might improve your next physical performance in PE. **Consider** which elements from PETTLEP will be crucial to improving your performance.
8 Read 'Olympic athletes harness the power of the mind's eye'. **Consider** why the athletes who did 25% physical training and 75% mental training performed better at the Olympics than those who did 100% physical training.

Evaluate and justify

9 Susie and Mei are both preparing for a golf tournament. They understand the importance of mental rehearsal in their preparations.
→ Susie uses an external perspective and visualises herself hitting a hole-in-one on each hole. She sees the ball clearly rolling into the hole and feels excited to start the tournament.
→ Mei mentally rehearses her swing, watching the club move through the air to hit the ball in the 'sweet spot' off the tee. She hears the crowd cheering and feels the butterflies in her stomach dissipating after her first successful shot.
a Whose mental rehearsal do you think will be more effective? **Justify** your decision using the PETTLEP model.
b What aspects of the PETTLEP model could help improve Susie and Mei's mental rehearsal? **Propose** strategies that you believe will help to improve their technique.

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Check your obook assess for the following additional resources and more:

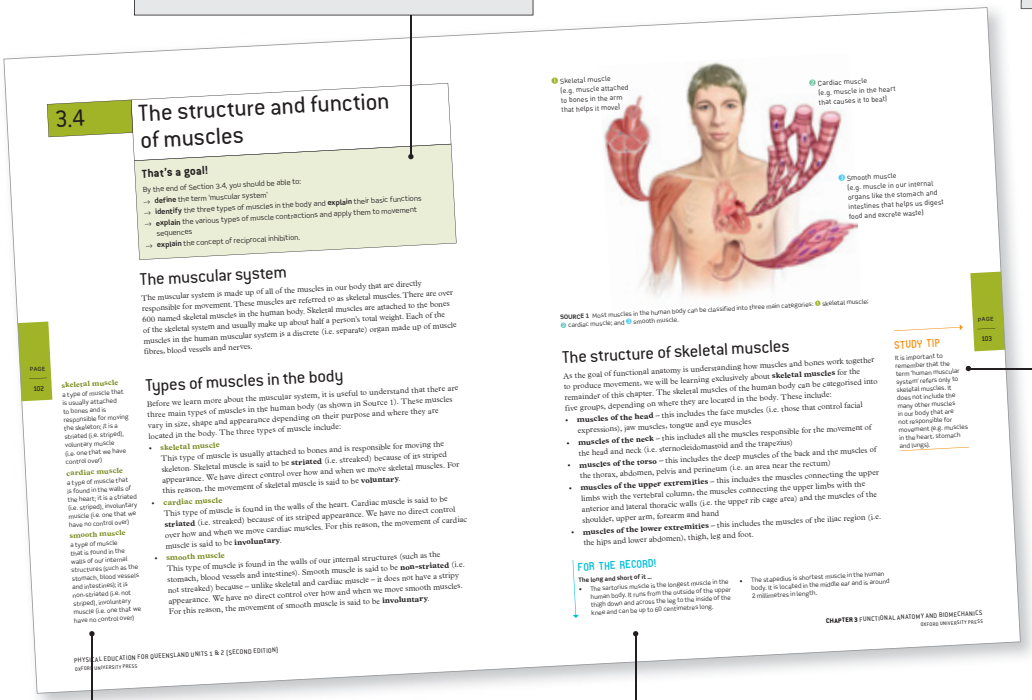
» Student book questions	» Video	» Student worksheet	» Skill drill
4.9 Check your learning	Details TBC	Details TBC	4.XX Title TBC

CHAPTER 4 SPORT PSYCHOLOGY

Links to supporting digital resources – additional student and teacher resources offered on obook assess

Check your learning – activity boxes with questions and tasks organised according to Marzano's taxonomy and using cognitive verbs

That's a goal! – a set of clear **learning objectives** from the syllabus



3.4 The structure and function of muscles

That's a goal!

By the end of Section 3.4, you should be able to:
→ **define** the term 'muscular system'
→ **identify** the three types of muscles in the body and **explain** their basic functions
→ **explain** the various types of muscle contractions and apply them to movement sequences
→ **explain** the concept of reciprocal inhibition.

The muscular system

The muscular system is made up of all of the muscles in our body that are directly responsible for movement. These muscles are referred to as skeletal muscles. There are over 600 named skeletal muscles in the human body. Skeletal muscles are attached to the bones of the skeletal system and usually make up about half a person's total weight. Each of the muscles in the human muscular system is a discrete (i.e. separate) organ made up of muscle fibres, blood vessels and nerves.

PAGE 102

skeletal muscle a type of muscle that is usually attached to bones and is responsible for moving the skeleton; it is a striated (i.e. striped), voluntary muscle (i.e. one that we have control over)

cardiac muscle a type of muscle that is found in the walls of the heart; it is a striated (i.e. striped), involuntary muscle (i.e. one that we have no control over)

smooth muscle a type of muscle that is found in the walls of our internal structures (such as the stomach, blood vessels and intestines); it is non-striated (i.e. not striped), involuntary muscle (i.e. one that we have no control over)

Types of muscles in the body

Before we learn more about the muscular system, it is useful to understand that there are three main types of muscles in the human body (as shown in Source 1). These muscles vary in size, shape and appearance depending on their purpose and where they are located in the body. The three types of muscle include:

- **skeletal muscle**
  This type of muscle is usually attached to bones and is responsible for moving the skeleton. Skeletal muscle is said to be **striated** (i.e. streaked) because of its striped appearance. We have direct control over how and when we move skeletal muscles. For this reason, the movement of skeletal muscle is said to be **voluntary**.
- **cardiac muscle**
  This type of muscle is found in the walls of the heart. Cardiac muscle is said to be **striated** (i.e. streaked) because of its striped appearance. We have no direct control over how and when we move cardiac muscles. For this reason, the movement of cardiac muscle is said to be **involuntary**.
- **smooth muscle**
  This type of muscle is found in the walls of our internal structures (such as the stomach, blood vessels and intestines). Smooth muscle is said to be **non-striated** (i.e. not streaked) because – unlike skeletal and cardiac muscle – it does not have a stripy appearance. We have no direct control over how and when we move smooth muscles. For this reason, the movement of smooth muscle is said to be **involuntary**.

1 Skeletal muscle (e.g. muscle attached to bones in the arm that helps it move)
2 Cardiac muscle (e.g. muscle in the heart that causes it to beat)
3 Smooth muscle (e.g. muscle in our internal organs like the stomach and intestines that helps us digest food and excrete waste)

SOURCE 1 Most muscles in the human body can be classified into three main categories: 1 skeletal muscle; 2 cardiac muscle; and 3 smooth muscle.

The structure of skeletal muscles

As the goal of functional anatomy is understanding how muscles and bones work together to produce movement, we will be learning exclusively about **skeletal muscles** for the remainder of this chapter. The skeletal muscles of the human body can be categorised into five groups, depending on where they are located in the body. These include:

- **muscles of the head** – this includes the face muscles (i.e. those that control facial expressions), jaw muscles, tongue and eye muscles
- **muscles of the neck** – this includes all the muscles responsible for the movement of the head and neck (i.e. sternocleidomastoid and the trapezius)
- **muscles of the torso** – this includes the deep muscles of the back and the muscles of the thorax, abdomen, pelvis and perineum (i.e. an area near the rectum)
- **muscles of the upper extremities** – this includes the muscles connecting the upper limbs with the vertebral column, the muscles connecting the upper limbs with the anterior and lateral thoracic walls (i.e. the upper rib cage area) and the muscles of the shoulder, upper arm, forearm and hand
- **muscles of the lower extremities** – this includes the muscles of the iliac region (i.e. the hips and lower abdomen), thigh, leg and foot.

FOR THE RECORD!

The long and short of it ...

- The sartorius muscle is the longest muscle in the human body. It runs from the outside of the upper thigh down and across the leg to the inside of the knee and can be up to 60 centimetres long.
- The stapedius is shortest muscle in the human body. It is located in the middle ear and is around 2 millimetres in length.

CHAPTER 3 FUNCTIONAL ANATOMY AND BIOMECHANICS OXFORD UNIVERSITY PRESS

STUDY TIP

It is important to remember that the term 'human muscular system' refers only to skeletal muscles. It does not include the many other muscles in our body that are not responsible for movement (e.g. muscles in the heart, stomach and lungs).

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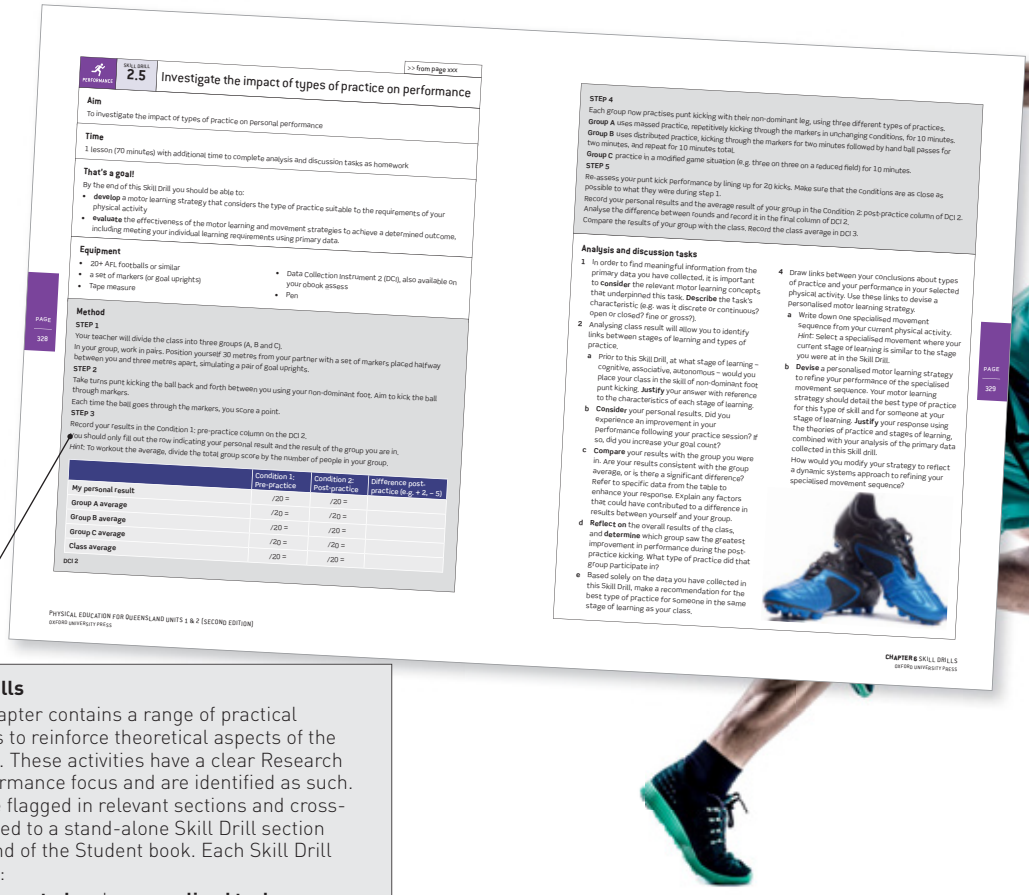
Study tip – practical advice to help students improve their performance in assessment tasks

Margin glossary – key terms bolded in text and defined on the page

For the record! – fun, interesting and quirky facts related to key subject matter



PERFORMANCE SKILL DRILL 2.5 Investigate the impact of types of practice on performance

>> from page xxx

Aim

To investigate the impact of types of practice on personal performance

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **develop** a motor learning strategy that considers the type of practice suitable to the requirements of your physical activity
- **evaluate** the effectiveness of the motor learning and movement strategies to achieve a determined outcome, including meeting your individual learning requirements using primary data.

Equipment

- 20+ AFL footballs or similar
- a set of markers (or goal uprights)
- Tape measure
- Data Collection Instrument 2 (DCI), also available on your eBook assess
- Pen

Method

STEP 1

Your teacher will divide the class into three groups (A, B and C).

In your group, work in pairs. Position yourself 30 metres from your partner with a set of markers placed halfway between you and three metres apart, simulating a pair of goal uprights.

STEP 2

Take turns punt kicking the ball back and forth between you using your non-dominant foot. Aim to kick the ball through markers.

Each time the ball goes through the markers, you score a point.

STEP 3

Record your results in the Condition 1: pre-practice column on the DCI 2.

You should only fill out the row indicating your personal result and the result of the group you are in.

Hint: To workout the average, divide the total group score by the number of people in your group.

	Condition 1: Pre-practice	Condition 2: Post-practice	Difference post-practice (e.g. + 2, – 5)
My personal result	/20 =	/20 =	
Group A average	/20 =	/20 =	
Group B average	/20 =	/20 =	
Group C average	/20 =	/20 =	
Class average	/20 =	/20 =	

DCI 2

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STEP 4

Each group now practises punt kicking with their non-dominant leg, using three different types of practices.

Group A uses massed practice, repetitively kicking through the markers in unchanging conditions, for 10 minutes.

Group B uses distributed practice, kicking through the markers for two minutes followed by hand ball passes for two minutes, and repeat for 10 minutes total.

Group C practice in a modified game situation (e.g. three on three on a reduced field) for 10 minutes.

STEP 5

Re-assess your punt kick performance by lining up for 20 kicks. Make sure that the conditions are as close as possible to what they were during step 1.

Record your personal results and the average result of your group in the Condition 2: post-practice column of DCI 2.

Analyse the difference between rounds and record it in the final column of DCI 2.

Compare the results of your group with the class. Record the class average in DCI 3.

Analysis and discussion tasks

1 In order to find meaningful information from the primary data you have collected, it is important to **consider** the relevant motor learning concepts that underpinned this task. **Describe** the task's characteristic (e.g. was it discrete or continuous? Open or closed? Fine or gross?).

2 Analysing class result will allow you to identify links between stages of learning and types of practice.

a Prior to this Skill Drill, at what stage of learning – cognitive, associative, autonomous – would you place your class in the skill of non-dominant foot punt kicking. **Justify** your answer with reference to the characteristics of each stage of learning.

b **Consider** your personal results. Did you experience an improvement in your performance following your practice session? If so, did you increase your goal count?

c **Compare** your results with the group you were in. Are your results consistent with the group average, or is there a significant difference? Refer to specific data from the table to enhance your response. Explain any factors that could have contributed to a difference in results between yourself and your group.

d **Reflect on** the overall results of the class, and **determine** which group saw the greatest improvement in performance during the post-practice kicking. What type of practice did that group participate in?

e Based solely on the data you have collected in this Skill Drill, make a recommendation for the best type of practice for someone in the same stage of learning as your class.

4 Draw links between your conclusions about types of practice and your performance in your selected physical activity. Use these links to devise a personalised motor learning strategy.

a Write down one specialised movement sequence from your current physical activity.
Hint: Select a specialised movement where your current stage of learning is similar to the stage you were at in the Skill Drill.

b **Devise** a personalised motor learning strategy to refine your performance of the specialised movement sequence. Your motor learning strategy should detail the best type of practice for this type of skill and for someone at your stage of learning. **Justify** your response using the theories of practice and stages of learning, combined with your analysis of the primary data collected in this Skill drill.

How would you modify your strategy to reflect a dynamic systems approach to refining your specialised movement sequence?

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CHAPTER 6 SKILL DRILLS OXFORD UNIVERSITY PRESS

Skill Drills

Each chapter contains a range of practical activities to reinforce theoretical aspects of the syllabus. These activities have a clear Research or Performance focus and are identified as such. They are flagged in relevant sections and cross-referenced to a stand-alone Skill Drill section at the end of the Student book. Each Skill Drill features:

- an **integrated** and **personalised task**
- links to **subject matter** coverage
- a consistent experiment-style layout
- a range of **Game Performance Assessment Instruments (GPAIs)** and **Data Collection Instruments (DCIs)** to support the collection of primary data
- a range of analysis and discussion tasks.

In the news – relevant issues and examples being reported and debated in the media

participation (such as having to purchase compulsory uniforms or pay high membership fees) act as a barrier to children from low income households. Certain institutions can also implement and enforce policies about wearing certain uniforms that make some athletes feel uncomfortable or go against their religious beliefs. These are also barriers.

An example of a sporting institution creating and enforcing a policy is discussed in the following news article.

IN THE NEWS

Caster Semenya: IAAF rules to limit testosterone levels for female runners

AP/REUTERS, ABC NEWS, 26 APRIL 2018

The International Association of Athletics Federations (IAAF) has published new rules for female athletes with high natural testosterone levels which could force two-time Olympic 800-metre champion Caster Semenya to stop running middle-distance races.

From November 1, the IAAF will limit entry for all international events from 400 metres through the mile (1500 metres) to women with testosterone levels below a specified level.

Women with elevated testosterone must reduce their level for "six months (e.g. by use of hormonal contraceptives) before being eligible to run, and maintain that lowered level.

IAAF president Sebastian Coe says track's governing body must "ensure a level playing field where success is determined by talent, dedication and hard work rather than other contributing factors."

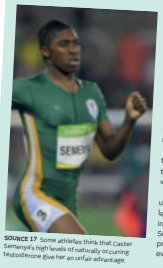
'We want athletes to be incentivised to make the huge commitment and sacrifice required to excel in the sport, and to inspire new generations to join the sport and aspire to the same excellence,' he said.

Semenya now faces taking daily medication or start racing for South Africa at 5000 metres.

Semenya, double Olympic and triple world champion over 800 metres and who completed the 800–1500 double at the Commonwealth Games this month, responded to the new rules on Twitter, saying 'I am 97 per cent sure you don't like me but I'm 100 per cent sure I don't care.'

Athletics authorities have struggled to find a solution to the issue that respected the rights of Semenya while also providing what they say is a level playing field.

Other athletes believe she has an unfair advantage because of the high levels of naturally occurring testosterone in her body. But, under the new rules Semenya will either have to take prescribed medication to compete at her event or move to longer-distance running.



SOURCE 17 Some athletes think that Caster Semenya's high levels of naturally occurring testosterone give her an unfair advantage.

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Theory in action – **real-life examples** and **case studies** to illustrate theoretical points being explained in the text

The influence of siblings is also significant in determining a child's sporting choices. It is common for younger children to be interested in the same sports and activities as their older siblings. Parents often encourage this, as having two children choosing the same sport can be more convenient and offer cost savings. This can be a barrier for some younger siblings who may not end up pursuing the sport they would prefer. In some cases, siblings can also be a negative influence. For example, when there is a clear difference in ability from one sibling to another, the less-able sibling can feel inadequate. This has been known to discourage young athletes from trying their hardest or continuing in the sport. The Theory in action below further explores how parents and peers act as enablers of physical activity.

Theory in action Agents of socialisation as barriers and enablers of physical activity

Siblings Ella and Liam Green from Siena Catholic College on the Sunshine Coast reflect on the ways in which agents of socialisation have acted as barriers and enablers of physical activity.

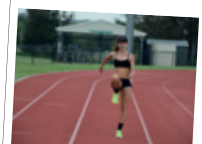
Ella Green, 17 years old

'Both of my parents were very athletic growing up and continue to follow sports today, so when they heard that I wanted to take on competitive running they were ecstatic. My parents supported me financially. Most importantly, my parents emotionally supported me; always making the time to come and watch me train and compete, rain, hail or shine. When training became a challenge, or my performance dipped, the support from my parents was crucial to helping me keep sight of my goals. When I reflect on my athletics experiences – my opportunities to participate at a regional, state and national level – my parents are a part of those wonderful memories.'

Liam Green, 15 years old

In Term 1 of Year 7, we were told to select a Wednesday afternoon sport option for the semester and I chose rugby league. I had never played a contact sport before and wanted to try it out, so after a bit of convincing and pleading with my mum I tried out for the team and was successful.

I played on the wing and in the first game I scored two tries and was instantly hooked, even though the tries were nothing to do with skill – they were more about speed and size, as I was taller than the average for boys of my age. After that game, all my friends wanted me to play rugby union for school and club. At the time, my sister was involved with multiple sports, mainly athletics, and we couldn't make it to many of the games so that meant I couldn't play. However, a few years later I was finally able to sign up and I am now playing in the U/16 rugby team. All the boys from my school that were playing for the University Club aren't playing now, because they want to concentrate on their studies, but I'm grateful to them for their encouragement in Year 7 because I may never have given rugby union a go otherwise. Now it's a sport that I have come to love and will continue to play for as long as possible.



SOURCE 4 The support from Ella Green's parents has been a strong enabler for her participation and success as athletics.

SOURCE 5 Liam Green was enticed into the game of rugby union by his friends. Peer influence, when positive, can act as a strong enabler.

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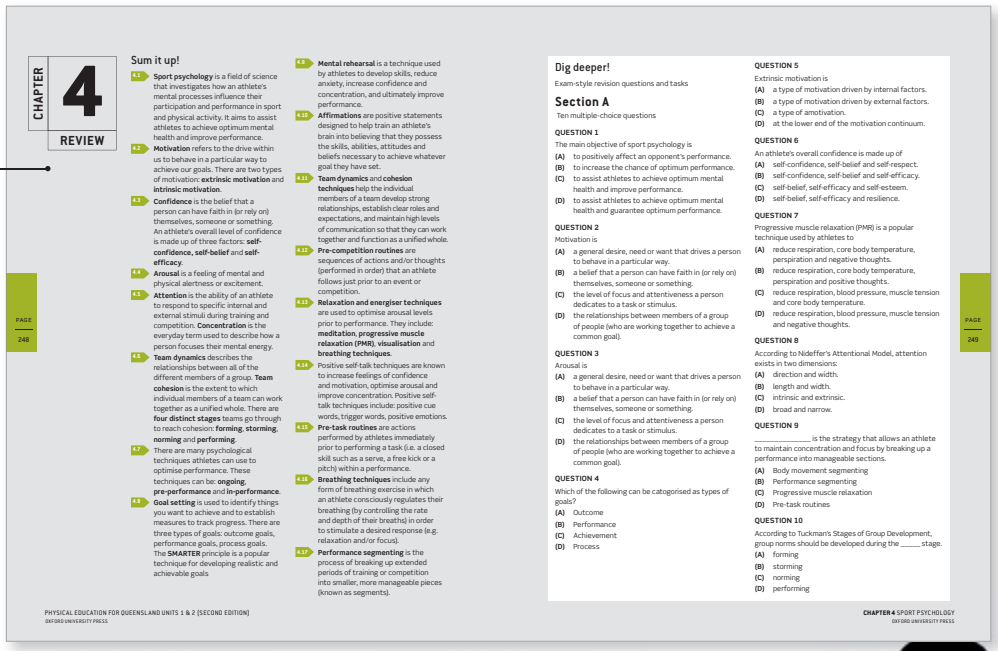
CHAPTER 5 EQUITY – BARRIERS AND ENABLERS OXFORD UNIVERSITY PRESS

Chapter reviews

Each chapter concludes with a chapter review that includes:

- a **summary of key learning** (with links back to relevant sections in the Student book for targeted revision)
- revision questions in the form of a **sample exam**
- a **sample assessment task with ISMG**.



CHAPTER 4 REVIEW

Sum it up!

4.1 **Sport psychology** is a field of science that investigates how an athlete's mental processes influence their participation and performance in sport and physical activity. It aims to assist athletes to achieve optimum mental health and improve performance.

4.2 **Motivation** refers to the drive within us to behave in a particular way to achieve our goals. There are two types of motivation: **extrinsic motivation** and **intrinsic motivation**.

4.3 **Confidence** is the belief that a person can have faith in (or rely on) themselves, someone or something. An athlete's overall level of confidence is made up of three factors: **self-confidence, self-belief** and **self-efficacy**.

4.4 **Arousal** is a feeling of mental and physical alertness or excitement.

4.5 **Attention** is the ability of an athlete to respond to specific internal and external stimuli during training and competition. **Concentration** is the everyday term used to describe how a person focuses their mental energy.

4.6 **Team dynamics** describes the relationships between all of the different members of a group. **Team cohesion** is the extent to which individual members of a team can work together as a unified whole. There are **four distinct stages** teams go through to reach cohesion: **forming**, **storming**, **norming** and **performing**.

4.7 There are many psychological techniques athletes can use to optimise performance. These techniques can be: **ongoing**, **pre-performance** and **in-performance**.

4.8 **Goal setting** is used to identify things you want to achieve and to establish measures to track progress. There are three types of goals: outcome goals, performance goals, process goals. The **SMARTER** principle is a popular technique for developing realistic and achievable goals

4.9 **Mental rehearsal** is a technique used by athletes to develop skills, reduce anxiety, increase confidence and concentration, and ultimately improve performance.

4.10 **Affirmations** are positive statements designed to help train an athlete's brain into believing that they possess the skills, abilities, attitudes and beliefs necessary to achieve whatever goal they have set.

4.11 **Team dynamics** and **cohesion techniques** help the individual members of a team develop strong relationships, establish clear roles and expectations, and maintain high levels of communication so that they can work together and function as a unified whole.

4.12 **Pre-competition routines** are sequences of actions and/or thoughts (performed in order) that an athlete follows just prior to an event or competition.

4.13 **Relaxation and energiser techniques** are used to optimise arousal levels prior to performance. They include: **meditation**, **progressive muscle relaxation (PMR)**, **visualisation** and **breathing techniques**.

4.14 Positive self-talk techniques are known to increase feelings of confidence and motivation, optimise arousal and improve concentration. Positive self-talk techniques include: positive cue words, trigger words, positive emotions.

4.15 **Pre-task routines** are actions performed by athletes immediately prior to performing a task (i.e. a closed skill such as a serve, a free kick or a pitch) within a performance.

4.16 **Breathing techniques** include any form of breathing exercise in which an athlete consciously regulates their breathing (by controlling the rate and depth of their breaths) in order to stimulate a desired response (e.g. relaxation and/or focus).

4.17 **Performance segmenting** is the process of breaking up extended periods of training or competition into smaller, more manageable pieces (known as segments).

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Dig deeper!

Exam-style revision questions and tasks

Section A

Ten multiple-choice questions

QUESTION 1
The main objective of sport psychology is
(A) to positively affect an opponent's performance.
(B) to increase the chance of optimum performance.
(C) to assist athletes to achieve optimum mental health and improve performance.
(D) to assist athletes to achieve optimum mental health and guarantee optimum performance.

QUESTION 2
Motivation is
(A) a general desire, need or want that drives a person to behave in a particular way.
(B) a belief that a person can have faith in (or rely on) themselves, someone or something.
(C) the level of focus and attentiveness a person dedicates to a task or stimulus.
(D) the relationships between members of a group of people (who are working together to achieve a common goal).

QUESTION 3
Arousal is
(A) a general desire, need or want that drives a person to behave in a particular way.
(B) a belief that a person can have faith in (or rely on) themselves, someone or something.
(C) the level of focus and attentiveness a person dedicates to a task or stimulus.
(D) the relationships between members of a group of people (who are working together to achieve a common goal).

QUESTION 4
Which of the following can be categorised as types of goals?
(A) Outcome
(B) Performance
(C) Achievement
(D) Process

QUESTION 5
Extrinsic motivation is
(A) a type of motivation driven by internal factors.
(B) a type of motivation driven by external factors.
(C) a type of amotivation.
(D) at the lower end of the motivation continuum.

QUESTION 6
An athlete's overall confidence is made up of
(A) self-confidence, self-belief and self-respect.
(B) self-confidence, self-belief and self-efficacy.
(C) self-belief, self-efficacy and self-esteem.
(D) self-belief, self-efficacy and resilience.

QUESTION 7
Progressive muscle relaxation (PMR) is a popular technique used by athletes to
(A) reduce respiration, core body temperature, perspiration and negative thoughts.
(B) reduce respiration, core body temperature, perspiration and positive thoughts.
(C) reduce respiration, blood pressure, muscle tension and core body temperature.
(D) reduce respiration, blood pressure, muscle tension and negative thoughts.

QUESTION 8
According to Nideffer's Attentional Model, attention exists in two dimensions:
(A) direction and width.
(B) length and width.
(C) intrinsic and extrinsic.
(D) broad and narrow.

QUESTION 9
_____ is the strategy that allows an athlete to maintain concentration and focus by breaking up a performance into manageable sections.
(A) Body movement segmenting
(B) Performance segmenting
(C) Progressive muscle relaxation
(D) Pre-task routines

QUESTION 10
According to Tuckman's Stages of Group Development, group norms should be developed during the _____ stage.
(A) forming
(B) storming
(C) norming
(D) performing

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CHAPTER 4 SPORT PSYCHOLOGY
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Integrated digital teaching and learning support

Oxford's award-winning digital platform – obook assess – provides secondary school students and teachers with access to a huge range of additional resources to support and enhance teaching and learning.

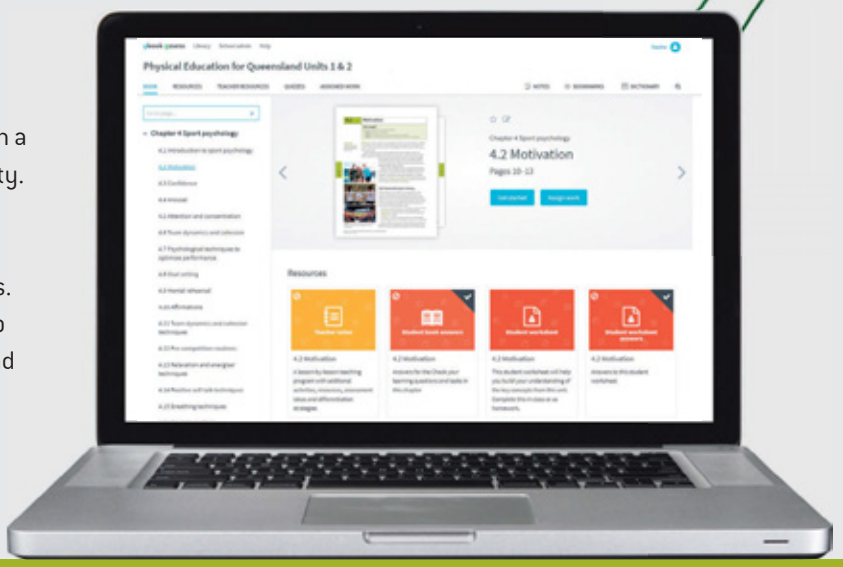
Student obook assess

Student obook assess provides a fully interactive digital experience for students that is compatible with laptops, iPads, tablets and IWBs. Access to content is available online and offline.

- obook is an interactive digital version of the Student book with note-taking, highlighting and dictionary support included. Every obook contains links to additional resources, such as videos, worksheets, weblinks, interactive modules and assessment support.
- assess is an online assessment platform that provides access to hundreds of additional auto-correcting questions designed to support student understanding and progression across all subjects.

Teacher obook assess

Teacher obook assess supports teachers with a range of additional resources and functionality. Access detailed teacher notes, planning and assessment advice, answers to all activities, class tests, videos and additional worksheets. **Teacher obook assess** also allows teachers to assign work electronically, track progress, and manage results and assessment.



PHYSICAL EDUCATION FOR QUEENSLAND UNITS 1 & 2 (SECOND EDITION)
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CHAPTER 1

PHYSICAL EDUCATION TOOLKIT

Welcome to Physical Education Units 1 & 2

Congratulations on choosing Physical Education as part of your QCE studies! Physical Education is an exciting, relevant and engaging subject that allows you to gain a deeper understanding of the importance of health and physical activity in the context of a diverse and changing world.

This Student book – and the many digital resources that support it – has been purpose-written to meet the requirements of the QCAA Physical Education 2019 General Senior Syllabus. It includes all of the content you are required to cover in Units 1 & 2.

QCE Physical Education involves more than just learning about theoretical subject matter in a classroom. It also involves learning practical subject matter in physical activity contexts. Furthermore, it involves making connections between the two – that is, how theoretical concepts and ideas can be used to improve your performance.

This Physical Education toolkit contains a range of useful and relevant information to help you achieve these goals and get the most out of QCE Physical Education. It can be used as an introduction and overview to the course, but is also designed as a handy reference that can be revisited throughout the year. It includes the following topics:

- Course overview for QCE Physical Education
- Assessment overview for QCE Physical Education
- The importance of data in QCE Physical Education
- Careers in physical education.

Best of luck in your studies this year,

Crystal Hede, Kate Russell, Ron Weatherby and Ben Williams.

1.1 Course overview for QCE Physical Education

STUDY TIP

Make sure you visit the QCAA website and download a copy of the Physical Education General Senior Syllabus. It sets out all of the information you are expected to learn and provides important information on how you will be assessed.

A link to the syllabus is provided via your obook assess.

Everything you need to know about the QCE Physical Education syllabus is set out in a document known as the **General Senior Syllabus** that is released by the **Queensland Curriculum and Assessment Authority (QCAA)**.

The General Senior Syllabus is the most important document supporting the QCE Physical Education course. It includes all of the information you are expected to learn and provides important information on how you will be assessed. The current syllabus will be taught for the first time in 2019 in Year 11 and 2020 in Year 12.

Structure of the QCE Physical Education course

QCE Physical Education is a two-year course is made up of four units. Each Unit of the course is separated into **Topics**. You are required to achieve an **Outcome** for each Area of Study.

Source 1 shows how Units 1 & 2 of the course are broken down into topics and notional hours. It also shows the chapters in this Student book that cover this content.

Source 2 shows how Units 3 & 4 of the course are broken down into topics and notional hours. It also shows how the chapters in *Physical Education for Queensland Units 3 & 4* cover this content.

COURSE STRUCTURE FOR UNITS 1 & 2

Units	Topics	Notional hours	Corresponding chapters in *Physical Education for Queensland Units 1 & 2*
Unit 1 – Motor learning, functional anatomy and biomechanics and physical activity	Topic 1: Motor learning integrated with a selected physical activity	→ 22 hours	Chapter 2
	Topic 2: Functional anatomy and biomechanics integrated with a selected physical activity	→ 33 hours	Chapter 3
Unit 2 – Sport psychology, equity and physical activity	Topic 1: Sport psychology integrated with a selected physical activity	→ 33 hours	Chapter 4
	Topic 2: Equity – barriers and enablers	→ 22 hours	Chapter 5

Source: *Physical Education 2019 v1.1 General Senior Syllabus © Queensland Curriculum & Assessment Authority.*

SOURCE 1 Structure of QCE Physical Education Units 1 & 2

COURSE STRUCTURE FOR UNITS 3 & 4

Units	Topics	Notional hours	Corresponding chapters in *Physical Education for Queensland Units 3 & 4*
Unit 3 – Tactical awareness, ethics and integrity and physical activity	Topic 1: Tactical awareness integrated with one selected 'Invasion' or 'Net and court' physical activity	→ 33 hours	Chapter 2
	Topic 2: Ethics and integrity	→ 22 hours	Chapter 3
Unit 4 – Energy, fitness and training and physical activity	Topic 1: Energy, fitness and training integrated with one selected 'Invasion', 'Net and court' or 'Performance' physical activity	→ 55 hours	Chapter 4

Source: *Physical Education 2019 v1.1 General Senior Syllabus © Queensland Curriculum & Assessment Authority.*

SOURCE 2 Structure of QCE Physical Education Units 3 and 4

SOURCE 3 QCE Physical Education is a two-year course made up of four units. Units 1 & 2 are covered in *Physical Education for Queensland Units 1 & 2* (Second edition) and Units 3 & 4 are covered in *Physical Education for Queensland Units 3 & 4* (Second edition).

Subject matter

Each topic in the course includes a series of **subject matter** dot points. These dot points tell you what you should know and learn. They are organised into three stages of inquiry.

Stages of learning

Stage 1: Engage and understand – At this stage you will gather data and learn about key concepts.

Stage 2: Apply and analyse – At this stage you will apply the data and concepts you have gathered during Stage 1 in authentic performance environments and devise strategies to optimise performance.

Stage 3: Evaluate and justify – At this stage you will evaluate the effectiveness of strategies you applied in Stage 2 and make decisions.

You will find the subject matter dot points for every topic at the start of each chapter of this book. It is important that you read and become familiar with these before you begin each chapter.

Body and movement concepts

body and movement concepts
a group of four concepts used to develop specialised movement sequences and strategies in different sports and physical activities. The concepts are body awareness, space awareness, quality of movement, and relationships (e.g. to objects and other people)

specialised movement sequence
a combination of movement skills that enable the body to move in response to a stimulus

Throughout the course, you will be expected to apply **body and movement concepts** to **specialised movement sequences** and movement strategies in your selected physical activity.

Body and movement concepts can be used as the criteria for evaluating your performance of specialised movement sequences and movement strategies. Specialised movement sequences represent the combination of movement skills and sequences relative to the position or event in a selected physical activity. Movement strategies refer to a variety of approaches that will help an individual or team achieve a determined outcome.

The body and movement concepts included in QCE Physical Education are shown in Source 4.

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
→ 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

Source: *Physical Education 2019 v1.1 General Senior Syllabus © Queensland Curriculum & Assessment Authority.*

SOURCE 4 Body and movement concepts

Categories of physical activity

Over the course of your studies in Physical Education you will be required to participate in a number of different physical activities and integrate these into your theoretical learning. When you and your teacher select physical activities, you must take care to follow these guidelines:

- the selected physical activities must come from the categories of physical activities in Source 5
- in Units 1 & 2, at least two categories of physical activity must be selected.
- in Units 3 & 4, physical activities must be selected from specific categories. You must select:
  - one physical activity from either the 'Invasion' or 'Net and court' category in Unit 3: Topic 1
  - one physical activity from one of the 'Invasion', 'Net and court' or 'Performance' categories in Unit 4: Topic 1.

Category	Physical activities	Units 1 & 2	Unit 3	Unit 4
Aesthetic	→ Aerobic gymnastics (sport aerobics)	•		
Invasion	→ Australian football → Basketball → Futsal → Netball → Soccer → Touch football → Water polo	•	•	•
Net and court	→ Badminton → Tennis → Volleyball	•	•	•
Performance	→ Duathlon, aquathlon, triathlon → Swimming → Track and field – jump → Track and field – throws → Track and field – track	•		•
Striking and fielding	→ Cricket → Softball	•		
Target	→ Archery → Golf → Lawn bowls	•		

SOURCE 5 Categories of physical activities

SOURCE 6 Swimming is one of the physical activities in the QCE Physical Education syllabus.

Check your obook assess for the following additional resources and more:

» **Chapter glossary**
Learn key terms from Chapter 1

» **Flashcard glossary**
A digital interactive to help you test your knowledge of key terms

» **Weblink**
QCAA Physical Education General Senior Syllabus

1.2 Assessment overview for QCE Physical Education

Structure of assessment in the QCE Physical Education course

ASSESSMENT STRUCTURE FOR UNITS 1 & 2

Units	Topics	Types of assessment
Unit 1 – Motor learning, functional anatomy and biomechanics and physical activity	→ Topic 1: Motor learning integrated with a selected physical activity	**Formative internal assessment/s** → For reporting purposes, schools should develop at least one assessment per unit, with a maximum of four assessments across Units 1 and 2. → All assessment that you complete in QCE Physical Education Units 1 & 2 will be developed and assessed within your school.
	→ Topic 2: Functional anatomy and biomechanics integrated with a selected physical activity	
Unit 2 – Sport psychology, equity and physical activity	→ Topic 1: Sport psychology integrated with a selected physical activity	
	→ Topic 2: Equity – barriers and enablers	

Source: *Physical Education 2019 v1.1 General Senior Syllabus © Queensland Curriculum & Assessment Authority.*

SOURCE 1 Structure of assessment for QCE Physical Education Units 1 & 2

ASSESSMENT STRUCTURE FOR UNITS 3 & 4

Units	Topics	Types of assessment
Unit 3 – Tactical awareness, ethics and integrity and physical activity	→ Topic 1: Tactical awareness integrated with one selected 'Invasion' or 'Net and court' physical activity → Topic 2: Ethics and integrity	**Summative internal assessment 1:** Project – folio (25%)
		Summative internal assessment 2: Investigation – report (20%)
Unit 4 – Energy, fitness and training and physical activity	→ Topic 1: Energy, fitness and training integrated with one selected 'Invasion', 'Net and court' or 'Performance' physical activity	**Summative internal assessment 3:** Project – folio (30%)
		Summative external assessment: Examination – combination response (25%)

Source: *Physical Education 2019 v1.1 General Senior Syllabus © Queensland Curriculum & Assessment Authority.*

SOURCE 2 Structure of assessment for QCE Physical Education Units 3 & 4

Types of assessment in Units 1 & 2

As you complete Units 1 & 2 of the QCE Physical Education course, your teacher will use a variety of learning activities and assessment tasks to assess your knowledge and understanding of key knowledge and key skills.

- Your level of knowledge and understanding of the topics in each unit will be demonstrated through the completion of assessment tasks. Each unit objective (see pages 30–31 and 186–187) will be assessed at least once.
- The types of assessment you will complete throughout Units 1 & 2 will be **formative**. This means they will provide feedback to you and your teacher about your progress throughout the year.
- In Units 1 & 2, your teacher should provide opportunities for you to experience and respond to the types of assessment you will encounter in Units 3 & 4 (see Source 2). As a result, it's very likely that types of assessment tasks that you will be required to complete in Units 1 & 2 will include:
  - Project – folio
  - Investigation – report
  - Examination – combination response.

  Each of these types of assessment will be discussed in more detail in Sections 1.2A, 1.2B and 1.2C.
- All assessment tasks that you complete in QCE Physical Education Units 1 & 2 will be developed and assessed within your school.
- In Units 1 & 2, your level of achievement will not be reported to the QCAA and there is no external end-of-year examination.

SOURCE 3 All assessment tasks that you complete in QCE Physical Education Units 1 & 2 will be developed and assessed within your school. These assessment tasks are likely to take the form of a Project – folio, an Investigation – report, or an Examination – combination response as these are the types assessment tasks you will be expected to complete in Units 3 & 4.

Reporting standards

Throughout Units 1 & 2, your teacher will use a tool known as an **instrument-specific marking guide (ISMG)** to make judgments about your performance on internal (i.e school-based) assessments. Each internal assessment in a syllabus is accompanied by an ISMG (similar to marking criteria). The ISMG for each internal assessment:

- aligns with the assessment objectives for the task
- describes the qualities of different levels student work (and assigns possible marks or grades available for each level).

instrument-specific marking guide (ISMG)
a tool for marking that describes the characteristics evident in student responses and aligns with the identified objectives for the assessment

1.2A Tips for success on the Project – folio

As part of your assessment for Physical Education Units 1 & 2, your teacher may require you to create and submit a **Project – folio**.

Planning and structuring your Project – folio

multimodal presentation
a presentation comprised of more than one media or component

The Project – folio requires you to create a **multimodal presentation**. This presentation can take a number of different forms, including:

- a pre-recorded presentation submitted to your teacher electronically
- a presentation you give in front of an audience (e.g. other students in your class)
- a digital portfolio of videos, images, diagrams and annotations you compile and curate
- a movie or slideshow you create and narrate.

Whatever form your Project – folio takes, it must combine **at least two** modes of communication (e.g. *verbal narration* combined with *visual images* or *written text* combined with *video footage*). Typically, you will be required to create a presentation that is around 9–11 minutes long.

Each of the units you will study in Physical Education is structured according to three stages of inquiry:

- In **Stage 1: Engage and understand** you will learn the knowledge, skills and concepts associated with the theoretical and practical subject matter of the unit.
- In **Stage 2: Apply and analyse** you will use the knowledge, skills and concepts you have learned in Stage 1 to devise and implement strategies or solutions to different kinds of movement problems. Typically, these movement problems involve improving your performance in whatever physical activity you are studying in the unit.
- In **Stage 3: Evaluate and justify** you will judge how well your strategy worked and reflect on how it could be improved.

The sequencing of these stages is important because each stage builds on the one before. The relationship between these three stages also has implications for how you will be assessed in your Project – folio and it affects how you should respond to the task.

Project – folio assignments will always ask you to **evaluate** the effectiveness of the strategy you devised and implemented during the unit and **justify** your evaluation using the data you gathered during the unit as evidence. In other words, they will direct you to create a presentation primarily about the subject matter of Stage 3. The idea is that by evaluating and justifying the strengths and weaknesses of the strategy you applied, you will also demonstrate to your teacher what you learned in Stage 1 and Stage 2 of the inquiry process.

So, whenever you are asked to complete a Project – folio, it can be useful to plan and structure your presentation using the following questions:

1. What strategy did you devise and implement?
2. Why did you devise and implement your strategy in this way?
3. Which parts of your strategy were effective?
4. How do you know these parts of your strategy were effective?
5. Which parts of your strategy were ineffective?

6 How do you know these parts of your strategy were ineffective?
7 How would you change your strategy if you were to repeat the process?
8 Why would you make these changes?

The advantage of being guided by questions like those above is that you will respond to all elements of the assessment task. For example, Questions 3, 5 and 7 prompt you to make **evaluations** (i.e. judgments of value or merit), while Questions 2, 4, 6 and 8 prompt you to **justify** your evaluations by providing reasons that are supported by evidence (i.e. the data you collected during the unit).

For more information about primary and secondary data, and to find out how you can best incorporate data into your Project – folio, go to Section 1.3.

SOURCE 4 The Project – folio requires you to create a multimodal presentation (i.e. it must combine **at least two** modes of communication) that is generally between 9–11 minutes in length.

STUDY TIP

Data is key to your success!
In order to perform well on your Project – folio, you will be required to gather, record, analyse, evaluate and justify a range of primary and secondary data relating to your performance of specialised movement sequences and movement strategies. For more information about all things data, go to Section 1.3 on pages 20–27.

PAGE 11

Creating and presenting your Project – folio

When you are creating your Project – folio, you will need to make the best possible use of the time limit set in the task conditions. A common mistake that students make is spending too much time telling the audience everything there is to know about the topic (e.g. defining all the concepts) and too little time reflecting on and justifying the strengths and weaknesses of the strategies they developed and put into practice.

In order to maximise your chance of success, it is important for you to carefully read the instrument-specific marking guide (ISMG) that your teacher will use before you begin work. Make sure you organise your presentation according to the structure and mark allocation provided in the ISGM.

For more advice and practical tips on how to capture video data and use it to create and present your Project – folio, complete the Skill Drills on your obook assess.

RESEARCH	SKILL DRILL 1.2A	Planning, creating and presenting a Project – folio
Refer to your obook assess to complete this integrated research activity.		

1.2B Tips for success on the Investigation – report

As part of your assessment for Physical Education Units 1 & 2, your teacher may also require you to create and submit an **Investigation – report**.

Planning and researching your Investigation – report

The Investigation – report requires you to research a particular topic (by gathering, analysing and synthesising relevant primary and secondary data) and produce a written report.

The process of researching, collecting, examining and combining a range of information about a topic that goes beyond what you already know as the 'investigation' aspect of the task. Once your investigation is complete, you are required to produce a report of between 1500–2000 words.

Similar to the Project – folio, the Investigation – report will often ask you to **evaluate** the effectiveness of a strategy you have devised and implemented during a unit, and to **justify** your evaluation using the data you gathered as evidence. For example, in Unit 1 – Topic 1, you may be asked to create and submit an Investigation – report in which you evaluate and justify the effectiveness a particular motor learning strategy you implemented in order to improve your performance in lawn bowls. In this case, to complete the Investigation – report, you would need to collect, analyse and synthesise primary and secondary data related to:

- your individual learning requirements
- the types of practice and feedback suitable for lawn bowls (and possibly other physical activities similar to lawn bowls)
- techniques for measuring changes in lawn bowls performance.

As with the Project – folio, organising your research and structuring your response around the eight questions on page 10–11 will help ensure you make the most of your research time and your word count.

Creating and presenting your Investigation – report

Unlike Project – folio assignments, Investigation – report assignments tend to have a specific format you must follow. Specifically, your Investigation – report should include the following sections.

Section	Description
Title page	In this section you should: → include the full title of your Investigation report → include your name, class and school
Table of contents	In this section you should: → reference the headings of each section of your report and list the corresponding page numbers

Section	Description
Introduction	In this section you should: → introduce the topic and frame the investigation by defining its focus (e.g. equity strategies for optimising engagement) → identify the context (e.g. the physical activity you are studying in the unit or topic and the setting in which the unit is taking place).
Discussion	In this section you should: → explain the strategy you devised and implemented and justify why you chose it → evaluate the effectiveness of this strategy and justify your appraisal of its strengths, weaknesses and means for improvement → base your justifications on the relevant primary and secondary data you collected, analysed and synthesised throughout the topic. This should be the largest section of your report.
Conclusion	In this section you should: → summarise (or briefly re-state) the main points you presented in the introduction and discussion sections.
Reference list	In this section you should: → acknowledge all the sources you cited in your report.

SOURCE 5 An Investigation – report should include the following sections.

Note that the title page, table of contents and reference are not included in the word count of your report.

Referencing and crediting sources in your Investigation – report

Since a lot of the information you present in your Investigation – report will come from sources other than your own knowledge and research, it is crucial that you use conventions such as in-text citations and reference lists to acknowledge all of the sources you have used. A link is provided on your obook assess that will show you how to do this.

Crediting and acknowledging secondary data sources is part of 'ethical scholarship'. Every time you make a claim in your report, you should support it with an in-text citation. That way, if the examiner asks themselves, 'Says who? Why should I believe you?' your in-text citation will reference all the other secondary data from authoritative people who have made the same claim. In other words, it will help persuade the reader to accept your evaluation of the strategy you are discussing. Using primary data to support your research serves a similar function. It helps to convince the reader that your arguments are based on evidence, rather than opinion.

For more information about primary and secondary data, and to find out how you can best incorporate data into your Investigation – report, go to Section 1.3.

For more advice and practical tips on how to create and present your Investigation – report, complete the Skill Drill on your obook assess.

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STUDY TIP

Data is key to your success!
In order to perform well on your Investigation – report, you will be required to gather, record, analyse, evaluate and justify a range of primary and secondary data relating to your performance of specialised movement sequences and movement strategies. For more information about all things data, go to Section 1.3 on pages 20–27.

RESEARCH

SKILL DRILL **1.2B**

Creating and presenting an Investigation – report

Refer to your obook assess to complete this integrated research activity.

1.2C Tips for success on the Examination – combination response

As part of your assessment for Physical Education Units 1 & 2, your teacher may also require you to complete an **Examination – combination response**.

The structure of the Examination – combination response

The examination will ask you to demonstrate your knowledge and understanding of the subject matter in a particular Unit by providing answers to a range of questions. During an examination, you will be asked to respond to unseen questions (i.e. questions you have never seen before) about subject matter from the Unit or Topic you have studied.

There are three parts you may encounter in Physical Education examinations:

- **Part 1: Multiple-choice questions** – In this part of the exam you will be presented with a series of multiple-choice questions. Your task will be to select the most correct answer to each question.
- **Part 2: Short-response questions** – In this part of the exam, you will be presented with a number of short-response questions. Your task will be to answer each questions in around 150–200 words.
- **Part 3: Extended response to stimulus** – In this part of the exam, you will be presented with an extended response question that includes a stimulus (e.g. a quote, data table, graph, image or illustration). Your task will be to compose a written response of 400 words or more in response to the stimulus.

STUDY TIP

Cognitive verbs are important!

- In order to perform well in your Examination, you will need to understand the meaning of a number of congnitve verbs.
- For more information about cognitive verbs, go to Section 1.2D on pages 17–19.

Conditions of the Examination – combination response

You will be required to respond to the questions on the examination on your own, under supervised conditions, and in a set time frame. You will have 2 hours (plus 15 minutes of perusal time) to complete the examination. During the perusal time, you are permitted to read the whole examination paper from start to finish and start planning your responses. You are not permitted to start writing until instructed.

In Units 1 & 2, examinations will be developed by your teacher. They will be marked internally at your school. In Units 3 & 4, examinations will be developed by the QCAA and will be completed by all students under the same conditions, at the same time and on the same day. They will be marked externally.

The importance of cognitive verbs in the Examination – combination response

Understanding the **cognitive verbs** used in Physical Education can help you do well in examinations. Short-response and extended response questions, in particular, will often be structured so that the cognition (i.e. thinking skill) appears at the very beginning of the

cognitive verbs
task words that will provide information on what students are expected to provide in an answer to a question

question. For example, you might be presented with a table of a player's performance data before and after implementing a given feedback strategy. The question may then ask you to:

> '**Analyse** the data provided to explore the relationship between the task, the player's results, and the feedback strategy they implemented.'
>
> Being able to correctly respond to a question like this requires you to know that the cognitive verb 'analyse' means to: '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'
>
> Source: Glossary of cognitive verbs February 2017, Queensland Curriculum & Assessment Authority

So, if you encountered this question in the examination, your answer should explain the links between the player's data, the task through which they generated this data and the strategy they implemented which was aimed at improving their performance in the task.

Following instructions in the Examination – combination response

It is important that you read and follow the instructions provided on the examination carefully, so that you give yourself the best chance of doing well.

Tips for answering multiple-choice questions

Understanding the structure and requirements of multiple-choice questions can help you improve your chances of success in the examination. Each multiple-choice question on the examination will require you to select *one* option only. Your task will be to select the most correct answer to each question.

- **Pay careful attention to the wording of each question** – Reading the question carefully will ensure you have the best chance of answering it correctly, so don't rush. Some questions also include particular wording, so be careful of questions that include:
  - negative phrases (e.g. Choose the answer which **does not** describe …)
  - subjective phrases (e.g. Choose the option that **best** describes …)
  - judgement phrases (e.g. Choose the **most correct** answer …)
- **Beware of distractors** – It's common for multiple-choice questions to contain a number of distractors (i.e. the incorrect options). In Physical Education examinations, it's unlikely that you will see any distractors that are obviously wrong. Instead, it's more likely that the question writer will be looking to test your knowledge by including distractors that include common student errors and misconceptions or are almost correct.
- **Don't leave any questions unanswered** – Unless the examination paper specifically states that there will be a penalty for incorrect answers, you should always answer every multiple-choice question. If you're not completely sure of the answer, make an educated guess.

SOURCE 6 Examinations will be taken under supervised conditions.

Tips for answering short-response questions and extended response to stimulus questions

- **Pay attention to the suggested word limits** – You should pay attention to the suggested word limits for each question and take care to follow them. If the suggested word limit for a question is 150 words and you find yourself writing 400 words,

there is a good chance that you are not on the right track. Avoid writing everything you know about a topic. Instead, look at what has been asked of you and provide a clear, concise response.

- **Refer directly to the stimulus** – If the question asks you to respond to a stimulus (e.g. a quote, data table, graph, image or illustration) it is essential that you do so in your answer. Most extended response to stimulus questions are designed to allow you to demonstrate your knowledge and understanding of a topic by applying it to the example provided. Whether you agree or disagree with the stimulus is not important. What is important is your ability to back up your point of view using what you have learned.
- **Structure your responses clearly** – Whether you are writing a short answer or an extended response, begin with a very clear statement that directly responds to the question. If you are writing a number of paragraphs, begin each one with a clear topic sentence that explains the main point that you will develop. Use cue phrases such as 'for example,' 'another example,' or 'In contrast' to highlight the fact that you are using specific evidence to support your ideas.
- **Don't just list facts** – Responses that include a long string of facts generally will not receive high marks. To impress the marker, you need to interpret, synthesise and apply these facts to a range of relevant examples to show how they support your opinion.

SOURCE 7 The Physical Education examination will ask you to demonstrate your knowledge and understanding of the subject matter in a particular unit by providing answers to a range of multiple-choice, short-response and extended-response questions.

For more advice and practical tips on how to maximise your chances of success in the Examination – combination response, complete the Skill Drill on your obook assess.

RESEARCH

SKILL DRILL 1.2C

Strategies for improving your results on the Examination – combination response

Refer to your obook assess to complete this integrated research activity.

1.2D Understanding cognitive verbs

In all of the assessments you are asked to complete throughout Units 1 & 2, it's likely that questions and tasks will include an action word (e.g. 'define', 'discuss', 'analyse'). In most cases, this action word is a 'cognitive verb' (i.e. it is a doing word that describes a particular mental process or procedure). In simple terms, cognitive verbs are words that tell you what to do in order to demonstrate your understanding of the subject matter in the syllabus.

Some cognitive verbs are simple to understand and master (e.g. define), while others are more challenging to understand and will take time and practice to master (e.g. synthesise). The table below lists the most common cognitive verbs and their definitions. It also provides examples of questions and tasks so that you can see how each cognitive verb is used in context. A complete list of all cognitive verbs is provided on your obook assess.

Term	Explanation	Example of question/task using cognitive verb
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** the influence of motor learning concepts and principles on your demonstration of the forehand in lawn bowls
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	**Apply** spatial awareness to effectively use court space in netball.
assess	measure, determine, evaluate, estimate or make a judgment about the value, quality, outcomes, results, size, significance, nature or extent of something	**Assess** the validity and reliability of data gathered from online tests and suggest how these factors might be improved.
classify	arrange, distribute or order in classes or categories according to shared qualities or characteristics	**Classify** the following movement sequences according to level of difficulty.
consider	think deliberately or carefully about something, typically before making a decision; take something into account when making a judgment; view attentively or scrutinise; reflect on	Based on your research, **consider** whether you think a player may be at different stages of learning for different skills.
compare	display recognition of similarities and differences and recognise the significance of the similarities and differences	**Compare** the three main types of muscle tissue in the human body.
contrast	display recognition of differences by deliberate juxtaposition of contrary elements; show how things are different or opposite; give an account of the differences between two or more items or situations, referring to both or all of them throughout	**Contrast** the differences between jumping into a striking action and hitting from a stationary position.
create	bring something into being or existence; produce or evolve from one's own thought or imagination; reorganise or put elements together into a new pattern or structure or to form a coherent or functional whole	Using what you have learned, **create** your own pre-competition routine for your selected physical activity.
define	give the meaning of a word, phrase, concept or physical quantity; state the meaning and identify or describe the qualities	**Define** the term 'sport psychology'.

Term	Explanation	Example of question/task using cognitive verb
demonstrate	prove or make clear by argument, reasoning or evidence, illustrating with a practical example; show by example; give a practical exhibition	**Demonstrate** how to set up an attack by forcing your opponent to the baseline or the corners of the court in tennis.
describe	give an account (written or spoken) of a situation, event, pattern or process, or of the characteristics or features of something	**Describe** the main purpose of performance segmenting.
design	produce a plan, simulation, model or similar; plan, form or conceive in the mind	**Design** a training program for your selected physical activity.
devise	think out; plan; contrive; invent	**Devise** a biomechanical strategy to optimise your demonstration of the freestyle stroke in swimming.
differentiate	identify the difference/s in or between two or more things; distinguish, discriminate; recognise or ascertain what makes something distinct from similar things	**Differentiate** between 'barriers' and 'enablers' to physical activity.
discuss	examine by argument; sift the considerations for and against; debate; talk or write about a topic, including a range of arguments, factors or hypotheses; consider, taking into account different issues and ideas, points for and/or against, and supporting opinions or conclusions with evidence	**Discuss** possible reasons for the lower participation rates in sporting clubs among girls aged 10–14.
evaluate	make an appraisal by weighing up or assessing strengths, implications and limitations; make judgments about ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria	**Evaluate** the effectiveness of a sport psychology strategy in optimising your attention while batting in cricket
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	**Examine** the key facts presented in the article and make a recommendation about the best way to reduce injuries in rugby.
explain	make an idea or situation plain or clear by describing it in more detail or revealing relevant facts; give an account; provide additional information	**Explain** that equity is concerned with giving value to, and celebrating personal, social and cultural differences in society.
explore	look into both closely and broadly; scrutinise; inquire into or discuss something in detail	**Explore** the components of projectile motion in the javelin throw.
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	**Identify** personal factors acting as barriers and enablers to your participation in sport aerobics.
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	**Investigate** the use of different types of practice and feedback on archery performance.
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	**Justify** modifying or maintaining the motor learning strategy you implemented to optimise your badminton performance.

Term	Explanation	Example of question/task using cognitive verb
make decisions	select from available options; weigh up positives and negatives of each option and consider all the alternatives to arrive at a position	**Make decisions** about whether to present your sprinting speed, velocity and acceleration data in a table or a graph.
predict	give an expected result of an upcoming action or event; suggest what may happen based on available information	**Predict** how demographic change in Australia over the next 50 years will affect participation rates in club sports.
recall	remember; present remembered ideas, facts or experiences; bring something back into thought, attention or into one's mind	**Recall** the four body and movement concepts.
recognise	identify or recall particular features of information from knowledge; identify that an item, characteristic or quality exists; perceive as existing or true; be aware of or acknowledge	**Recognise** the concept motivation as a continuum from extrinsic to intrinsic.
reflect on	think about deeply and carefully	**Reflect on** the primary data you gathered about your implemented equity strategy.
summarise	give a brief statement of a general theme or major point(s); present ideas and information in fewer words and in sequence	**Summarise** the main points of the newspaper article in your response.
synthesise	combine different parts or elements (e.g. information, ideas, components) into a whole, in order to create new understanding	**Synthesise** primary and secondary data about access, equity and engagement in the sport of basketball in your local community.
use	operate or put into effect; apply knowledge or rules to put theory into practice	**Use** the written language features of a report when presenting the findings of your research.

Source: Glossary of cognitive verbs February 2017, Queensland Curriculum & Assessment Authority

SOURCE 8 Cognitive verbs

SOURCE 9 A cognitive verb is a doing word that describes a particular mental process or procedure that you are required to demonstrate.

Check your obook assess for the following additional resources and more:

- **Video** Preparing your assessment tasks for Physical Education Units 1 & 2
- **Skill Drill worksheet** 1.2A Planning, creating and presenting a Project – folio
- **Skill Drill worksheet** 1.2B Creating and presenting an Investigation – report
- **Skill Drill worksheet** 1.2C Strategies for improving your results on the Examination – combination response

1.3 The importance of data in QCE Physical Education

data
information collected for reference, analysis and evaluation

Data is a key element of the QCE Physical Education syllabus. In fact, the ability to analyse and synthesise data is one of the objectives of the course and references to data are present in many of the subject matter dot points at every stage of inquiry across Units 1–4. This means that throughout your studies this year (and next), you will be required to gather, record, analyse, evaluate, synthesise and reflect on a number of different types of data. Your ability to do this well will have a huge impact on your overall performance in the subject. So, what is data and why is it so important?

Defining data

The word data is the plural form of the word datum which means 'a piece of information'. In general, data is any set of information that has been gathered for some purpose – usually analysis. It can include text and numbers, pictures, sound or video.

Data is an important component of the Physical Education syllabus because gathering and analysing data on your performances in your selected physical activities can help you develop an accurate picture of your strengths and identify areas for improvement. Knowing how to collect, analyse and draw appropriate conclusions from your data will also help you to evaluate whether the training programs and strategies for improvement you have put in place have been successful.

Types of data

There are many different types of data that you will be expected to work with in Physical Education. These include:

Primary and secondary data

- Primary data includes any data that you collect and record yourself. Primary data can relate directly to your performance or the performance of another person that you have observed. Examples of primary data in Physical Education include video footage or photographs of your performance, sketches you make of another person's performance, the results of an interview you have conducted, personal performance statistics, or reflections you record in your journal.
- Secondary data includes any data that you did not collect or record yourself. Secondary data may still relate directly to your performance, but it was gathered and recorded by someone else. Examples of secondary data in Physical Education include video footage or photographs of elite athletes recorded by other people, sketches or visual analysis performed by other people, performance data for other athletes published in newspapers, books, magazines, journals, or even information you find in this textbook.

When completing your assessments this year, you will be expected to draw on a combination of primary and secondary data. Secondary data should never replace primary data in your assessments. Instead, it should be included to provide supporting evidence to help you justify the conclusions you have made based on your primary data.

Qualitative and quantitative data

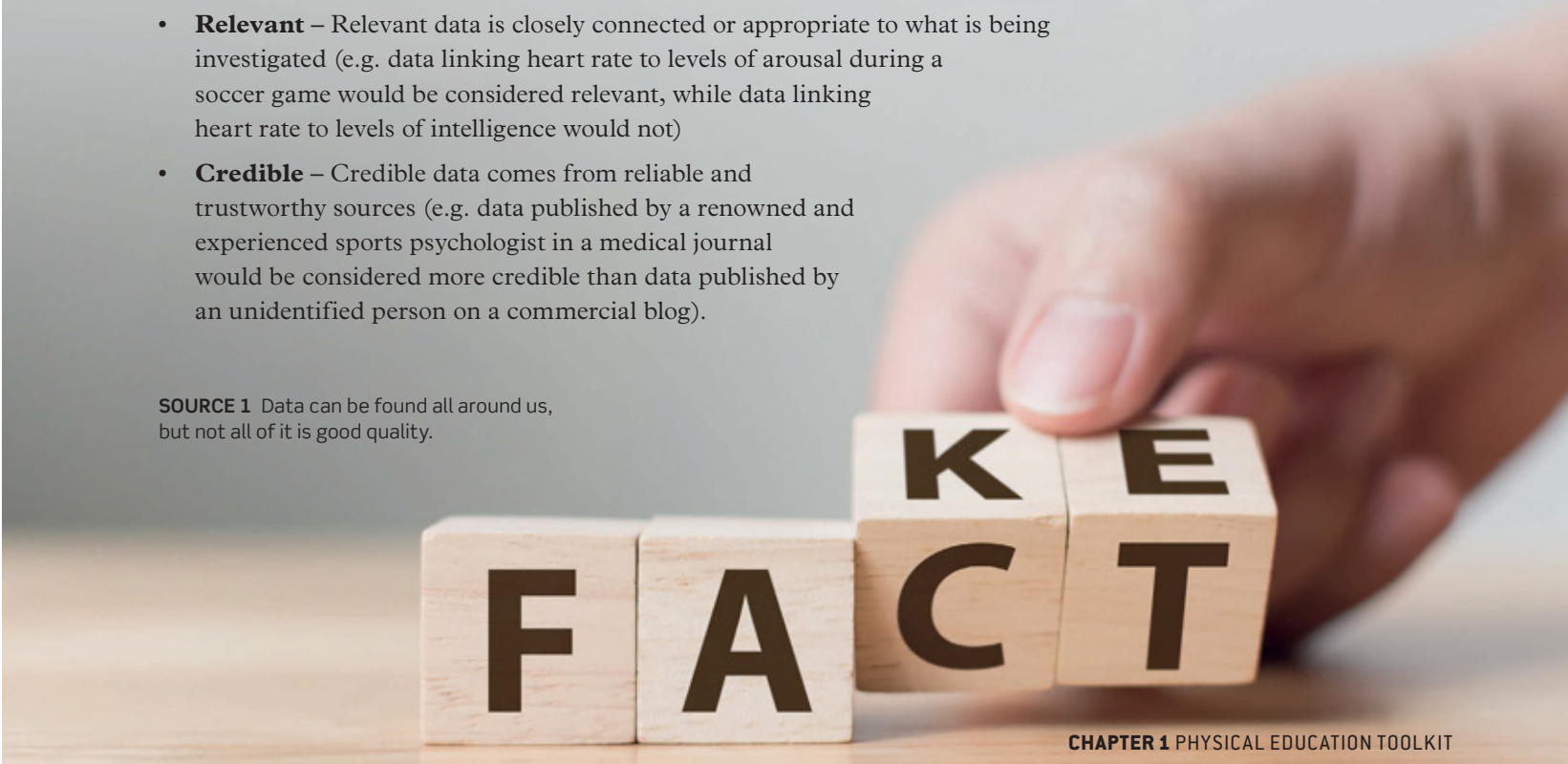
- Qualitative data includes any type of data that can be recorded in **words**. Examples of qualitative data in Physical Education include describing aspects of performance such as personal feelings, 'quality' of movement, smells, colours, textures, tastes and thoughts, and recording them in a journal or diary.
- Quantitative data includes any type of data that can be recorded in **numbers**. Examples of qualitative data in Physical Education include measuring aspects of performance such as heart rate, weight, height, speed, stride length, distance covered, and time spent in the air, and recording them in a Game Performance Assessment Instrument (GPAI).

When completing your assessments this year, you will be expected to draw on a combination of qualitative and quantitative data.

Assessing the quality of your data

Data can be found all around us, but not all of it is good quality. In order to ensure that you are working with the best data possible, make sure that it has the following characteristics. Your data should be:

- **Reliable** – Reliable data is consistent and can be replicated under stable conditions (e.g. data collected by a student every day over five days under the same conditions that yields similar results each time is considered reliable. Data collected by a student each day over five days under different conditions – and when the student is sick – that yields different results each time is considered unreliable)
- **Valid** – Valid data has a sound basis in logic and fact and is actually testing what it is supposed to be testing (e.g. data collected in an authentic game environment will be more accurate than data collected in a controlled environment such as a classroom or lab)
- **Accurate** – Accurate data has been checked for errors and is precise and exact (e.g. start and finish times collected during a race using a state of the art computer timing system will generally be more accurate than start and finish times collected by a person using an old stop watch)
- **Relevant** – Relevant data is closely connected or appropriate to what is being investigated (e.g. data linking heart rate to levels of arousal during a soccer game would be considered relevant, while data linking heart rate to levels of intelligence would not)
- **Credible** – Credible data comes from reliable and trustworthy sources (e.g. data published by a renowned and experienced sports psychologist in a medical journal would be considered more credible than data published by an unidentified person on a commercial blog).



SOURCE 1 Data can be found all around us, but not all of it is good quality.

1.3A Putting data to use in Physical Education

Key stages of data analysis

There are three key steps you need to follow in order to ensure that you have the data you need to help you devise strategies about body and movement concepts that will help you optimise your performance and engagement. These are outlined in Source 2. If you follow these steps, you will have good quality data to incorporate into your assessments in Physical Education this year and maximise your chance of performing well in the subject.

STEP 1 – Gather, record and organise data

- Before you begin gathering your data, you need to be sure about what you need it for. Ask yourself what you need it for, what you want or need to do with the data, and exactly what you want to find out. Once you have established this, you can decide on the best method of gathering and recording the data you need (e.g. video recordings, journal entries, observation, etc.). A number of methods of data collection and tools used for recording this data are discussed in more detail below.
- Once you have all of your data collected and recorded, it can be helpful to organise it. To organise your data you can group it into different categories, making sure it is all complete and in the correct format. Having your data well organised will help make Step 2 of the process run more smoothly.

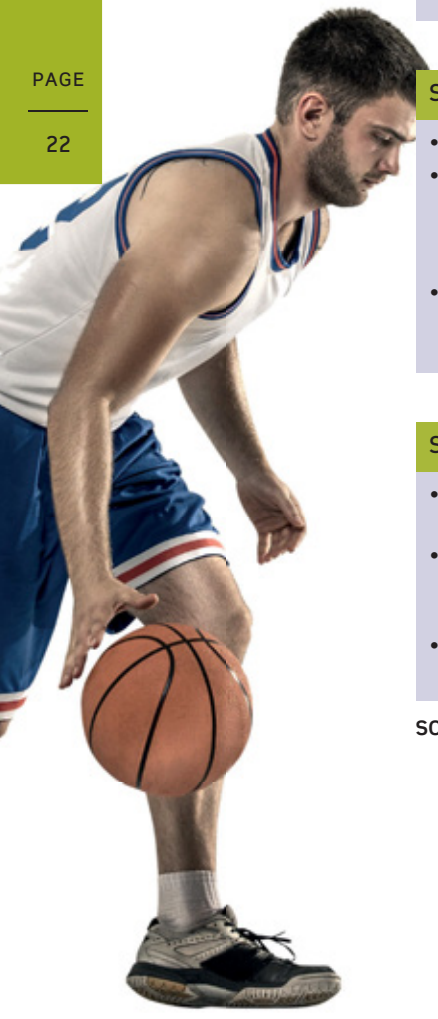
STEP 2 – Analyse and synthesise data

- Once you have collected and recorded your data, you need to analyse and synthesise it.
- To analyse data, you need to examine and inspect what you have gathered. You want to make sure it is valid, reliable and credible. To do this, you will often need to break information down into smaller parts and look for relationships, patterns, trends, similarities and differences in what the data is saying. The goal of analysis is to be able to clearly explain and interpret the data you have collected.
- To synthesise data, you need to combine information and data from different sources (that you have already analysed) to produce new information or ideas. Synthesis is often the stage at which you put all of the smaller pieces of data together and draw conculsions about the bigger picture.

STEP 3 – Communicate your findings

- Communicating your findings is the final step of the process. It involves converting the data into formats that can be easily understood by the people you are communicating with.
- There are many ways to effectively communicate your findings. Think about converting data tables into graphs, editing raw video footage into a shorter highlights reel, presenting your journal entries in an interactive presentation, creating infographics, flowcharts or short films.
- The main goal of communication is to clearly and effectively get your message across in a way that engages your audience.

SOURCE 2 The key stages of data analysis



Gathering primary data

There are a number of different ways of gathering and recording primary data. These are described in the following sections.

Observation

Observation is one of the most common and useful methods for gathering data in Physical Education. Observation is a way of gathering data by watching behaviours or events in authentic environments and making notes about what you see and hear. Recording sheets and checklists (see below) are the most common and useful way of collecting observation data. They should be prepared ahead of your observation session to help to focus your attention on the key characteristics you are interested in. It is important to stay focused during observations. Any distractions will decrease the reliability and validity of your data.

Useful tools for gathering data during observations:

- Game performance assessment instrument (GPAI) – This is an observation tool that includes a range of criteria and is used to record information relevant to the performance of an athlete during a game or physical activity (e.g. data relating to skill execution, game involvement, game performance, performance analysis). A sample GPAI is provided on your obook assess.
- Data collection instrument (DCI) – This is an observation tool that includes a range of criteria and is used to record information relevant to an athlete but not directly related to their performance (e.g. data related to demographics, motivation, participation, environmental factors, fairness). A sample DCI is provided on your obook assess.

Video recordings

Video recordings are an important and powerful method for collecting primary data relating to your performance. Video can be used to capture data about your performances (and the performances of others) so that it can be incorporated into your assessments. In fact, there is a requirement for you to create a folio of video recordings as part of your assessment in Physical Education in Units 3 & 4, so it's helpful to gain some experience with this in Units 1 & 2. You will use these recordings to demonstrate your ability to devise and apply strategies designed to optimise your performance.

Useful tools for gathering data during video recordings:

- **Digital video equipment** – This can include smart phones, digital cameras, GoPro, etc.
- **Continuous high-speed photography** – This can include smart phone 'burst' mode or digital cameras
- **Video analysis apps** – This can include apps such as Coach's Eye, Spark Motion, Coach My Video, Dartfish
- **Camera drone** – This can include a mobile drone fitted with video camera to capture game play from above.

RESEARCH	SKILL DRILL 1.3A	Capturing and analysing video footage of physical performances
Refer to your obook assess to complete this integrated research activity.		

Personal reflection

Reflection is one of the most important ways of collecting primary data relating to your performance. It is a record of your feelings, thoughts and opinions on how you are performing throughout the year. Although this data is mostly qualitative, it can give clear indications about your strengths and areas for development. A personal reflection should include more than just your thoughts and feelings. It should include information about the context, a review of your performance, information about the playing conditions, team dynamics, your mood and physical condition.

Useful tools for gathering personal reflections

- **Personal journal** – a journal is the best way to record your reflections (see Source 3). The template will help you to record important aspects of your performance and keep your notes consistent. Every time you perform, you should get into the habit of making an entry in your journal. By combining quantitative data gathered about a performance (using a GPAI or DCI) with qualitative data gathered about the same performance (using a journal entry) you will have a complete picture and have lots of great data to include in your assessments. A template that you can use to create personal journal is provided on your obook assess.

Journal Template- completed

Name: Crystal Hede
Date: 28/2/2019
Physical activity: Badminton
Topic: Motor learning
Dependent variable: Performance summary (Link to data collected if available):
Excellent Good ok Poor

My performance today was mostly good. I played 4 games of singles and 2 doubles. I won 3 out of 4 of my singles and 1 of my doubles. In the games I won, I was able to perform a range of shots effectively but my net kills were particularly good. My GPAI shows that of the 23 net kill opportunities I had in my matches, 18 were winners. My poorest shot was my backhand clear. I was only successful in those 20 out of 47 attempts.

Independent variables	Summary (Include a brief description that provides context and relevance of the information)
Lesson experiences	We played a round robin in both singles and doubles. I was paired with Kate Russell for doubles who is about the same ability as me. My opponents in 3 of the singles games were cognitive learners and in the other match I played the best kid in the class.
Playing conditions (Weather, equipment etc)	It was really hot and stuffy in the gym as usual. I played at the 'good end in 3 out of the 6 matches (the good end does not have the windows right behind the back of the opponent's court making it hard to see the shuttle)
Position played	N/A
Mood (arousal, motivation, confidence, concentration etc)	I was in a good mood today. I felt pumped for the tournament and love playing badminton so was easily able to concentrate. I won my first 2 games easily which meant my confidence was high and stayed high all the way through even after the losses I had.
Physical condition (health, fitness, injury status etc)	My physical condition was pretty good because I am a swimmer and have a lot of stamina and strength. I didn't have any injuries and I felt healthy.
Team dynamics	I get on really well with Kate. We are able to read each other's minds and communicate well on court. Because we play a similar way and at the same level, we have respect for each other and can trust each other to make shots when needed.

SOURCE 3 An example of an entry from a personal journal

Interviews and surveys

Interviews and surveys are another great way to collect data from an individual or group of people.

- **Interviews** are generally conducted as a face-to-face discussion and are designed to help you gather detailed qualitative data about a particular topic. They can also be recorded (e.g. audio or video) and used in your assessments. You should prepare some questions ahead of time and have a good idea of the information you are looking for in the interview, but you should also be responsive to issues that arise during the discussion and be prepared to ask questions on the spot if required (in order to get the best information possible).
- **Surveys** (also known as questionnaires) include a set of questions that participants are required to complete in writing. Depending on the questions you ask, surveys generally produce a good range of qualitative and quantitative information. As you may not be present when your survey is completed, it's important that your questions are clear and cannot be misinterpreted. A weblink to help you write good survey questions is provided on your obook assess.

Useful tools for interviews and surveys:

- **Online surveys** – Websites such as SurveyMonkey and Typeform can be a free and easy way of gathering larger numbers of responses in a shorter period of time. They can also help you increase the reliability and validity of the data you collect and make it easier for you to analyse and graph the results.

SKILL DRILL **1.3B** Conducting a survey and presenting the results

Refer to your obook assess to complete this integrated research activity.

Gathering secondary data

There are a number of different ways of gathering and recording secondary data. These are described in the following sections.

Published sources

Published secondary sources include things like textbooks, newspapers, magazines, government reports, TV news reports and journals.

Useful tools for gathering data from published sources

- School, local and state libraries – even in the digital age, libraries can be a great source of secondary data. Many libraries – including the State Library of Queensland – also offer services that you may not be aware of (such as shipping books to you for free), so give them a try. This can be a great way to get valid and reliable data if you are short on time or live in a regional area.

Online sources

Although printed sources such as books and newspapers are valuable sources of secondary data, most research today is conducted online. Online sources include websites, social media groups, online journals, news sites and blogs.

In order to ensure that sources gathered online are accurate, reliable and relevant, you should always:

- verify that the information is supported by evidence that is referenced
- check and verify the information against other sources to make sure it aligns with the findings of other similar research
- check that the author is qualified, credible and not associated with any commercial company (i.e. is not biased)
- check to see if the material has been checked and edited by a professional publisher.

You should never cut and paste information from the internet straight into your own work. Taking someone else's work, ideas or words and using them as if they were your own is called **plagiarism** and can result in very serious consequences.

Useful tools for gathering data from online sources

- **Search engines** – Search engines such as Google and Google Scholar are useful research tools, but much of the material found using these tools may not be reliable and may contain inaccuracies, false and misleading information or material that is out of date. When using search engines like Google or Yahoo, be sure to define your search using keywords.
- **Online educational databases** – A reliable way of searching for sources is to use sites linked to educational institutions, government departments, reputable companies, museums, universities and educational institutions. A quick way of telling if a site is reputable is to look at the domain name in the URL (Internet address). Some of the most common domain names are listed in Source 4 along with some information about their reliability.

Domain	Description
.edu	The site is linked to an educational institution such as a university or school. These sites are generally very reliable.
.gov	The site is linked to a government institution. These sites are generally very reliable.
.net	This site is linked to a commercial organisation or network provider. Anyone is able to purchase this domain name and generally there is no one to regulate the information posted on the site. As a result, these sites may be unreliable.
.org	This site is linked to an organisation. Generally, these organisations are not for profit (e.g. Greenpeace, World Vision International, ACHPER). If the organisation is reputable and can be contacted, it generally means that the information provided has been checked and verified by that organisation. You need to be aware of any special interests that the organisation may represent (e.g. particular religious, commercial or political interests) as this may influence what they have to say on a particular issue. If you are unsure about the reliability of information found on a website with this domain name, check with your teacher or librarian.
.com	This site is linked to a commercially based operation and is likely to be promoting certain products or services. These domain names can be purchased by anyone, so the content should be carefully checked and verified using another, more reliable source.

SOURCE 4 Domain name descriptions

RESEARCH SKILL DRILL **1.3C** Using the internet to find relevant, credible and reliable sources

Refer to your obook assess to complete this integrated research activity.

Citing secondary sources

As you identify and locate relevant sources, it is essential that you record details to include in your reference list or bibliography.

Citing published sources

When citing (i.e. mentioning) a published source in a bibliography, include the following, in this order, if available:

1. author surname(s) and initial(s)
2. year of publication
3. title of book (in italics)
4. edition (if relevant)
5. publisher
6. place of publication
7. page number(s).

SOURCE 5 The internet is a useful tool to find relevant, credible and reliable sources.

Example:

Hede, C., Russell, K., Weatherby, R. & Williams, B., 2018, *Physical Education for Queensland Units 1 & 2 Second edition*, Oxford University Press, Melbourne, pp. 18–19.

Citing online sources

When citing an online source in a bibliography, include the following information, if available:

1. author surname(s) and initial(s) or organisation name
2. year of publication or date of web page (last update)
3. title of document (article) enclosed in quotation marks
4. date of posting
5. organisation name (if different from above)
6. date you accessed the site
7. URL or web address enclosed in angle brackets <…>.

Example:

Australian Psychological Society, 'Sport and exercise psychologists', accessed 20 August 2018, <www.psychology.org.au/for-the-public/about-psychology/types-of-psychologists/Psychologists-with-an-Area-of-Practice-Endorsement/Sport-and-exercise-psychology>.

For more advice and practical tips on how to evaluate the reliability and validity of online sources, complete the Skill Drill on your obook assess.

Check your obook assess for the following additional resources and more:

- **» Video**
  Introduction to data
- **» Skill Drill worksheet**
  1.3A Capturing and analysing video footage of physical performances
- **» Skill Drill worksheet**
  1.3B Conducting a survey and presenting the results
- **» Skill Drill worksheet**
  1.3C Using the internet to find relevant, credible and reliable sources

1.4 Careers in physical education, sport and fitness

The sport and recreation industry makes a significant contribution to the Australian economy. According to Sport Australia's current national sport plan, *Sport 2030*, the industry delivers economic, health and educational benefits to the tune of $83 billion each year. Approximately 3.2 million Australians are involved in non-playing roles within organised sport and physical activity programs, almost half of whom identified as coaches, instructors or teachers. Currently, around 222,000 Australians are employed in the sport and recreation industry and 1.8 million Australians volunteer within the sector. One segment of this sector that has boomed in recent years is the fitness industry. As Australians have become more and more health conscious, demand for fitness products and services like gym memberships, fitness equipment and personal trainers has increased. Based on data presented in documents like *Sport 2030* and the CSIRO's *The Future of Australian Sport*, the Australian sport and recreation industry is likely to continue being a prominent feature of our society and our economy for some time to come.

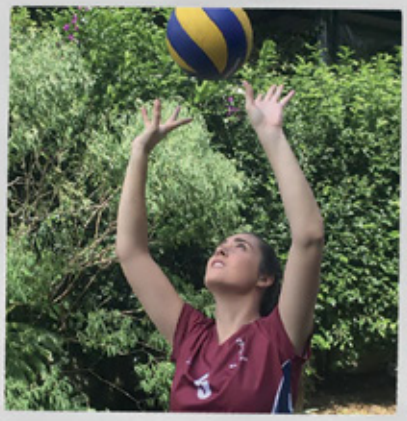
The Australians employed within the sport and recreation industry possess a variety of different qualifications, knowledge and skills. Physical Education can help you develop these knowledge and skills. It can also help you pursue the pathways of further study that lead to these qualifications. Within universities, Physical Education provides the basis for undergraduate and postgraduate studies in fields like sport and exercise science, physiotherapy, health and physical education teaching, sports development, sports journalism, sports marketing, leisure tourism and sports coaching. Australian universities are regarded as some of the best in the world in these areas, particularly the sport and exercise sciences. Physical Education also establishes a foundation for pursuing certificate-level qualifications within the vocational education and training system, such as the Certificate II in Sport and Recreation and the Certificate III in Fitness.

In addition to the sport and recreation industry, Physical Education is also suited to students thinking about pursuing a career in the health industry. As Australia's population ages and increasing emphasis is given to population-level and individually targeted preventive health efforts, the country's health industry is predicted to be one of its largest areas for new employment. Studying Physical Education can provide a platform for further studies in health sciences, public health, health education, allied health, nursing and medicine.

SOURCE 1 While many people who choose to study Physical Education go on to work in the sport and fitness industry, this is certainly not the only career path available. In fact, a sound knowledge and understanding of the value of health and physical activity is highly valued in a range of different industries.

Career profile: Georgia Parsons

Georgia Parsons is a former QCE Physical Education student who now works full-time as an Occupational Therapist for Blue Care in Toowoomba, Queensland. As an occupational therapist, she helps clients whose health has been compromised due to injury or illness to return to work. Georgia continues to stay active in her personal life and was recently selected as a member of the Queensland Pirates to play in the Australian Volleyball League.



Georgia Parsons
Occupational Therapist

How did you first become interested in sport, health and physical education?
I became interested in sport, health and physical education from a very young age – with a father who was the head of Physical Education at local high school, how could I not! I remember waiting on the half-court in our backyard for Dad to get home and beat me at tennis! I always thought my career would involve sport. The day I signed my volleyball scholarship was one of the greatest days of my life as it meant another four years playing the sport I loved at a high level.

What did you enjoy about Physical Education at school?
Definitely being able to escape the classroom and do something active! I have quite a competitive nature, so I enjoyed the endless opportunities to participate in a range of sports and activities. I was always very interested in the human body and knew I wanted to work in the healthcare sector. The Physical Education syllabus at high school provided me with a wealth of knowledge on health and wellbeing which I am very grateful for – and still rely on to this day!

What qualifications have you completed since completing your QCE?
After high school I received a full athletic scholarship to attend Alcorn State University in Mississippi, USA, which is a Division 1 college that is part of the National Collegiate Athletic Association (NCAA). While in the US, I played volleyball and studied a Bachelor of Biology Pre-Physical Therapy. After 4 years, I returned to Australia and completed my Masters of Occupational Therapy at the University of Queensland in Brisbane.

What is a typical day at work like for you?
The role of an Occupational Therapist is very different in each unique setting. At the moment I am working on: upper limb rehabilitation with clients who have suffered strokes; mirror-box therapy with a client with unilateral neglect; strategising with a client who has muscular dystrophy on ways to dress and undress; home modification and equipment recommendations to allow clients to participate in their daily occupations and remain independent for as long as possible.

What do you like best about your job?
Each day is different! There are always new injuries or illnesses to learn about and the ways which these injuries and illnesses affect people can be very different. That keeps me interested and challenged. One thing is always the same though – every day I get to help someone in need. It's an incredible feeling to go home with!

SOURCE 2 Career profile for Georgia Parsons

Check your obook assess for the following additional resources and more:

» **Weblink**
A guide to careers in the health and fitness industry

» **Weblink**
Starting your career in health and fitness

UNIT 1

MOTOR LEARNING, FUNCTIONAL ANATOMY, BIOMECHANICS AND PHYSICAL ACTIVITY

UNIT 1 OBJECTIVES

In this unit you will:

- → recognise and explain motor learning, functional anatomy, and biomechanical concepts and principles about selected physical activities
- → demonstrate specialised movement sequences and movement strategies in selected physical activities
- → apply concepts to specialised movement sequences and movement strategies in selected physical activities
- → analyse and synthesise data to devise strategies about motor learning and biomechanics
- → evaluate motor learning, biomechanical and movement strategies
- → justify motor learning, biomechanical and movement strategies
- → make decisions about and use language, conventions and mode-appropriate features for particular purposes and contexts.

UNIT 1 TOPICS

The learning for this unit has been divided into two topics. The table below shows how each topic aligns with the chapters in this book and lists the notional hours of teaching time for each topic.

Topic	Chapter	Notional hours
Topic 1 Motor learning integrated with a selected physical activity from one of the six categories	Chapter 2 Motor learning	22
Topic 2 Functional anatomy and biomechanics integrated with a selected physical activity from one of the six categories	Chapter 3 Functional anatomy and biomechanics	33

‘I fear not the man who has practised 10 000 kicks once, but I fear the man who has practised one kick 10 000 times.’

Bruce Lee (1940–1973)

Hong Kong–US martial arts expert, actor, director and pop-culture icon who starred in cult movie classics in the early 1970s

CHAPTER 2

MOTOR LEARNING

KEY TERMS

By the end of this chapter, you should understand the meanings of the following key terms. They are defined throughout the chapter, as well as in the glossary. Use this handy checklist to test your understanding.

- ☐ associative stage
- ☐ autonomous stage
- ☐ blocked practice and random practice
- ☐ body and movement concepts
- ☐ cognitive systems approach
- ☐ cognitive stage
- ☐ constant practice and varied practice
- ☐ constraints
- ☐ discrete and serial motor skills
- ☐ dynamic systems approach
- ☐ fine and gross motor skills
- ☐ information processing model
- ☐ internal and external stimuli
- ☐ intrinsic and extrinsic feedback
- ☐ massed practice and distributed practice
- ☐ motor learning
- ☐ motor program
- ☐ motor reflex
- ☐ motor skill
- ☐ musculoskeletal system
- ☐ nervous system
- ☐ open and closed motor skills
- ☐ rate limiters
- ☐ response selection
- ☐ self-organisation
- ☐ serial and parallel processing
- ☐ specificity and variability of practice
- ☐ stimulus identification
- ☐ sub-routine
- ☐ whole practice and part practice

SUBJECT MATTER OUTCOMES COVERED IN CHAPTER 2

The following tables list all of the subject matter dot points you are required to cover in **Unit 1 – Topic 1** of the Physical Education General Senior Syllabus. They also show you exactly where that subject matter is covered in this Student book.

Unit 1 – Topic 1: Motor learning integrated with a selected physical activity

In Unit 1 – Topic 1, students engage in learning that involves the integration of the motor learning subject and the subject matter from a selected physical activity.

Stage 1: Engage and understand

Subject matter	Section/s	Page/s
In this area of study, students will:		
→ 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	2.1	38–40
→ recognise and explain motor learning concepts including: – motor skills – activities that involve voluntary muscular movement to complete a predetermined task	2.2	41
– motor programs – a movement plan that contains all the commands for the muscles to execute motor skills	2.1	39
→ recognise and explain classifications of motor skills to include: – fine and gross motor skills – as determined by the size of the muscles involved in the movement – open and closed motor skills – as determined by the stability of the environment – discrete, continuous and serial skills – as determined by whether the movement has a specific beginning and ending	2.2	41–43
→ recognise and explain characteristics of motor skill learning to include improvement, consistency, stability, persistence and adaptability	2.2	44–45
→ recognise and explain that two major approaches to investigate motor learning have developed over time: – the cognitive systems approach, which is considered the more traditional approach, involves a hierarchical model of control where higher control centres pass commands to lower control centres resulting in linear changes in movement; it requires an understanding of the process that occurs in making decisions, planning and executing movement	2.3	46–55
– the dynamic systems approach, where 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 system	2.4	56–61
→ identify and explore cognitive models of learning including: – the information processing model, based on the central nervous system that controls the body. This model describes separate cognitive stages involving perception, decision-making and response execution to enable a performer's decision-making to occur prior to any action	2.3	47–50
– Fitts and Posner's (1967) stage model of motor learning, based on learning as a continuous process of information processing and gradual change as learning progresses; the stage model includes: ▪ the cognitive stage e.g. identifying the goal, rapid performance gains, error-ridden and inefficient movement sequences ▪ the associative stage e.g. associating environmental cues with actions, achieving consistency, refinement, fewer errors, errors can be detected and corrected ▪ the autonomous stage e.g. almost automatic, habitual, sub-conscious control, multitask, minimal performance variability and few errors	2.3	51–54
→ 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	2.4	59–60
→ investigate rate limiters in relation to personal motor learning and performance in the selected physical activity	2.4	59–61

Subject matter	Section/s	Page/s
→ recognise and explain that repetitive practice of skills is necessary for optimal performance and 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	2.5	62–65
→ 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 feedback – the sensory information that occurs during and after a movement – extrinsic feedback – the augmented feedback that is received at the completion of a movement, including knowledge of results and performance	2.6	66–68
→ identify and explore how body and movement concepts interact to develop specialised movement sequences and movement strategies for the selected physical activity. Body and movement concepts are: – body awareness – what movements the body can perform: balance, weight bearing, stability, transfer of weight and flight – space awareness – where the body can move: using general or personal space, direction, pathways of movement, and levels and planes of movement – quality of movement – how the body moves: time and speed, accuracy, force development, effort, efficiency, effect, flow, sequence, continuity and outcome of movement – relationships – connection with implements, interaction with opponents and other players	2.7	69–75
→ investigate the use of different types of practice and feedback in relation to personal motor learning and performance in the selected physical activity	2.5	62–65
→ gather primary data about the influence of motor learning concepts and principles, including rate limiters, practice and feedback, on personal performance of specialised movement sequences and movement strategies in authentic performance environments	2.6	66–67
→ use secondary data to analyse how motor learning concepts and principles can influence performance in the selected physical activity.	Chapter 2	38–79

Stage 2: Apply and analyse

Subject matter	Section/s	Page/s
In this area of study, students will: → analyse and synthesise primary data and secondary data about the influence of motor learning concepts and principles on specialised movement sequences and movement strategies in the selected physical activity	Skill Drill 2.4 Skill Drill 2.5 Skill Drill 2.6 Skill Drill 2.7	326–327 328–329 330–331 332–333
→ devise personal motor learning strategies to optimise performance in the selected physical activity that consider: – stage of learning – rate limiters – types of practice suitable to the requirement of the physical activity and the individual – feedback suitable to the requirements of the physical activity and the individual – relevant body and movement concepts, specialised movement sequences and movement strategies		
→ implement the motor learning strategy to gather primary data about the outcomes, implications and limitations of the strategy		
→ analyse primary data and secondary data to ascertain relationships between the motor learning and movement strategies, concepts and principles, and personal performance.		

Stage 3: Evaluate and justify

Subject matter	Section/s	Page/s
In this area of study, students will: → reflect on primary data and secondary data to evaluate the effectiveness of the motor learning strategy and movement strategies to achieve a determined outcome, including: – meeting the learning requirements of the individual – using suitable types of practice and feedback for the selected physical activity – optimising performance of specialised movement sequences and movement strategies	Skill Drill 2.4 Skill Drill 2.5 Skill Drill 2.6 Skill Drill 2.7 Chapter 2 review – Practice assessment task	326–327 328–329 330–331 332–333 79
→ make decisions to maintain or modify the motor learning strategy and movement strategies		
→ justify the development of the motor learning strategy and movement strategies using evidence from primary data and secondary data		
→ justify maintenance or modification of the motor learning strategy and movement strategies using evidence from primary data and secondary data		
→ make decisions about and use language, conventions and mode-appropriate features to convey meaning for particular purposes and contexts.		

Stage 3: Evaluate and justify

Subject matter	Section/s	Page/s
In this area of study, students will: → reflect on primary data and secondary data to evaluate the effectiveness of the motor learning strategy and movement strategies to achieve a determined outcome, including: – meeting the learning requirements of the individual – using suitable types of practice and feedback for the selected physical activity – optimising performance of specialised movement sequences and movement strategies	Skill Drill 2.4 Skill Drill 2.5 Skill Drill 2.6 Skill Drill 2.7 Chapter 2 review – Practice assessment task	326–327 328–329 330–331 332–333 79
→ make decisions to maintain or modify the motor learning strategy and movement strategies		
→ justify the development of the motor learning strategy and movement strategies using evidence from primary data and secondary data		
→ justify maintenance or modification of the motor learning strategy and movement strategies using evidence from primary data and secondary data		
→ make decisions about and use language, conventions and mode-appropriate features to convey meaning for particular purposes and contexts.		

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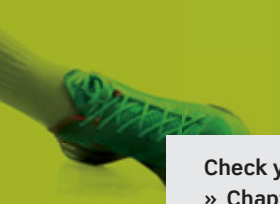


Check your obook assess for the following additional resources and more:

» **Chapter glossary**
Learn key terms from Chapter 2

» **Flashcard glossary**
A digital interactive to help you test your knowledge of key terms

» **Weblink**
QCAA Physical Education General Senior Syllabus

2.1 Introduction to motor learning

That's a goal!

By the end of Section 2.1 you should be able to:

→ **understand** and **define** the concept 'motor learning'
→ **understand** and **define** the term 'motor skills'
→ **understand** and **define** the term 'motor programs'
→ **explain** how sub-routines are part of motor programs.

The ability to move is a huge part of what it means to be human. It is also essential to our survival. Moving our bodies helps us to survive threats to our safety, allows us to gather food and water for survival, and means we are able to thrive in almost every environment on Earth. Throughout this chapter you will learn how different organs and muscles in the body control movement and how you learn to move in specialised ways to achieve particular outcomes.

motor learning
a field of science that investigates human movement with the goal of understanding how humans acquire and retain the motor skills required to perform specialised movements (i.e. through practice, experience and/or feedback)

nervous system
a body system made up of organs, cells and fibres (including the brain, spinal cord and nerves) that collects information (stimuli) from different parts of the body and processes that information before transmitting impulses to activate responses in the muscles

musculoskeletal system
a body system that is a combination of both the muscular system and the skeletal system; the musculoskeletal system provides support, stability, structure and movement to the body through the bones and muscles

What is motor learning?

Motor learning is a field of science that studies and explains many aspects of human movement. It aims to understand how humans learn (acquire) and remember (retain) the skills required to perform specialised movements. Motor learning researchers do this by:

- studying different organs and systems in the body – such as the **nervous system** and **musculoskeletal system** – and understanding the relationship between them
- investigating the stages that people go through in order to learn and master a new movement or skill – including practice and feedback.

We've all heard the saying 'Practice makes perfect', but many scientists who study motor learning believe this approach is too simplistic. While science backs up the idea that the more times you do something, the better you become at it, there are also many other factors that influence the acquisition and retention of complex movement patterns. These include:

- previous experience
- physical characteristics
- psychological characteristics
- skill complexity and difficulty.

These factors help to explain why some people seem to pick up certain sports or physical activities more easily than others (or can play more than one sport to a high level of proficiency).

In order to better understand and describe the many different types of movements and processes involved in motor learning, researchers use a number of specific terms and concepts. Some of the most fundamental concepts include motor skills, motor reflexes and motor programs.

What are motor skills and motor reflexes?

There are two broad categories of movement that human bodies perform:

- **motor skills** – these are voluntary movements that involve the use of specific muscles with the goal of achieving a predetermined purpose or goal (e.g. catching a ball, doing a push up, running a race). Motor skills can be learnt and improved with practice (e.g. like performing a punt kick in Australian football or a somersault in gymnastics). They can also be classified according to how difficult they are to perform. Simple motor skills require low degrees of coordination and thought processing (e.g. a throw-in basketball). Complex motor skills require higher degrees of coordination and thought processing (e.g. a layup in basketball).

SOURCE 1 Serving a ball is a complex motor skill commonly performed in tennis. It is made up of a number of simpler motor skills performed in a specific sequence (such as grip, stance, ball toss, backswing and forward swing). These specific motor skills are also referred to as sub-routines.

- **motor reflexes** – these are involuntary movements that are not consciously controlled and aren't designed to achieve an intended goal (e.g. the knee jerk reflex movement produced when the patella tendon is tapped).

Both motor skills and motor reflexes are a result of the nervous system and musculoskeletal system working together to create motion.

What are motor programs?

A **motor program** is a movement plan (i.e. a plan of action) that contains all the commands from the brain to the muscles that are needed to perform a complex motor skill. Motor programs are made up of a number of simple motor skills put together in a specific sequence in order to produce the successful and controlled execution of a more complex motor skill. These simple motor skills are often referred to as **sub-routines**. Source 2 shows the sub-routine sequence involved in a motor program for a tennis serve.

Motor program	Sub-routines
Tennis serve	→ Grip → Stance → Ball toss → Backswing → Forward swing → Impact → Follow through

SOURCE 2 A motor program for a tennis serve is made up of smaller motor skills that are referred to as sub-routines.

Each of these sub-routines is critical to the overall performance of the skill. For example, the accuracy of the ball toss can dictate the overall outcome of the serve.

FOR THE RECORD!

The word 'motor' is derived from a Latin word meaning motion. Research indicates that you can develop a motor skill memory by completing 300 to 500 repetitions of the same skill or technique. The same research suggests that it can take over 3000 repetitions to correct a skill or technique that was learnt incorrectly!

motor skill
a voluntary movement that involves the use of specific muscles with the aim of achieving a defined purpose or goal; motor skills can be learnt and improved with practice

motor reflex
an involuntary movement that is not consciously controlled and isn't designed to achieve a particular purpose or goal

motor program
a movement plan (i.e. a plan of action) that contains all the commands from the brain to the muscles that are needed to perform a motor skill

sub-routine
a simple motor skill that – when combined with a number of other simple motor skills and sequenced in a specific order – is part of a motor program

STUDY TIP

Throughout this chapter you will come into contact with the terms 'skill' and 'ability'. While they are related, and sometimes used interchangeably, it is important to recognise the difference.

Having the ability to do something means that you can perform it, but having the skill means that you have the ability to perform it well.

As such, you need ability to have skill.

Why study motor learning?

Understanding the theories that explain motor learning can give you a better idea of what is required to improve your own skills as an athlete. In this chapter, you will learn that skill development requires time and specific practice in order to ensure the human body can produce controlled and purposeful movements. By the end of this chapter, you will:

- be able to identify the different stages of learning a person goes through when acquiring a new skill
- develop an understanding of how skills can be transferred from one sport to another
- learn to modify training drills to cater for different skill levels
- understand the two main models (i.e. theories) that scientists have proposed to help explain motor learning
- learn how specific types of practice can help us make better decisions under pressure that result in better outcomes
- learn how types of feedback can impact learning
- learn how to develop a personal learning strategy to optimise performance based on: stage of learning, rate limiters, appropriate types of practice, appropriate feedback, and relevant body movement concepts, specialised movement sequences and movement strategies.

2.1 Check your learning

Engage and understand

1 **Define** the term 'motor learning'.

2 **Explain** the terms 'motor skill' and a 'motor reflex'.

3 **Identify** the two body systems that interact to move the human body.

Apply and analyse

4 A volleyball serve can be performed in a variety of different ways, some of which are less complex than others. For example, serving underarm is simpler than performing a topspin jump-serve. **Identify** one simple and one complex skill from the five different sports listed below and **determine** the key differences between each:

Sport	Simple skill	Complex skill
a badminton		
b soccer		
c Australian football		
d tennis		
e aerobic gymnastics		

5 **Classify** the skills listed for each of the sports below from simple to complex.

- **a** volleyball – dig, spike, serve, set, block
- **b** touch football – roll ball, wrap, switch, dump and split, pass left to right, pass right to left
- **c** cricket – hitting the ball, bowling the ball, catching, fielding
- **d** basketball – dribbling, bouncing the ball, set shots, layups, 3-point shots

Evaluate and justify

6 Consider the old saying, 'Practice makes perfect' in relation to motor learning. Conduct some additional research and decide if you agree or disagree with this saying. **Justify** your point of view in a written response of 200 words.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  2.1 Check your learning
- **» Student worksheet**
  2.1 Introduction to motor learning worksheet
- **» Video weblink**
  Introduction to motor learning
- **» Weblink**
  Understanding motor learning

2.2 Motor skills

That's a goal!

By the end of Section 2.2 you should be able to:

→ **recognise** and **explain** the differences between fine and gross motor skills; open and closed motor skills; and discrete, continuous and serial skills

→ **recall** the five characteristics of motor skill learning (i.e. improvement, consistency, stability, persistence and adaptability).

As discussed in Section 2.1, motor skills are voluntary movements that involve the use of specific muscles to achieve a defined purpose or goal. Because there are many different types of motor skills, experts classify them into groups according to characteristics they have in common. Doing this helps coaches, teachers and trainers to determine how particular motor skills are best learnt, controlled and analysed. It can also help you understand how to tailor your practice to the nature of the skill you are trying to learn.

Types of motor skills

We have already touched on the fact that motor skills can be classified based on how simple or complex they are. In addition to this, motor skills are often grouped in the following categories:

- fine and gross motor skills – this category is based on the size of the muscles involved in the skill
- open and closed motor skills – this category is based on the stability of the environment in which the skill is being performed
- discrete, continuous and serial skills – this category is based on whether the skill has a specific beginning and end point.

We will now look at each of these categories in more detail.

SOURCE 1 Hockey involves both gross motor skills (e.g. sprinting down a pitch) and fine motor skills (e.g. intricate stick work).

Fine and gross motor skills

Fine and gross motor skills are determined based on the size of the muscles involved in the skill.

fine motor skills skills that require precise movements and use smaller muscle groups (e.g. writing with a pen)

Fine motor skills are very precise and require the movement and use of smaller muscle groups. The following activities require the use of fine motors skills:

- writing with a pen or typing on a keyboard
- threading a needle
- throwing a dart
- putting spin on a cricket ball
- hitting a drop shot in badminton.

SOURCE 2 This softball pitcher is using a combination of gross and fine motor skills to deliver the pitch. The pitching action (shown left) relies on gross motor skills, but adding spin to the ball (shown right) relies on fine motor skills.

Gross motor skills are less precise and require the movement and use of larger muscle groups (or even the whole body). The following activities require the use of gross motor skills:

- throwing a ball
- walking or running
- punching a bag
- throwing a discus
- jumping and skipping.

Many sports and physical activities require athletes to use a combination of both fine and gross motor skills if they are going to be successful. For example, a good softball pitch involves gross motor skills for movements of the shoulder, arm, back and legs, but it also involves fine motor skills for the movement of hands and fingers. The pitching action relies on gross motor skills, but adding spin to the ball relies on fine motor skills.

gross motor skills
skills that do not require a great deal of precision and use larger muscle groups or the whole body (e.g. running)

open motor skills
skills that are performed in unstable, unpredictable or changing environments and require the person performing the skill to react to many different variables (e.g. passing the ball or shooting for goal in a netball game)

closed motor skills
skills that are performed in stable and predictable environments and where the person performing the task is in control of the timing of the movement sequence and doesn't need to consider other variables (e.g. serving a ball in tennis)

Open and closed motor skills

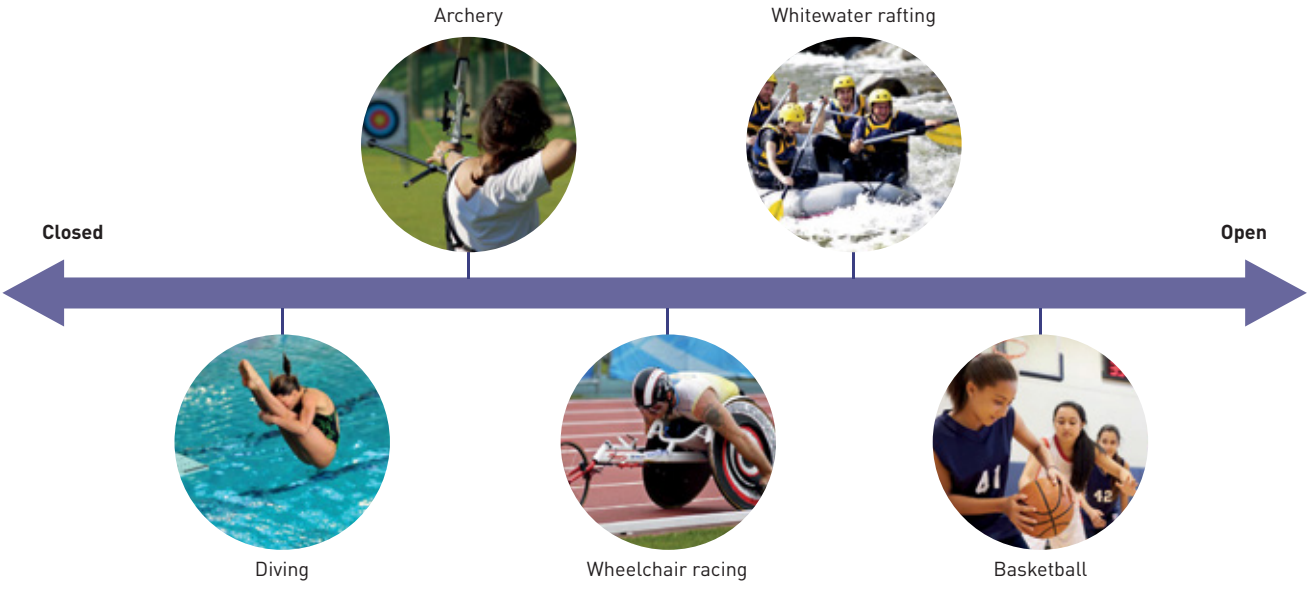
Open and closed motor skills are determined based on the stability and predictability of the environment in which the skill is being performed. When discussing open and closed motor skills, the 'environment' can refer to:

- an object or piece of sporting equipment (e.g. a racquet or ball)
- the context or situation (e.g. weather conditions, other players/competitors, condition of the playing surface or venue, mood of the spectators).

Open motor skills are affected by the environment. They require the athlete or person performing the skill to make decisions and adapt their skills in contexts that are unstable or unpredictable. Team games such as basketball, netball, football and rugby all involve the use of open motor skills because they are externally paced by factors mostly out of the athletes' control. Such factors can include opponents, teammates, the speed of the ball, weather conditions and condition of the playing surface.

Closed motor skills are not affected by the environment. They are performed in environments that are stable and predictable and do not require the athlete or person performing the skill to make decisions or adapt their skills in response to stimuli. The athlete or person performing a closed skill is in control of their actions and can use learnt skills or movement patterns without making major changes to allow for a changing environment. They can also begin to complete the skill in their own time. Solo sports such as archery, weightlifting, diving and gymnastics all involve the use of closed motor skills.

It is important to note that motor skills are not always classified purely as open or closed. Many sports and physical activities have skills that fall onto a continuum as illustrated in Source 3.



SOURCE 3 Physical activities vary on a continuum from closed to open when the motor skills within them are considered as a whole. For example, although basketball is comprised of some closed skills (e.g. the free throw), most skills are open. So when we consider basketball as a whole, it is far more unpredictable than, say, diving, and is therefore more open.

However, the same skill can vary in its placement along the continuum depending on:

- the environment (e.g. how windy it is, the positions of the sun)
- psychological factors (e.g. impact of the crowd on concentration levels, confidence of the performer)
- physical factors (e.g. the ability of the performer to apply their chosen strategy).

Discrete, continuous and serial motor skills

Discrete, continuous and serial skills are determined based on whether the skill has a specific beginning and end point.

Discrete motor skills have a clearly defined start and finish point. Examples of discrete motor skills include:

- throwing a ball
- diving off a block
- kicking a ball
- swinging a bat.

Continuous motor skills do not have a clearly defined start and finish point. They consist of discrete motor skills linked together and repeated continuously. The start and finish points of continuous motor skills are determined by the athlete or person performing the skill, rather that the skill itself having a natural beginning and end point. Examples of continuous motor skills include:

- swimming
- running
- cycling
- steering a car.

Serial motor skills consist of a group (i.e. series) of different, discrete skills linked together to create a more complex movement sequence. Examples of serial motor skills include:

- dance routines
- gymnastics routines
- ice-skating programs
- playing the piano.

discrete motor skills
skills that have a clearly defined start and finish point (e.g. throwing a ball)

continuous motor skills
skills that do not have a clearly defined start and finish point and are made up of discrete motor skills linked together continuously (e.g. running)

serial motor skills
skills that are made up of a group (series) of different, discrete skills linked together to create a more complex movement sequence (e.g. a floor routine in gymnastics)

Characteristics of motor skill learning

STUDY TIP

A good way to remember the five characteristics of motor skills is to use the mnemonic (i.e. memory trick) 'SPICA':
Stability
Persistence
Improvement
Consistency
Adaptability.

Whether you are a student, a teacher or a coach, it is important to be able to assess the progress and development of motor skills. There are five characteristics of motor skill learning. These characteristics provide a framework for analysing skill level and give direction for modifying specialised movement sequences and strategies. They include:

- stability
- persistence
- improvement
- consistency
- adaptability.

We will now look at each of these characteristics in more detail.

Stability

stability
a characteristic of motor skills; stability refers to the ability of an individual to control the influence of internal and external factors on their performance of a motor skill

The characteristic of **stability** refers to the ability of an individual to control the influence of internal and external factors on their performance of a motor skill. Factors such as stress, anxiety, weather conditions, crowd noise and refereeing decisions can all have an impact on a player's ability to perform a particular motor skill. With practice, athletes can learn to control the influence of these factors on their ability to perform. By practising motor skills under different conditions and learning psychological techniques to improve focus (see Chapter 4), an athlete can improve their stability.

Persistence

persistence
a characteristic of motor skills; persistence refers to the ability of an individual to retain (i.e. keep) and perform a motor skill over time

The characteristic of **persistence** refers to the ability of an individual to retain (i.e. keep) and perform a motor skill over time. When a motor skill is being learnt, connections (known as neural pathways) are created between the brain and the muscle. Once these neural pathways are established, they make it easier for an athlete to perform the same motor skill – even if it has not been performed for many years. This not only applies to sporting skills, but to all motor skills acquired throughout life.

An advantage of playing sport and learning motor skills as a child is the ability to perform them in adulthood. The skill and performance level may not remain the same, but adults who have mastered a motor skill as children are generally far better than if they had never learnt the skill. This is due to the fact that training effects are relatively long-lasting.

Improvement

improvement
a characteristic of motor skills; improvement refers to the ability of an individual to get better at performing a motor skill over time

consistency
a characteristic of motor skills; consistency refers to the ability of an individual perform a particular motor skill reliably and dependably over time

The characteristic of **improvement** refers to the ability of an individual to get better at performing a motor skill over time. Gathering statistics is a popular indicator for measuring learning and improvement. If a netball shooter increases the percentage of goals scored in each game over the season, this would indicate that they have improved. However, it is also important to take variables into account when using statistics to measure improvement. For example, playing while unwell, against a very tall defender, or outdoors on a very windy day will likely reduce the number of goals the shooter scores. This subsequent reduction in goals would therefore not be a solid indicator that the athlete has not improved. To measure improvement accurately, coaches and athletes should use a few different indicators and methods of data collection.

Consistency

The characteristic of **consistency** refers to the ability of an individual to perform a particular motor skill reliably and dependably over time. That is, their performance will become more consistent in terms of the processes (i.e. the quality of their technique) and the outcomes (i.e. the number of successful attempts or winning points scored). Beginners generally show a greater variation in their movement patterns, which often leads to inconsistent results. For example, a beginner rugby player can kick numerous winning goals, yet repeated efforts do not yield the same results.

SOURCE 4 These rugby players have developed the motor skills necessary to perform at a consistently high level, regardless of the conditions in which they play. This is an example of adaptability.

Adaptability

The characteristic of **adaptability** refers to the ability of an individual to perform a particular motor skill in response to what is required in a given situation. Being adaptable is crucial in team sports and game situations where circumstance dictates which motor skill is required. For example, in a rugby game, an athlete needs to constantly assess where a teammate is or what the wind conditions are like, and adapt accordingly.

adaptability
a characteristic of motor skills; adaptability refers to the ability of an individual to perform a particular motor skill in response to what is required in a given situation

2.2 Check your learning

Engage and understand

1 **Explain** open motor skills and closed motor skills, using examples to support your response.
2 **Define** discrete, continuous and serial skills and provide an example of each.
3 Source 2 shows a softball player using both fine and gross motor skills when pitching. **Identify** three examples from other physical activities that use a combination of fine and gross motor skills.

Apply and analyse

4 Consider the assessment criteria 'consistency'. **Determine** why weekly match statistics cannot be the only data used to assess consistency using examples from your selected physical activity.
5 **Classify** the following motor skills along a continuum from closed to open.
Explain your reasoning in each case.
a Surfing
b Snooker
c Javelin throwing
d High jump
e Aerial skiing
f Taking a penalty stoke in hockey

Evaluate and justify

6 'Closed skills are just simple skills.' Do you agree or disagree with this statement? **Justify** your response with examples from your selected physical activity.
7 The characteristics of motor skill learning can help us draw conclusions about our own skill level. **Evaluate** your own current skill level using the characteristics listed in the SPICA mnemonic and examples from your sport in focus.

Check your obook assess for the following additional resources and more:

» **Student book questions**
2.2 Check your learning

» **Video**
Types of motor skills

» **Student worksheet**
2.2 Motor skills worksheet

» **Weblink**
Types of motor skills

2.3 The cognitive systems approach to motor learning

That's a goal!

By the end of Section 2.3 you should be able to:

→ **explain** what is meant by the cognitive systems approach
→ **define** and **explain** the 'information processing model'
→ **define** and **explain** Fitts and Posner's (1967) stage model of learning
→ **apply** these concepts and theories to examples from your selected physical activity.

Learning is an extremely complex process that involves many different organs and systems in the body. For centuries, scientists have investigated the process of learning and developed many different theories that attempt to explain exactly how we learn and remember the thousands of motor skills and complex movement sequences we perform every day.

Over the centuries, two major approaches have been developed to help explain how the process of motor learning takes place. These are known as:

- the **cognitive systems approach** – this is an older, more traditional approach used to help us understand and explain the processes involved in motor learning. The cognitive systems approach will be discussed in this section.
- the dynamic systems approach – this is a newer, less traditional approach to study and understand motor learning. The dynamic systems approach will be discussed in Section 2.4.

cognitive systems approach
a theoretical framework used to help explain the processes involved in motor learning; according to this approach, the brain acts as the central command centre for the body. It creates action plans for movements based on information it receives from the body's senses and instructs the muscles to perform these actions in a linear order (i.e. step-by-step)

An 'approach' is a broad theoretical framework that has developed over time. Think of both the approaches listed above as 'big ideas' that try to explain the entire process of learning. Within these approaches or 'big ideas' there are a number of smaller, more specific models and theories that explain smaller parts of the process. Because we don't yet understand everything there is to know about the process of learning, both approaches (and some of the theories within them) have different explanations for parts of the learning process.

It's important to keep in mind that these approaches and models are all just tools that can be used as frameworks to help us talk and learn about the process of learning.

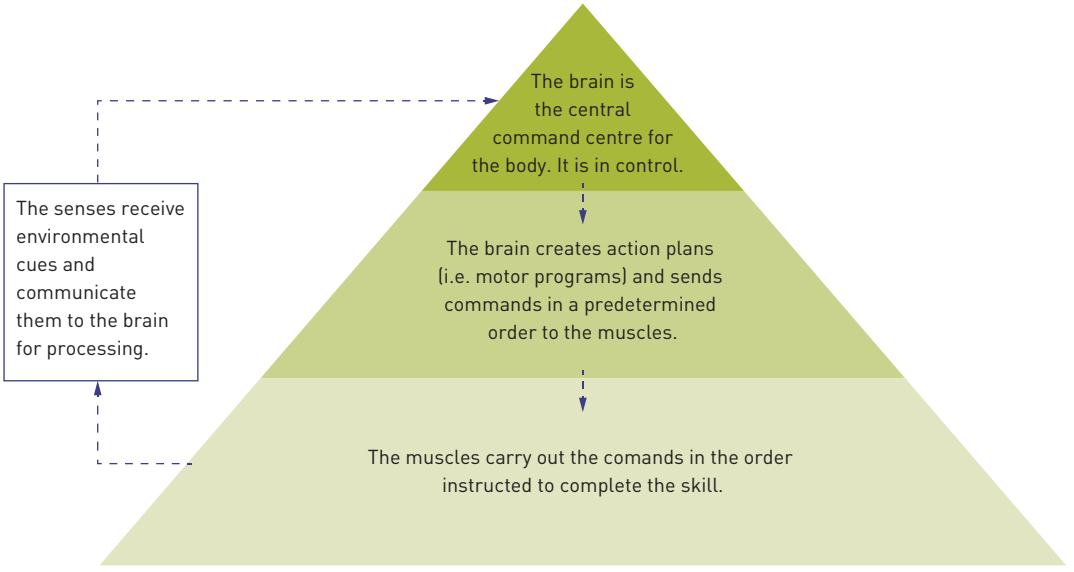
Introduction to the cognitive systems approach

information processing model
a theory that suggests humans receive, process and store information from their environment via the central nervous system (i.e. the brain and spinal cord)

The basic idea behind the cognitive systems approach is that the brain works like a computer that controls the body. According to this approach, a part of the brain (known as the prefrontal cortex) acts as the central command centre and creates an action plan for movement based on information it receives from the body's various senses. Once the action plan is in place, the brain informs the relevant muscles to carry out the plan one step at a time.

For these reasons, the cognitive systems approach is often described as:

- **hierarchical** or 'top down' – it assumes that higher control centres (i.e. the brain) pass commands down to lower control centres (i.e. the muscles and nerves)
- **linear** – it assumes that the commands are sent from the brain in a predetermined order (i.e. step-by-step, one command after the other).



SOURCE 1 The cognitive systems approach is used to explain the process of motor learning. It is described as hierarchical and linear.

For example, according to the cognitive systems approach, to perform a serve in tennis the brain creates an action plan (i.e. motor program). That action plan lists all of the necessary movements (i.e. sub-routines) required to complete the serve. It then sends each of these commands (in a predetermined order) to the relevant muscles that are needed to perform the skill and complete the task.

hierarchical
a term used to describe a process in which higher control centres (i.e. the brain) pass commands down to lower control centres (i.e. the muscles and nerves) in order to control movements

linear
a term used to describe a process in which commands are carried out one after the other in sequential order

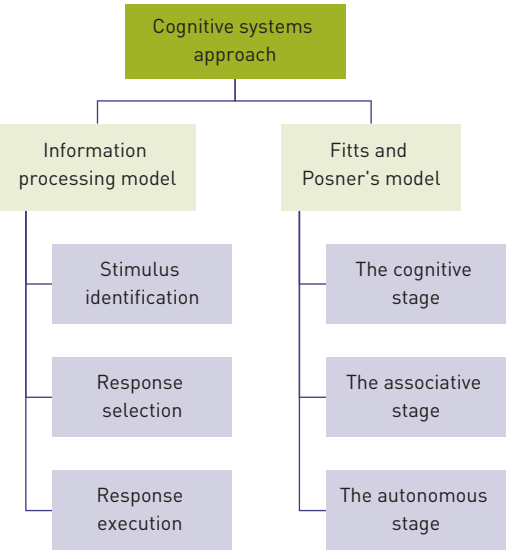
central nervous system
part of the larger body system known as the nervous system, the central nervous system consists only of the brain and spinal cord (i.e. the central part of the system). It does not include the network of nerves that run throughout our bodies (referred to as the peripheral nervous system)

Cognitive models of learning

Within the broader cognitive systems approach to learning, there are two main models (i.e. theories) that are used to explain how we process and learn motor skills (see Source 2). These include:

- the information processing model
- Fitts and Posner's (1967) stage model of motor learning.

While both of these models fit within the cognitive systems approach to learning, there are some differences in the way they explain the process and stages of learning.



SOURCE 2 The cognitive models of learning include the information processing model and Fitts and Posner's model. These approaches to learning will be further explored in this topic.

The information processing model

The **information processing model** proposes that humans receive, process and store information from their environment via the **central nervous system** (i.e. the brain and spinal cord).

FOR THE RECORD!

How good is your reaction time?

- The average speed of a professional male tennis player's serve is around 181 km/h. This allows their opponent 0.47 seconds to return the serve.
- The average speed of a professional female tennis player's serve is around 140 km/h. This allows their opponent 0.55 seconds to return the serve.

In both cases, there isn't a lot of time for processing environmental cues!

input
information received by the brain from the body's senses (such as sight, touch, taste, smell and hearing) according to the information processing model

output
a physical response or action executed by the body according to the information processing model

internal stimuli
information or cues that come from inside the body (e.g. thoughts, feelings, urges)

external stimuli
information or cues that come from outside the body (e.g. changes in the environment such as sounds, sights, smells, etc.)

According to this model, information (referred to as **input**) is received by the brain from the body's senses (such as sight, touch, taste, smell and hearing). It is then processed and a plan is prepared. Finally, a response or action is executed (referred to as **output**). A piece of information received by the body is often referred to as a stimulus (plural stimuli). Stimuli can come from inside the body or from outside the body. Stimuli from inside the body (e.g. the tickle in our throat that urges us to cough) are known as **internal stimuli**. Stimuli from outside the body (e.g. the urge to move your hand away from a hot surface) are known as **external stimuli**.

As shown in Source 3, there are three separate stages involved in performing an action:

- Stage 1 – stimulus identification (perception)
- Stage 2 – response selection (decision making)
- Stage 3 – response execution (action).

We will now look more closely at each of these stages.

Stage 1
Stimulus identification (perception)
- The stimulus is recognised and identified (cues).
- Example: The batsman identifies the line and length of the ball.

Stage 2
Response selection (decision making)
- The appropriate response is decided.
- Example: The batsman prepares for a full pitched delivery by stepping towards the ball.

Stage 3
Response execution (action)
- The response is performed.
- Example: The batsman performs a cover drive shot.

SOURCE 3 The information processing model has three stages – stimulus identification, response selection and response execution.

Stage 1 – Stimulus identification

stimulus identification
the first stage of the information processing model; the stage when the learner recognises and identifies the input

environmental cues
the relevant information from the environment

Stimulus identification is the first stage of the information processing model. It is when the learner recognises and identifies the input. This cognitive process is often referred to as perception. For example, during a game of cricket, a batter uses their sight to receive information about the kind of delivery coming from the bowler (i.e. whether it is it fast, slow, short or full). A player's ability to identify the relevant external stimuli (also known as **environmental cues**) is often the difference between success and failure. Identifying relevant environmental cues is dependent on a range of factors such as:

- how long the cue is present (e.g. the longer it is detectable, the easier it is to identify)
- the intensity of the cue (e.g. more obvious cues are easier to identify)
- the level of irrelevant background distractions present (e.g. the level of noise can make it more difficult to identify a relevant audio cue)

- physical characteristics of the player (e.g. some athletes have naturally sharper senses than others)
- the level of experience of the player (e.g. more experienced players can know what to look for).

Stage 2 – Response selection

Response selection is the second stage of the information processing model. It is when the learner makes a decision or develops a motor program in response to the input. For example, during a game of touch football an attacking player running towards a defender needs to decide if they will pass the ball, take the touch and play the ball, or try a side step.

There are two types of processing that can occur at the response selection stage:

- **serial processing** – where one piece of information is processed before moving onto the next piece
- **parallel processing** – where more than one piece of information can be processed simultaneously. Our senses often perceive a range of information at any given time, so parallel processing can help us to make a faster decision and, subsequently, a faster response.

In this situation, the footballer would probably be comparing information with similar experiences held in their long-term memory to determine the best course of action.

Both serial and parallel processing can sometimes be a challenge at the response selection stage due to the limited time available. Serial processing can be slower, while parallel processing can be more difficult. While it can be difficult to make multiple decisions at once, decisions and subsequent actions can often become automatic through practice. We can perform these automatic responses due to our ability to develop a link between a particular stimulus and a successful action.

response selection
the second stage of the information processing model; the stage when the learner makes a decision by comparing information in stored memory

serial processing
the act of processing one piece of information at a time

parallel processing
the act of processing multiple pieces of information at the same time

SOURCE 4 This batsman is receiving a number of environmental cues relating to the delivery of the ball from the bowler. Information relating to the speed, height and direction of the ball, as well as the body position of the bowler, are all being received. In addition to this, memories of prior experience in similar situations are being triggered.

Stage 3 – Response execution

response execution
the third stage of the information processing model; the stage when the learner produces a response or action by implementing a developed motor program

Response execution is the third stage of the information processing model. It is when the learner produces (i.e. executes) a response or action. For example, in a game of tennis a player returning a forehand serve will execute the motor program to hit a forehand. Based on the sensory information received in the stimulus identification stage, a decision has already been made about what sort of shot to play in response to the serve (e.g. a topspin or slice forehand). By this stage, a motor program has been selected and is executed.

The information processing model in Sport

Applying the information processing model to different training contexts can have a number of benefits for athletes (of all abilities) and coaches.

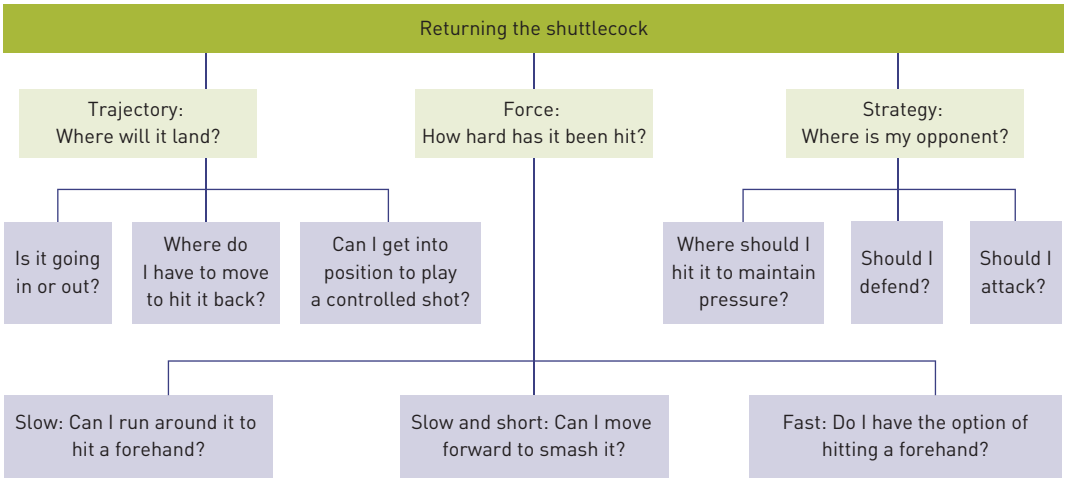
How well a skill is executed depends on how well each of the information processing stages is completed. If you are distracted by the crowd watching you during Stage 1 – Stimulus identification, there is an increased chance of missing the vital information cues that will enable you to complete Stages 2 and 3 successfully.

Your performance can be improved by looking at your decision-making processes. Responses become more successful when you can identify which environmental cues (Stage 1) are linked to specific skill responses (Stage 3). Source 5 identifies three environmental cues that you may encounter during a game of badminton. These cues would all need to be received in Stage 1 and processed in Stage 2 before a response could be put into action in Stage 3.

Once a player has completed these three steps of the information processing model, a decision will be made about which shot to take. The selection of the skill will be based on its success. If it worked, great! The player knows that they can repeat the action in similar situations. If it did not work, the player will have to consider what option would be better. Keeping a mental record of choices can help in future skill selections when facing a similar situation.

STUDY TIP

Using mind maps is an excellent way to organise your knowledge and to help you understand relationships between concepts. Explaining relationships between concepts (insight) is an essential element in the syllabus objective to analyse primary and secondary data to devise strategies about movement.



SOURCE 5 This mind map shows the information processing required for returning a shuttlecock in badminton.

Fitts and Posner's (1967) stage model of motor learning

Another model used to explain the process of learning motor skills is known as the **stage model of learning**. It was proposed by US psychologists Paul Fitts and Michael Posner in 1967 and is still one of the most widely taught theories used to explain the process of motor learning today.

stage model of learning
a theory developed by Fitts and Posner in 1967 that explains the process of learning a motor skill in three stages – cognitive, associative and autonomous

According to Fitts and Posner's model, there are three stages of learning:

- Stage 1 – the cognitive stage
- Stage 2 – the associative stage
- Stage 3 – the autonomous stage.

We will now look more closely at each of these stages.

Stage 1 – The cognitive stage

The **cognitive stage** is the first stage of Fitts and Posner's model of motor learning. It can be thought of as the 'understanding' stage. During this stage, the learner is trying to understand the skill and figure out exactly what needs to be done in order to perform it.

cognitive stage
the first stage of Fitts and Posner's stages of learning model; during this stage, the learner is trying to understand the skill and figuring out exactly what needs to be done in order to perform it

At this stage, learners do a lot of thinking. Neural pathways for specific motor programs are formed at this stage, so a large amount of thought is required to work through the technical requirements of a skill. As a result, the movement sequences are often slow, inconsistent and inefficient with a large numbers of errors.

Learners in the cognitive stage may know what they are doing is not producing the desired result, but are unsure how to correct it. For example, while learning to shoot a layup, beginners will have many thoughts going through their head relating to the approach steps, take off position, arm actions, hoop positions and so on. With this in mind, it's little wonder that many beginner basketball players completely miss the hoop on their first attempt.

The length of time spent in this stage can vary, but generally it is relatively short. With regular trial and error through practice, a learner's proficiency will improve quickly. Learners at this stage can become frustrated if they don't experience success as quickly as they would like. To increase the chances of success, a coach should teach simple, fundamental skills by demonstrating and giving clear instructions. Instructions should be brief and should focus on only a few technique points at a time.

At this stage of learning, feedback is very important and should be provided mostly through demonstrations and explanations. Learners need specific information and attention paid to the most critical elements of the skill. Coaches must also keep in mind that the learner might not understand the task, so the amount and speed of information should be controlled to avoid information overload.

SOURCE 6 Feedback is very important during the cognitive stage of learning and should be provided mostly through demonstrations and explanations.

Stage 2 – The associative stage

associative stage
the second stage of Fitts and Posner's stages of learning model; during this stage, the learner has grasped the fundamentals and mechanics of the skill and their performance becomes more consistent with fewer errors

The **associative stage** is the second stage of Fitts and Posner's model of learning. It can be thought of as the 'practice' stage. During this stage, the learner has grasped the fundamentals and mechanics of the skill and their performance becomes more consistent. Throughout the associative stage, errors become smaller and less frequent, as the learner is able to identify and correct them as they occur.

Compared to the cognitive stage, the associative stage is quite long. Yet, many athletes never move beyond the associative stage of learning. While they can recognise errors are being made, they are not always able to identify relevant environmental cues in order to correct them. They may also lack perception and timing to perform the skill fluently.

For other athletes, the associative stage is a time when their confidence and experience builds. These learners find that their movements can be linked to specific environmental cues, helping to build a bank of experiences on which to base future decisions. Practice sessions to refine motor skills can be lengthened, and it is the role of the coach to provide a range of experiences to help the learner further determine relevant and irrelevant environmental cues. Coaches should also continue to assist learners to analyse their errors and correct their skills during this stage of learning.

Stage 3 – The autonomous stage

autonomous stage
the third stage of Fitts and Posner's stages of learning model; during this stage, the learner can perform the skill consistently and fluently in different environments without conscious effort

The **autonomous stage** is the third stage of Fitts and Posner's model of motor learning. It can be thought of as the 'automatic' stage. During this stage, the learner can perform the skill consistently and fluently in different environments without conscious effort. At this stage, learners focus little attention on the skill basics and pay more attention to identifying relevant environmental cues to enhance decision making. Improvements at this stage take place slowly. For example, a volleyball player performing a spike no longer needs to think about footwork, body position and arm swing. Instead, they can focus on the position of the blockers and finding space on the other side of the court for the spike.

Even though players in the autonomous stage can manage their own errors, an experienced coach may often still be necessary to help identify minor technical shortages that have caused an increase in performance errors. This can lead to a skilled performer returning to the associative stage for a brief period while they make minor adjustments to a skill. Generally, a skilled performer will fluctuate between the associative stage and autonomous stage throughout their career. An example of such a regression is discussed in the Theory in action on the following page.

FOR THE RECORD!

A golf handicap is a measurement of a golfer's ability; the lower the handicap, the better the golfer. While most people can hit a golf ball and achieve some success, only 4% of golfers worldwide achieve a single-digit handicap. For example, the average handicap for males (including social golfers) is around 29. So it is fair to say that most golfers never leave the associative stage.

Theory in action | Ian Healy and the 'golf ball drill'

Former Australian international cricketer, Ian Healy is commonly regarded as Australia's best ever wicketkeeper. He played 119 tests for Australia from 1988–1999.

To keep his motor skills at peak performance Healy developed two techniques that would help him improve how he caught the ball:

→ The first was to 'watch the ball into the gloves'. Following this simple tip, Healy found that he became more and more consistent.

→ The second was to develop 'soft hands' by listening to the sound of the ball going into the glove with a soft thud.

To practise these two skills, Healy used the 'golf ball drill'. This involved throwing a golf ball against a wall and concentrated on watching the ball go into the glove and catching it as he would correctly catch a cricket ball.

Healy claims he would modify this drill throughout his career when he came into contact with different bowlers. His subsequent technique change would mean an initial increase in errors but with persistent practice such changes helped him improve his game on many occasions. This is a great example of how changing a practice technique can take even an elite athlete like Ian Healy from the autonomous stage to the associative stage, if only temporarily.

SOURCE 7 Ian Healy played 119 tests for Australia from 1988–1999. During this time he made 395 dismissals.

Fitts and Posner's stage model of learning in sport

Applying Fitts and Posner's stage model of motor learning to different training contexts can have a number of benefits for both athletes and coaches. Source 8 below summarises some key points.

Stage of learning	At this stage, learners typically:	At this stage, coaches should:
Stage 1 – the cognitive stage (or understanding stage)	→ spend a large amount of time thinking about what is required and working through the technical requirements of a skill (often step-by-step) → have poor timing → make lots of errors → make movements that are slow, inconsistent and inefficient	→ provide demonstrations and explanations of the skill → use a range of motivational techniques → break the skill into parts (where possible), rather than having the student practise a whole skill → use mainly closed drills for practice – for example, when coaching someone new to basketball, practise shooting alone rather than within a game environment → have learners follow an example first, and then try the skills themselves with more instruction → allow for constant but small blocks of practice with plenty of recovery time (known as distributed practice) → provide feedback regularly.
Stage 2 – the associative stage (or practice stage)	→ refine the accuracy and consistency of the skill → make fewer errors → begin to identify and correct their own errors → begin to develop confidence and experience → link their movements to specific environmental cues (and build a bank of experiences on which to base future decisions)	→ mainly practice skills as a whole skill → include more problem-solving drills to develop strategies → use a combination of distributed and massed practice → use specificity to ensure focus is specific to the needs of the athlete → offer frequent and detailed feedback but also encourage learners to conduct self-analysis to consolidate their understanding and find solutions
Stage 3 – the autonomous stage (or automatic stage)	→ perform skills accurately and consistently → detect more environmental cues, faster → focus more on strategies and tactics → improve slowly → benefit from psychological skills training	→ use problem-solving drills and authentic game environments → develop game plans and strategies with the athlete based on their strengths and weaknesses → provide expert, highly attuned feedback → use specificity to guide their sessions

SOURCE 8 This table uses examples to summarise Fitts and Posner's stage model of learning.

SOURCE 9 Learners at the cognitive stage benefit greatly from demonstrations.

2.3 Check your learning

Engage and understand

1 **Recall** the three stages of the information processing model.
2 **Identify** the three stages described in Fitts and Posner's (1967) stage model of learning.
3 **Explain** the key features of the cognitive stage and the associative stage in Fitts and Posner's (1967) stage model of learning.
4 **Explain** the terms 'serial' and 'parallel' processing.
5 **Select** a specific game situation or skill from your selected physical activity and **sketch** your own mind map to organise your knowledge. See Source 5 on page 50 for an example.

Apply and analyse

6 According to Fitts and Posner's (1967) stage model of learning, some learners will never progress beyond the associative stage. **Reflect on** why you think this can occur.
7 Based on what you have learnt, **consider** whether you think a player could be at different stages of learning for different skills. **Identify** examples from your selected physical activity to support your opinion.
8 **Determine** why it is important for coaches and students to understand the three stages of learning.
9 **Identify** which cues are required to enhance decision making for your selected physical activity. **Determine** which cue is the most important to perceive in order to choose a successful response.
10 **Develop** a written record of your performance in your selected physical activity. **Reflect** on what is working and why. This will be extremely useful when justifying specific movement sequences and game strategies for assessment. **Consider** what other cues you should look for to increase the chances of success, and how these cues impact on your movement sequences and game strategies.

Evaluate and justify

11 'Athletes operating at the autonomous stage of learning have no need for coaches.' Do you agree or disagree with this statement? **Justify** your opinion in a 200-word written response.
12 Conduct some additional research to **examine** whether the quality of practice or the quantity of practice yields the quickest improvements for a learner. **Synthesise** your findings and present them in a table.
13 Read 'Ian Healy and the "golf ball drill"'. **Decide** which of the following statements best captures how Ian Healy improved his skill level. **Justify** your choice, referencing what you have learnt about the stages of learning.
   (A) A skilled performer can make minor adjustments to a skill where they will fluctuate between the associative and autonomous stages.
   (B) Players can recognise errors being made, but they do not always identify all relevant cues.
   (C) To ensure the fastest possible improvement, practice sessions should be well organised and simulate various real-life situations.
   (D) Learners need specific information and attention paid to the most critical elements of the skill.

SOURCE 10 A skilled performer will often fluctuate between the associative and autonomous stage of learning.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  2.3 Check your learning
- **» Student worksheet**
  2.3 Cognitive systems approach worksheet
- **» Weblink**
  The information processing model
- **» Weblink**
  Fitts and Posner's stage model of motor learning

2.4 The dynamic systems approach to motor learning

dynamic systems approach
a theoretical framework used to help explain the processes involved in motor learning; according to this approach, the intelligence that coordinates and controls body movements is the result of complex interactions between the individual, the environment, and the task

dynamic
a term used to describe a process or system that is constantly changing

non-linear
a term used to describe a process in which commands are not carried out step-by-step in sequential order

constraint
any internal or external variable that has an impact on an athlete's performance

task constraint
any aspect of a task that an athlete needs to overcome or adapt to (e.g. rule of a game)

environmental constraint
any changeable aspect of the environment that an athlete needs to overcome or adapt to (e.g. weather)

individual constraint
any individual characteristic that an athlete needs to overcome or adapt to (e.g. height, weight, skill level)

That's a goal!

By the end of Section 2.4 you should be able to:

→ **define** what is meant by the term 'dynamic systems approach'
→ **define** what is meant by the term 'constraint' and 'rate limiter'
→ **identify** examples of these concepts in action.

Introduction to the dynamic systems approach

Unlike the cognitive systems approach – which views motor learning as an organised process – the **dynamic systems approach** views motor learning as a much more complex, unpredictable and constantly changing process (hence the name **dynamic**).

The basic idea behind the dynamic systems approach is that the body is a complex system made up of millions of different parts. All of these parts are constantly interacting with each other and outside world. Unlike the cognitive systems approach, the dynamic systems approach does not suggest that our movements are coordinated exclusively by a single, centralised command centre (i.e. our brain). Instead, it suggests that our movements are coordinated and controlled through complex, **non-linear** interactions between all parts of the body. The dynamic systems approach suggests that motor skills are learnt and carried out dynamically in response to certain variables, known as **constraints**. There are three types of constraints and all are central to the dynamic systems approach. They include:

- **task constraints** – These are the aspects of the task that need to be overcome or adapted to (such as the rules of a game, the shape and weight of equipment, the size and shape of the playing surface, etc.)
- **environmental constraints** – These are the changeable aspects of the environment that need to be overcome or adapted to (such as weather conditions, the condition of playing surface, the number of spectators, etc.)
- **individual constraints** – These are the characteristics of the individual that need to be overcome or adapted to (such as height, weight, skill, strength, motivation and confidence).

SOURCE 1 Task constraints can include the weight, shape and size of sports equipment.

A good way to understand how the dynamic systems approach works is to apply it to an everyday situation like walking down a hill. As shown in Source 1, people automatically change their gait (i.e. way of walking) when they begin to walk down a steep, rocky slope. As they take the first step from a level surface onto the slope, they automatically lean backwards and begin to take smaller, more cautious steps with their knees bent. With each step, they also place more weight on the heel than they normally would on a level surface. All of this happens without conscious thought. Instead, the body self-organises to achieve the most stable state for

navigating the surface and steepness of the slope. According to dynamic systems approach, in this situation our body responds in real-time to:

- task constraints – such as the steepness of the slope
- environmental constraints – such as the unstable, slippery or uneven surface
- individual constraints – such as the height and weight of the person, the length of the legs, and the strength of the muscles and joints.

Self-organisation is a key concept in the dynamic systems approach. It refers to the many adjustments that a learner is constantly making in response to the constraints placed on them – without any conscious thought or specific instructions from a coach or teacher. The human body always strives to maintain equilibrium (i.e. balance) – right down to a cellular level. When the body self-organises, it is trying to establish a movement pattern that is stable and balanced. The dynamic systems approach suggests that all parts of the body work together to achieve this stability, as opposed to just the brain and the central nervous system controlling the body (as suggested by the cognitive systems approach). Once a person becomes stable, they become comfortable and can produce a motor skill easily and reliably.

self-organisation a term used to describe a process in which many different systems and organs in the body interact with each other in order to achieve a task and establish a movement pattern that is stable

The dynamic systems approach in sport

When it comes to sport and physical activity, the dynamic systems approach suggests that with a favourable environment and a suitable task to perform, an individual will spontaneously produce effective and efficient movement sequences. It also suggests that the body will develop efficient movement patterns based on the constraints that it faces.

For example, an inexperienced netball player who is defending an opponent from shooting for goal will likely start defending with two feet planted on the ground and two hands outstretched. The constraints they face in this situation include:

- task constraints (e.g. the 3 ft rule, the height of their opponent, etc.)
- environmental constraints (e.g. whether the surface of the court is wet or dry,
  the level of noise created by the spectators, etc.)
- individual constraints (e.g. their height, level of experience, core strength, etc.).

In most cases, these constraints will prompt a response in the body to self-organise and change stance (as shown in Source 2). In an effort to extend their reach towards the ball, the body will lean forward, one arm will naturally drop away and one foot will be extended behind them as a counter balance to create stability. This is not generally something netball coaches need to teach young players. Instead, a combination of different constraints elicits this physical response from the individual.

SOURCE 2 According to the dynamic systems approach, when walking down a steep hill your body responds in real-time to task constraints, environmental constraints and individual constraints. It self-organises and changes your movement pattern to become more efficient and stable. As a result, you lean back more and place more weight on your heel as you take each step.

At this point you might be wondering whether it is possible for a netballer to become a skilled performer without any coaching. That is, according to the dynamic systems approach, can a player learn everything they need to know and do through experiences only? The answer here is maybe. However, without any formal instruction or coaching, this would likely require many years of experiential learning. When a learner finds an effective and efficient movement sequence, it does not mean they have mastered that skill. Work is still required to ensure the appropriate neural pathways are established and other relevant body systems are strengthened through ongoing practice.

SOURCE 3 According to the dynamic systems approach, a range of different constraints will prompt a response in the body to self-organise and change stance. A netball coach can also manipulate task and environmental constraints to encourage learners to solve movement problems through the exploration of different movement sequences. This can help fast-track their development.

According to the dynamic systems approach, teachers and coaches still have an important role to play as facilitators helping learners in the acquisition of skills. By manipulating task and environmental constraints, teachers and coaches can encourage learners to solve movement problems through the exploration of different movement sequences.

Referring again to the netball example, a coach might manipulate constraints by having the shooter shoot from a number of different positions while the defender defends. Additional players might also be positioned so that the defender is unable to adopt a traditional front-on stance and is forced to make alterations to their technique. The shooter might also be replaced by a much taller player, forcing the defender to learn how to jump in order to defend the goal.

Constraints

As mentioned earlier, constraints are a central part of the dynamic systems approach. In 1986, motor learning researcher, Karl Newell, developed the 'Theory of constraints'. He proposed that a number of variables – known as constraints – can affect an athlete's motor development. In a sporting context, a constraint is any internal or external variable that has an impact on an athlete's performance. A constraint can do one of two things:

- elicit an adjustment to an athlete's performance
- restrict an athlete's performance.

Source 3 shows how Newell's theory relates to the three constraints – the task, the environment and the individual.

Task constraints	environment constraints	Individual constraints
Characteristics of the task (e.g. rules, goals and equipment)	**Characteristics of the physical and social environment**	**Characteristics of the individual**
→ Cannot use hands	→ Weather (e.g. wind, rain, fog)	→ Height
→ Off-side rule	→ Temperature	→ Weight
→ No-contact rule	→ Noise	→ Body composition
→ Cannot run with the ball	→ Light level	→ Endurance
→ Playing zones	→ Gravity	→ Flexibility
→ Aim to score	→ Spectators	→ Strength
→ Keep ball in the court	→ Friends	→ Speed
→ Opposition	→ Teachers	→ Technique
→ Number of players on court	→ Family	→ Motivation
→ Size, shape and weight of equipment	→ Cultural norms	→ Confidence
		→ Learning style
→ Size and shape of playing surface		→ Tactical knowledge

Source: adapted from Spittle. M, (2013) *Motor Learning and Skill Acquisition: Applications for Physical Education and Sport.*

SOURCE 4 Newell's 'Theory of constraints' proposed that a number of variables – known as constraints – can affect an athlete's motor development.

Constraints can lead to the development of a new motor skill or the emergence of a new technique as the body self-organises to overcome instability in the task, the environment or the individual. For example, when a touch football match is played in the rain, some players will take advantage of this environmental constraint. A player approaching the try line might decide to use the slippery grass to slide from further out than they normally would. Furthermore, a player who has been previously reluctant to dive – for fear of a painful landing – might now attempt this skill.

The development of a new motor skill can also be compromised or restricted by one or more of these constraints. For example, a young child will find it difficult to develop basketball shooting and passing skills with a ball that is too large or heavy for them because the physical strength and size of their hands negatively impacts their ability to execute the skill.

SOURCE 5 Tennis great Roger Federer demonstrates a common task constraint for young tennis players – the size of the racquet.

Rate limiters

When constraints have a negative effect on learning processes and restrict performance, they are referred to as rate limiters. Rate limiters can be related to the individual, the environment or the task (see Source 4). Individual rate limiters can be further categorised as:

- **Physical rate limiters** – These are related to a learner's physical characteristics (e.g. height, weight, physical strength, fitness).
- **Physiological rate limiters** – These are related to the functions of learner's body systems and processes (e.g. strength, speed and stamina)
- **Psychological rate limiters** – These are related to the learner's mental state (e.g. confidence, motivation and arousal)
- **Perceptual rate limiters** – These are related to the learner's senses (e.g. ability to detect and process cues)
- **Tactical rate limiters** – These are related to a learner's knowledge and understanding of individual and team tactics and strategies within a particular sport or physical activity (e.g. a player's understanding of defensive tactics in basketball)
- **Technical rate limiters** – These are related to a learner's technique (e.g. a player's foot position in a soccer corner kick).

Rate limiters help to explain why an individual may have difficulty completing a skill, despite a concerted effort.

SOURCE 6 Constraints can lead to the development of a new motor skill or the emergence of a new technique. For example, when a touch football match is played in the rain, some players will take advantage of this environmental constraint.

SOURCE 7 When learning motor skills such as a basketball jump shot, task, environmental and individual constraints can have a negative effect on the rate of development. These constraints are known as rate limiters.

SOURCE 8 Rate limiters such as a weaker non-dominant leg can be overcome through the use of specially designed task and environmental constraints activities during practice.

In the earlier basketball example, the size of the child's hand would be a physical rate limiter to the child shooting a jump shot with a large ball. In the junior leagues, basketball clubs overcome this type of rate limiter by offering different ball sizes for different age groups. Examples of other individual rate limiters that may affect a child's jump shot development include:

- not being confident enough to back themselves in pressure situations (i.e. psychological rate limiter)
- not being physically strong enough to produce the force required to propel the ball to the basket (i.e. physiological rate limiter)
- inability to take in relevant cues such as the open teammate to their right (i.e. perceptual rate limiter)
- limited understanding of options for getting past a tall defender (i.e. tactical rate limiter)
- placing one foot behind the other during the take-off phase (i.e. technical rate limiter).

Working with rate limiters

An understanding of rate limiters can help players maximise their learning potential. It is important to be able to identify constraints that might be negatively affecting their development and then look for ways to compensate for these constraints or overcome them. For example:

- an Australian football player might identify their lack of flexibility as a rate limiter and develop strategies to improve this aspect of their physical ability
- a soccer coach might identify the lack of coordination in a key player's non-dominant leg as a rate limiter and manipulate a task or environmental constraint to restrict the use of the dominant foot for certain activities (in order to encourage the player to improve coordination in the other leg).

In some cases, it is not possible to change a rate limiter. It might be necessary to find ways to adjust strategies or positioning to work with that constraint. For example:

- a short basketball player may be better off staying outside of the key and instead working on their long-range shot accuracy. Shorter players often find ball carrying suits their short stature as they can keep the ball protected low to the ground and use their agility to avoid the defence
- a sprinter might realise their upcoming track meet will be run on a grass track and modify the spikes on their shoes to increase their chance of success.

PERFORMANCE | SKILL DRILL 2.4

Assess the impact of rate limiters on performance

>> Turn to pages 326–327 to complete this integrated physical performance activity.

2.4 Check your learning

Engage and understand

1 In your own words, **summarise** the key principles of the dynamic systems approach to motor learning.
2 **Identify** the three types of constraints that are central to the dynamic systems approach. Provide one example of each.
3 **Explain** the term 'self-organising'. **Use** an example to support your explanation.
4 **Define** the term 'rate limiter'.

Apply and analyse

5 **Determine** what is meant by the following statement from the text: 'When a learner finds an effective and efficient movement sequence, it does not mean they have mastered that skill.'
6 **Categorise** the following rate limiters using Source 8 below:
   - **a** A volleyball spiker's non-hitting arm during the flight phase
   - **b** A soccer player not detecting his open teammate in his peripheral vision
   - **c** A track runner's lack of self-belief
   - **d** A beginner touch football player's lack of team-strategy knowledge
   - **e** A backstroker's inability to see the 5 m warning flags due to impaired vision
   - **f** A triathlete suffering from a chest infection.
   - **g** A lawn bowler's injured knee.
   - **h** A leg strength of a triple jumper who continually 'buckles' between the hop and step phase of the jump.
7 **Consider** this statement from the text: 'By manipulating task and environmental constraints, teachers and coaches can encourage learners to solve movement problems through the exploration of different movement sequences'.

   Reflect on whether your teacher or coach has applied the dynamic systems approach to learning skills this term. Use examples from your classes to support your response.

Evaluate and justify

8 **Devise** a constraints-based activity to help you improve a specialised movement sequence or movement strategy in your selected physical activity. **Justify** your design.
9 **Justify** whether the cognitive systems approach or dynamic systems approach best describes how you have learnt motor skills in your selected physical activity for this unit. **Comment** on the distinction between linear and non-linear skill development.

Physical	Physiological	Psychological
Perceptual	**Tactical**	**Technical**

SOURCE 8 Types of rate limiters

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  2.4 Check your learning
- **» Video**
  Understanding constraints and rate limiters
- **» Skill Drill worksheet**
  2.4 Assess the impact of rate limiters on performance
- **» Weblink**
  Rate limiters

2.5 Types of practice

That's a goal!

By the end of Section 2.5 you should be able to:

→ **define** and **distinguish** between the different types of practice

→ **identify** examples of these concepts in your selected physical activity.

STUDY TIP

Develop your own concise study sheet for the major types of practice discussed in this section. In addition to describing each type, determine its suitability for cognitive, associative and autonomous learners.

Practice is an essential part of learning and refining a motor skill. Practice is also one of the main ways to develop the five characteristics of motor skill learning: stability, persistence, improvement, consistency and adaptability.

Through practice, the development of these characteristics will increase a player's confidence and ability to make better decisions under pressure. However, practice will only assist the player when the type of practice is relevant to their particular stage of learning.

Learners who are in the cognitive stage (i.e. beginners) generally need to practise in a closed environment to make their skills more fluent and consistent; whereas learners at the autonomous stage generally need to practise in a range of different environments to develop the consistency required in stressful real-life situations.

Practice can be classified into the following types:

- massed practice and distributed practice
- whole practice and part practice
- blocked practice, serial practice and random practice
- constant practice and varied practice
- drills and problem solving
- specificity and variability practice.

We will look more closely at each of these now.

Massed practice and distributed practice

massed practice
when a skill is practiced in a continuous and constant manner (and rest periods are either very short and non-existent)

distributed practice
when a skill is practised with periods of rest that are equal to (or longer than) the periods spent training

Massed practice is when a skill is practised in a continuous constant manner (and rest periods are either very short or non-existent). An example of massed practice is a netball goal shooter practising shooting continuously for 20 minutes. Successful massed practice requires correct technique, high levels of concentration and sufficient fitness to minimise fatigue affecting the performance. For these reasons, massed practice is more suited to highly skilled performers.

Distributed practice is when a skill is practised with periods of rest that are equal to (or longer than) the periods spent training. For example, a netball goal shooter practises shots from the right of goal for 5 minutes, has a break for 5 minutes and then repeats the process with another 5 minutes of goal shooting from a different point.

Both of these methods are effective when learning basic skills. However, to improve performance, distributed practice is more effective than massed practice because it allows time for feedback and decreases the risk that the learner becomes tired and loses concentration. Distributed practice is also more effective when the energy demands of the skill are high, when the skill being learnt is complex and when the learner's motivation is low.

SOURCE 1 Different types of practice can be used depending on the skill being learnt and the player's stage of learning.

Whole practice and part practice

Whole practice is when a skill is practised as a whole (i.e. in its entirety). **Part practice** is when a skill is practised in its separate parts. For example, a golf swing can be taught in its entirety or broken up into its component parts of grip, stance, takeaway, downswing, impact position and follow-through.

When choosing between whole and part practice, coaches and players need to consider which stage of learning the student is at and the complexity of the skill. Although part practice can make a skill simpler, coaches need to be cautious not to change the nature of the skill. For this reason, when determining 'parts' of the skill, they should be the largest component a learner can handle – that is, as many small parts as possible after each other. This will aid in developing the timing and rhythm required to perform the skill as a whole.

whole practice
when a skill is practised as a whole (i.e. in its entirety)

part practice
when a skill is practised in its separate parts

Blocked practice, serial practice and random practice

Blocked practice is when learners repeat an isolated skill for a period of time or number of repetitions. For example, blocked practice in volleyball might consist of 50 digs, 50 sets and 50 serves. This is a traditional approach and the intention is to correct errors and refine motor skills. Learners at the cognitive stage gain more confidence from blocked practice but their ability to retain and adapt these skills does not necessarily carry through to game situations.

Serial practice is when a set of skills is performed in a set sequence. For example, practising a set of six touches in touch football. This replicates the skills typical to an authentic game situation, yet it lacks the unpredictability found in competitive environments.

Random practice is when several different sets of skills are practised in an order that is constantly changing. In volleyball, random practice would involve a learner switching between performing digs, sets and spikes from different positions on the court. During random practice, the learner does not practise any one particular skill for a length of time, but changes from one skill to another until a certain time or number of repetitions has been achieved. Switching from one skill to another develops stronger neural pathways, which increases the chance that the learner will remember and produce the skill in a competitive environment. Random practice is better suited to athletes at the associative and autonomous stages of learning.

blocked practice
when learners repeat an isolated skill for a period of time or number of repetitions

serial practice
when a set of skills is performed in a set sequence

random practice
when several different sets of skills are practised in an order that is constantly changing

Constant practice and varied practice

constant practice
when a skill is practised under the same (i.e. constant) conditions

variability practice
when practice sessions incorporate a variety of movement options and context changes

Constant practice is when a skill is practised under the same (i.e. constant) conditions. An example of this is throwing a softball to a partner who is 10 metres away for a specific period of time or a specific number of repetitions. This essentially reinforces the motor skill for one specific condition.

Varied practice is when variations of a particular skill are practised in no particular order. For example, throwing a softball over specific distances or chipping a golf ball at different targets ranging from 20 to 60 metres.

Both constant and varied practice have their advantages, but varied practice can replicate competitive conditions more accurately. It is rare to get an opportunity to replay the same skill in a game situation. In golf, you may only get one chance to hit the chip shot of 50 metres that round, and when throwing a softball from the outfield, the distance to the target will change every time.

Drills and problem-solving drills

drills
activities set up to allow for practising skills; they can target the development of one or multiple skills in various environments and can vary from simple to complex in nature

problem-solving drill
a type of task that requires learners to solve common problems (e.g. reading environmental cues) and respond to those problems in the most suitable way

specificity practice
when skills are practised in an environment that is as close to match conditions as possible

varied practice
when variations of a particular skill are practised in no particular order

Drills are a common method for developing skills. The traditional model for drills is to repeat an isolated individual skill, or small set of skills, in a relatively closed, simple environment. This reinforces the motor program and can be recalled from a player's 'bank of skills' as required in various environments. An example of a cricket drill is batting in the nets against a bowling machine to practise front foot drives. Reproducing the same movement that you have been drilling in an actual match condition can be positive (i.e. when it's an automatic response that is executed to suit a specific situation) or negative (i.e. a predictable response that is unsuitable for the situation and that the opponent can read).

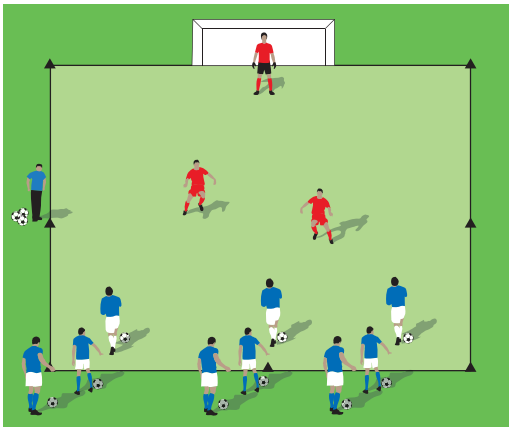
Problem-solving drills can be used to help players practise reading a situation based on environmental cues and respond to those cues in the most suitable way. A player who can do this has greater potential to produce successful performances. Because it is concerned with adapting to the environment, it reflects the philosophy of the dynamic systems approach (Section 2.4).

Games and sports often have tactical problems that players need to solve to increase successful outcomes, such as how to create space in invasive games to increase the chance of passing to your teammate or how to isolate a player to create a scoring opportunity. The advantages of problem-solving drills are that they can be modified to suit the learner level. When developing 'moving into space' strategies, a larger grid with less players can be used for learners at the cognitive stage. The same drill can be used for associative and autonomous learners by decreasing the size of the playing grid and/or increasing the number of players. Modifications to drills to prompt problem solving could include:

- the skills used (e.g. using handballing only in Australian football practice)
- the size of the field (e.g. shortening and widening the field in touch football practice)
- the scoring zones (e.g. adding an extra goal for each team in soccer practice, as in 'four goal soccer')
- the method of scoring (e.g. scoring by getting the ball to the shooter inside the goal circle in netball practice, instead of by shooting through the hoop)
- the team composition (e.g. reducing or increasing the number of defenders or attackers in basketball practice).

Specificity and variability practice

Specificity practice is when skills are practised in an environment that is as close to match conditions as possible. The drills developed for specificity practice need to be realistic and include the specific skills that would be used in a match situation. For example, on match day, a tennis player will not only have to hit balls, but run around the court as well. A specificity practice that has the player alternating between hitting and running sprints on the court is a good way to replicate the degree of fatigue that they will probably experience on match day. Likewise, if a cricketer is playing matches on a turf wicket, then they should practise on that exact surface.



SOURCE 2 This problem-solving drill aims to help the three attackers (in blue) increase their chance of dribbling past the defenders (in red) and having a shot at goal. Next, they might use just two balls to score a goal.

Variability practice is when practice sessions incorporate a variety of movement options and context changes. Due to the increase in skill complexity in these types of exercises, neural pathways are strengthened. This leads to stronger motor program development. The skill can be made more complex and unpredictable by making changes to the movement, equipment or the environment. Movement modifications might see players practise shooting a goal while standing on one leg or catching a ball while standing on a wobble board. Equipment modifications are often used to increase unpredictability, such as practising a racquet sport using fewer strings in the racquet or using weighted touch footballs to improve passing strength. Changes to environmental conditions could include running on sand and unfamiliar terrain, or practising golf in the rain.

PERFORMANCE | SKILL DRILL 2.5 | Investigate the impact of types of practice on performance

>> Turn to pages 328–329 to complete this integrated physical performance activity.

2.5 Check your learning

Engage and understand

1 **Explain** the purpose of practice. Refer to both the skill and the learner in your response.
2 **Describe** the conditions that need to be considered when choosing whole or part practice.
3 **Identify** the variables that can be used in problem-solving drills.

Apply and analyse

4 **Select** a drill from your current physical activity. Provide conditions for this drill to satisfy each of the following types of practice:
   a blocked
   b random
   c constant
   d varied.
5 **Identify** errors in one motor skill from your selected physical activity. **Reflect on** the various types of practice and identify which one would best help you correct these errors.
6 **Consider** your stage of learning for your selected physical activity and explain whether massed or distributed practice will improve your skills the most.

Evaluate and justify

7 'Constant practice is better than varied practice for closed environment games.' Do you agree or disagree? **Justify** your response using what you have learnt in this section.

Check your obook assess for the following additional resources and more:

- **Student book questions**
  2.5 Check your learning
- **Video**
  Distributed and massed practice
- **Student worksheet**
  2.5 Types of practice worksheet
- **Skill Drill worksheet**
  2.5 Investigate the impact of types of practice on performance

2.6 Types of feedback

That's a goal!

By the end of Section 2.6 you should be able to:

→ **define** the term 'feedback'
→ **distinguish** between intrinsic and extrinsic feedback
→ **distinguish** between knowledge of performance and knowledge of results
→ **identify** examples of these concepts in your selected physical activity.

feedback
information about a person's skills or performance; can include intrinsic and extrinsic feedback

intrinsic feedback
the internal or sensory information that a player receives during and after a movement

Feedback is a term used to describe all of the information an individual receives about their performance of a skill. Feedback is organised into two categories:

- intrinsic feedback (i.e. from inside the body)
- extrinsic feedback (i.e. from outside the body).

We will look at each of these types of feedback in detail in this section.

Intrinsic feedback

Intrinsic feedback is the internal (or sensory) information that a player receives during and after the performance of a skill. The main types of intrinsic feedback are:

- visual (what you see)
- tactile (what you feel)
- auditory (what you hear)
- proprioceptive (what you sense – particularly in terms of the position and movement of your body).

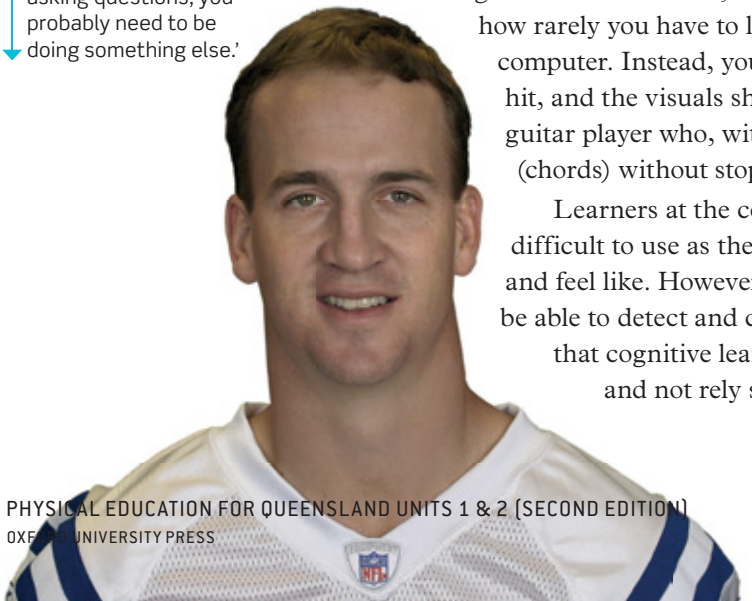
For example, during a game of basketball a player is aware (proprioceptive) of their stance, grip and action throughout the skill. They can feel (tactile) the ball leaving their fingers, see (visual) the trajectory of the ball's flight, and can see (visual) and hear (auditory) it being caught by a teammate. In this way, individuals receive intrinsic feedback about the performance without relying on feedback from technology or other people.

You can explore your intrinsic feedback by trying to perform a skill with your eyes closed (making sure it is safe to do so) and focusing on the 'feeling' of the movement. We might not think about it, but we all use intrinsic feedback constantly. Consider how rarely you have to look down at the keyboard when you type on a computer. Instead, you rely on the feeling and the sound of the keys being hit, and the visuals showing up on the screen. Another example is a guitar player who, with a degree of proficiency, changes finger positions (chords) without stopping to look at the strings.

Learners at the cognitive stage will find intrinsic feedback more difficult to use as they are still working out what the skill should look and feel like. However, to progress to the associative stage, you need to be able to detect and correct your own errors. It is therefore important that cognitive learners learn to recognise and use intrinsic feedback and not rely solely on extrinsic feedback.

FOR THE RECORD!

Peyton Manning is considered one of the greatest quarterbacks to have ever played in the NFL in America. He acknowledges the importance of external feedback: 'I love being coached. I ask a lot of questions and certainly appreciate any insight and feedback. I think if you ever stop listening to coaching or stop asking questions, you probably need to be doing something else.'



Extrinsic feedback

Extrinsic feedback (also known as augmented feedback) is the external information that a player receives after the completion of performance of a skill. For example, after a basketball game a player might watch a replay of their performance and be given constructive criticism by their coach. Extrinsic feedback adds to the intrinsic feedback an individual has received during their performance and is particularly important for beginners (who may not yet be able to detect errors in their own performance). The main types of extrinsic feedback are:

- knowledge of results
- knowledge of performance.

extrinsic (augmented) feedback
information from external sources that is received at the completion of a movement

Knowledge of results

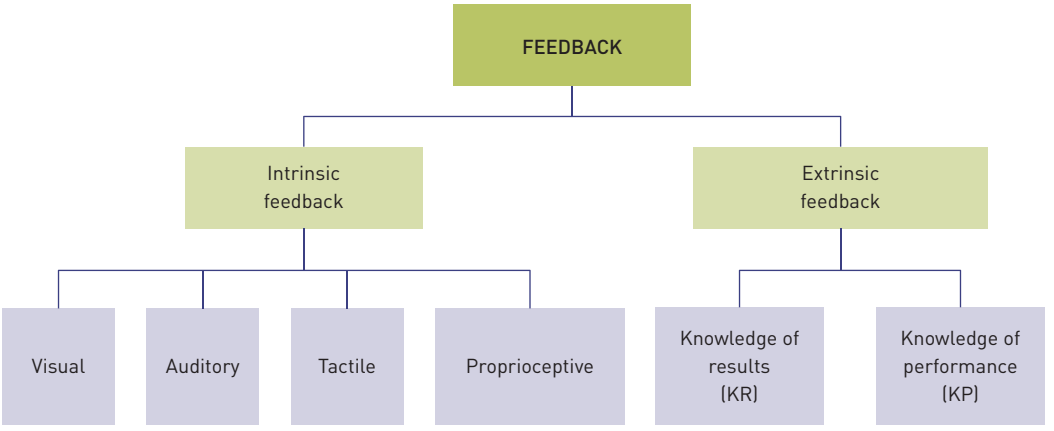
Knowledge of results (KR) feedback is based on the outcome (i.e. result) of the performance. This type of feedback is particularly helpful when learning a skill as it allows an individual to determine their progress. Shooting a soccer ball at a goal from a certain distance and counting the number of goals is an example of how KR can be used to determine a learner's skill level. Learners at the cognitive stage often find this type of feedback easy to use.

knowledge of results (KR) feedback
feedback based on the outcome (i.e. result) of the performance

Knowledge of performance

Knowledge of performance (KP) feedback is concerned with the execution or process of the movement, as opposed to the outcome. For example, a gymnastics coach might explain to a gymnast that they had good body shape during a movement or that they need to keep their arms straight during a handspring. KP feedback is often used by coaches to reinforce the 'technical cues' an individual received when the skill was initially presented. Learners can apply this information to enhance their ability to detect and correct their own errors.

knowledge of performance (KP) feedback
feedback that is concerned with the execution or process of the movement, as opposed to the outcome



SOURCE 1 The main types of intrinsic and extrinsic feedback.

SOURCE 2 Coaches will often provide both KP feedback (i.e. feedback based on the execution or process of the movement) as well as KR feedback (i.e. feedback about the outcome of the performance).

PERFORMANCE

SKILL DRILL **2.6**

Evaluate the impact of different types of feedback on performance

>> Turn to pages 330–331 to complete this integrated physical peformance activity.

2.6 Check your learning

Engage and understand

1 **Define** the term 'feedback'.
2 **Describe** the four types of intrinsic feedback.
3 **Summarise** the two main types of extrinsic feedback.

Apply and analyse

4 **Differentiate** between intrinsic and extrinsic feedback.
5 **Analyse** one skill from your current physical activity. **Determine** the visual, tactile, auditory and proprioceptive feedback that could be provided to improve this skill.
6 **Distinguish** which type of feedback (i.e. intrinsic or extrinsic) you prefer to receive. **Analyse** the pros and cons of your preferred feedback method.

Evaluate and justify

7 **Decide** whether intrinsic or extrinsic feedback is more beneficial for learners at the cognitive stage. **Justify** your response.
8 **Evaluate** a coach's decision to only use knowledge of results feedback for autonomous learners. **Justify** your response.

Check your obook assess for the following additional resources and more:

- **Student book questions**
  2.6 Check your learning
- **Skill Drill worksheet**
  2.6 Evaluate the impact of different types of feedback on performance
- **Video weblink**
  Feedback in sports
- **Weblink**
  Feedback: Factors affecting performance

2.7 Body and movement concepts

That's a goal!

By the end of Section 2.7 you should be able to:

→ **define** and **explain** what is meant by the term 'body and movement concepts'

→ **define** each of the four body and movement concepts

→ **identify** examples of the four body and movement concepts in your selected physical activity.

body and movement concepts
a group of four concepts used to develop and improve specialised movement sequences and strategies in different sports and physical activities. The concepts are: body awareness, space awareness, quality of movement, and relationships (e.g. to objects and other people)

specialised movement sequence
a combination of fundamental movement skills (and movement elements) that enable the body to move in response to a stimulus

movement strategies
a tactic or plan that assists a player or team to achieve an outcome or goal (e.g. moving into an opponent's space to intercept a pass or hit the ball away so they cannot score)

Body and movement concepts include a number of approaches that can help individual athletes or teams to be more aware of their bodies and adapt their movements in order to achieve specific goals. These concepts can be applied by athletes and coaches to help support the teaching and learning of specialised movement sequences and strategies in different sports and physical activities.

Defining body and movement concepts

Developed by Hungarian dance artist and theorist Rudolf Laban in the early 1900s, body and movement concepts provide a framework for understanding and improving:

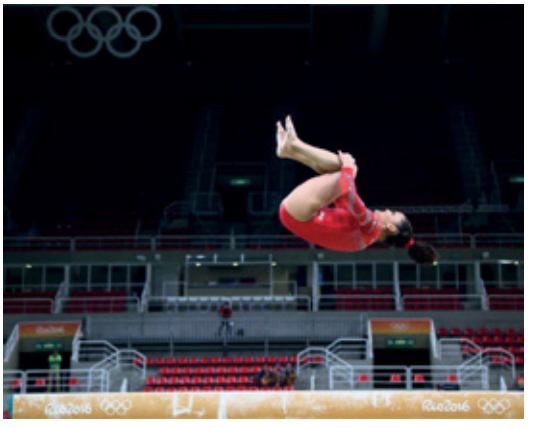
- **specialised movement sequences** (i.e. combinations of fundamental movement skills, and movement elements)
- **movement strategies** (i.e. possible solutions to the movement problems posed by any particular game).

An understanding of the specialised movement sequences and movement strategies within a selected physical activity is essential for developing skill mastery and proficiency. In addition to this, body and movement concepts can also help athletes to transfer their knowledge of one activity to another activity. For example, a tennis player might use their knowledge of body and movement concepts when batting in cricket for the first time.

There are four body and movement concepts:

- body awareness
- space awareness
- quality of movement
- relationships (e.g. to objects and other people).

We will look in more detail at each of the concepts in this section.



SOURCE 1 A gymnast needs to have an understanding of body and movement concepts to execute skills and maintain their balance.

Body awareness

body awareness
a body and movement concept; body awareness relates to the sense (or consciousness) we have of our own body when performing a skill

Body awareness relates to the sense (or consciousness) we have of our own body when performing a skill. The quality of a physical performance – and the difference between success and failure – can come down to knowing where your body position should be during execution of a skill. Generally speaking, body awareness involves an understanding of:

- **body parts** (i.e. a knowledge of exactly which body parts are being used in the skill and the order in which those body parts are being used). For example, a javelin thrower needs to be aware of exactly where their feet, arms and body are positioned at the point they initiate the throw.
- **body shape** (i.e. a knowledge of exactly what 'shape' your body needs to be in to execute the skill). For example, gymnasts need their bodies to be curled up tight to perform a somersault, but extended and symmetrical to perform a split jump.
- **body action and position** (e.g. a knowledge of exactly what movements your body needs to make to execute the skill, specifically, transfer of weight, balance and stability during movement). For example, a surfer must successfully transfer weight from one side of the body to execute turns. Surfers also need to change the position of their centre of gravity to maintain balance when riding a wave.

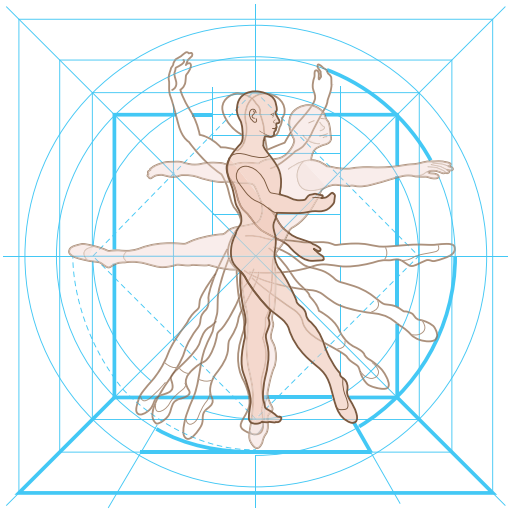
The stability of the body changes between sports to reflect the skill requirements. Some sports require higher levels of stability for successful outcomes. For example, making a tackle in rugby league or any striking activity requires a stable base. Decreasing the body's stability can increase performance where speed and change of direction are critical, such as when performing baulks and fakes in netball.

weight bearing
a term used to describe the ability to support your own weight and/or an external load

Weight bearing activities require you to support your own weight and/or an external load. Weight bearing activities include running, jumping, aerobics, weight lifting and stretching. Having the correct technique when performing a skill (and knowing what specific parts of your body should feel like during the performance) can improve efficiency and reduce injuries.

space awareness
a body and movement concept; space awareness relates to the relationship between the body and its surroundings (i.e. the space around it)

Space awareness



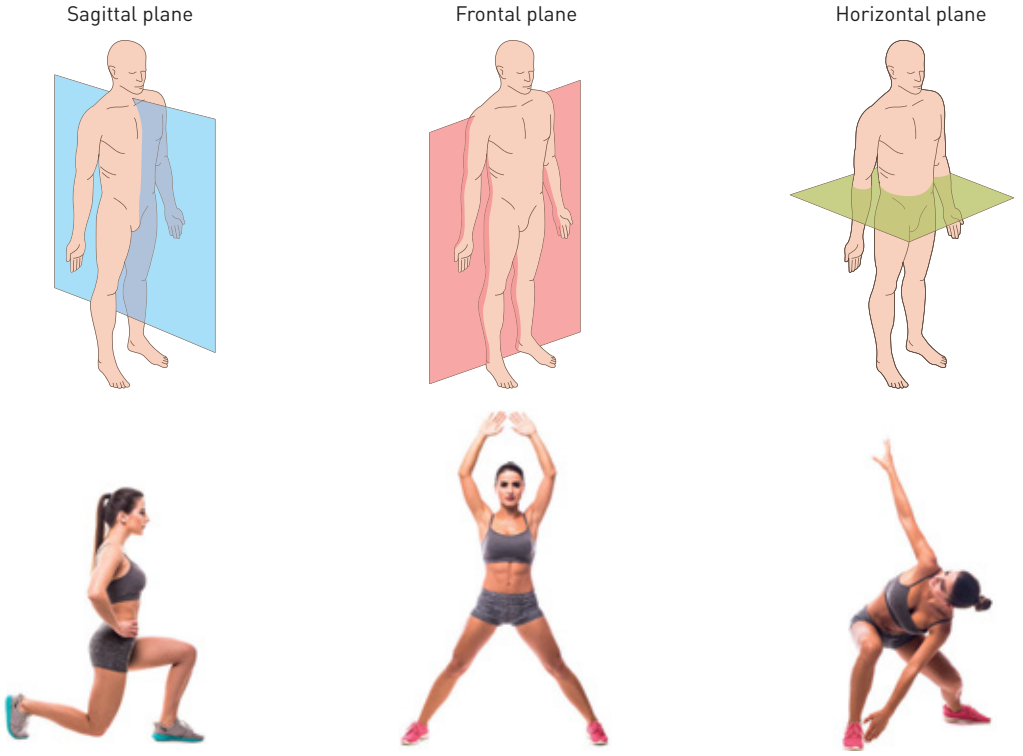
SOURCE 2 Personal space (also known as the kinesphere) is defined as the space around the body whose limits can be reached by easily extending the arms and legs when standing on one foot.

Space awareness relates to the relationship between the body and its surroundings (i.e. the space around it). Specifically, space awareness is concerned with how an athlete can move their body through available space to perform a skill successfully and increase the chance of a positive outcome.

There are two kinds of space we can focus on when attending to this body and movement concept:

- **general space** (i.e. the space or environment in which the individual can move)
- **personal space** also known as the kinesphere (i.e. space around an individual that they can reach with their limbs without moving).

A player's position on the field can be crucial to their success in receiving a pass. Being 'out of position' or surrounded by more than one opponent can lead to unsuccessful skill outcomes. A player will often need to look for space to move into in attack to ensure they improve the options they give their teammates in that period of play.



SOURCE 3 The three plans of movement include: the sagittal plane, the frontal plane, and the horizontal plane.

When receiving a pass in Australian football, for example, a player could consider moving forwards, backwards, sideways, up or even down to find space for the pass (see Source 4). In confined spaces, such as netball, players may need to combine movement directions to find space.

Other sports require athletes to execute specific **pathways of movement** in order for them to have sufficient space to execute a skill. For example, when you hit the ball to your opponent in tennis, you need to anticipate where in the court the ball will come back to in order for you to run in the right direction. This requires space awareness.

Space awareness also takes into account the **planes of movement**. Think of a plane as an imaginary flat surface that runs through an object or thing. There are three planes of movement that help to describe the movement of the body.

The three planes of movement (see Source 3) include:

- the **sagittal plane** – movements in this plane are forwards and backwards. A forward lunge is an example of movement along this plane
- the **frontal plane** – movements in this plane are side to side. A star jump (or jumping jack) is an example of movement along this plane
- the **horizontal (or transverse) plane** – movements in this plane are rotational. Twisting the trunk in a crossover toe touch is an example of movement along this plane.

All human movements can be described as taking place along one or more of these planes. Working through these three planes during training drills will increase body strength and reduce injuries.

pathways of movement
a term used to describe the pattern of direction the body is moving in (e.g. straight, curved, zigzag, angular or twisted)

planes of movement
an approach used to describe the different movements of the body; there are three planes (i.e. imaginary flat surfaces) that run through the body and along which the body moves: the sagittal plane (describes forwards and backwards movements), the frontal plane (describes side to side movements) and the horizontal plane (describes rotational movements)

sagittal plane
one of the three planes of movement; movements in this plane are forwards and backwards. A forward lunge is an example of movement along this plane

frontal plane
one of the three planes of movement; movements in this plane are side to side. A star jump (or jumping jack) is an example of movement along this plane

horizontal (or transverse) plane
one of the three planes of movement; movements in this plane are rotational. A golf swing is an example of movement along this plane

FOR THE RECORD!

Leon Walraven is not a professional sportsman, but he holds four Guinness World Records! In 2017, Walraven beat the previous world record by bouncing a basketball 609 times in one minute. He has certainly mastered the quality of speed when it comes to dribbling a ball!

Walraven also holds the record for the most football touches in one minute with the soles of the feet (270), with the shoulders (214) and with the shins (224).

SOURCE 4 Sometimes athletes need to move up to find the space needed to execute a skill. Here, Western Bulldogs player Josh Hill finds space above his teammates and opponents.

Quality of movement

quality of movement
a body and movement concept; quality of movement relates to the characteristics (i.e. qualities) of a movement (e.g. speed, effort, force, accuracy, level of effort, etc.)

Quality of movement relates to how the body moves. In particular, this concept helps to describe the characteristics of particular movements. The quality of a movement can relate to things such as:

- the **speed** at which it is performed
- the **time** in which it is performed
- the **accuracy** with which it is performed
- the **level of effort** that is invested in it
- the **amount of force** that it created
- the different levels of **fluency** or **flow** present
- the **outcome** of the movement.

Each of these movement characteristics is relative to an athlete's ability and stage of learning. For example, a skilled performance is typically more fluent than an unskilled performance, and skilled performers are generally able to manipulate the quality and the sequencing of their movements with greater efficiency and effectiveness in relation to the movement outcome.

Dancing is an activity that illustrates the quality of movement concept well. A single dance move can be performed in a number of different ways to achieve a desirable movement outcome. For instance, a dance move can be performed quickly or slowly in

relation to the accompanying music. It can also be performed in time or out of time with the music.It could be performed in a jagged, aggressive and forceful manner, or it could be performed in a smooth, flowing and gentle manner. Although it is the same movement in these cases, each of these movement qualities will have a significant impact on the overall feeling and appearance of the dance.

Relationships

Relationships relates to the connection a player has with the people and **implements** that they interact with during the performance of the skill. In other words, it is about the people and/or the objects involved in the movement. In sporting contexts, the people that an athlete interacts with are generally teammates and opponents. The implements include sporting equipment, uniforms and any other equipment or supplies used during training or competition.

An awareness of the relationships concept makes is possible to understand how movement skills and specialised movement sequences vary between individual and team versions of the same sport. Playing doubles in sports such as table tennis, badminton, tennis and squash requires a different perspective on space compared to playing singles, because you need to consider where your partner is situated on the court. You also need to be conscious of the specific tactics and roles you will each put into practice. Having a strong, familiar relationship with teammates can enable better communication and a better understanding of their game strengths and weakness.

A player can also have a relationship with the implements involved in their physical activity. How well a softball or cricket player holds their bat and how familiar an Australian football player is with the size, shape and weight of the ball relative to their own foot or hands is important. As a player's experience grows, they become more familiar with their equipment and more comfortable using it in performing skills. The following news article discusses how Ash Barty used body and movement concepts to improve her performance in cricket.

relationships
a body and movement concept; relationships relates to the objects (i.e. the people and equipment) that an athlete interacts with during the performance of the skill

implements
equipment (e.g. bats, balls and other sporting apparatus such as a balance beam) that an athlete carries or uses when participating in a physical activity

In the news

Cricket cameo may prove best thing Ash Barty ever did for tennis career

STEPHANIE BRANTZ, ESPN COLUMNIST, 13 JANUARY 2017

What a difference a year can make: Ash Barty is back on the tennis circuit with a whole new outlook.

At just 20 years old, she has packed a lot into her young life. A Wimbledon junior singles champion at 15, the Queenslander had played in three Grand Slam doubles finals by the age of 18 before she'd had enough after four years on the international tennis circuit. Citing homesickness and symptoms of depression, Barty walked away to consider her future.

Back home in Brisbane, the break from tennis was not spent idly. As well as doing some tennis coaching, an invitation to address the Australian Women's Cricket team about her experiences as an elite athlete was followed by an invitation to train with the Queensland Fire squad ahead of the Women's National Cricket League season. Shortly after, Barty signed with Brisbane Heat for the inaugural season of the Women's Big Bash League and loved every minute.

'It was never my plan, it just happened' she tells ESPN. 'It was amazing

to move into a team sport for a change, to have a group working together to achieve a goal.'

That cricket cameo may yet prove to be the best thing Ash Barty ever did for her tennis career.

A refreshed Ash Barty Mark II has held onto the 'team' mentality, and references to her comeback (which began in May last year) are couched in terms of 'we' rather than 'I'.

'We've taken our time and done the right things and the work we have done in the little off-season has paid off,' Barty says from her Melbourne base, where she headed after shoulder soreness forced her withdrawal from the Hobart International.

'We're feeling great.'

SOURCE 5 Ashleigh Barty won the Newcombe Medal for the most outstanding Australian tennis player in 2017.

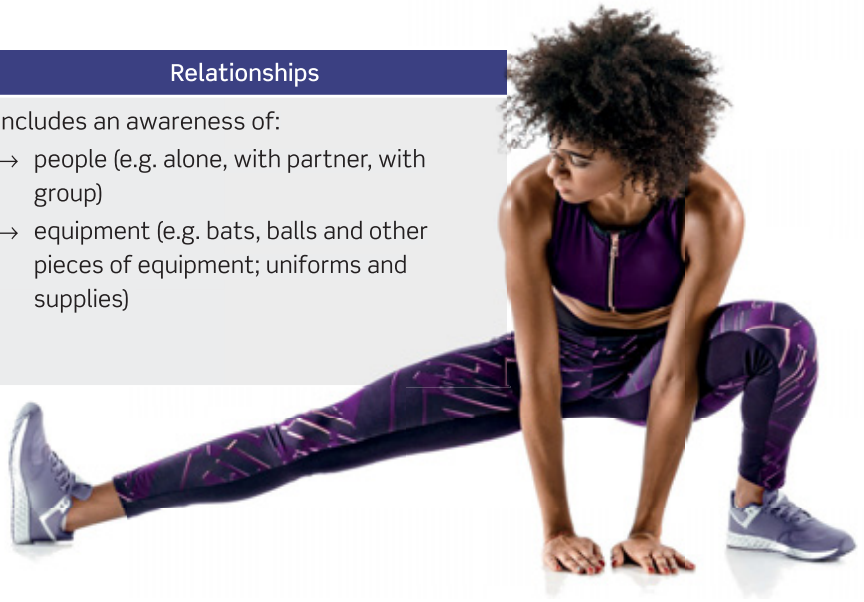
A summary of body and movement concepts

Source 6 provides a summary of the body and movement concepts that can be applied by athletes and coaches to help support the teaching and learning of specialised movement sequences and movement strategies in different sports and physical activities.

Body awareness	Space awareness
Includes an awareness of: → body parts (e.g. arms, legs, elbows, knees, head) → body shape (e.g. stretched, curled, wide, narrow, twisted, symmetrical, asymmetrical) → body action (e.g. flexion, extension, rotation, swing, push, pull, transfer of weight, stability)	Includes an awareness of: → space (e.g. personal and general space) → pathways of movement (e.g. curved, straight, zigzag) → planes of movement (e.g. sagittal, frontal, horizontal) → direction (e.g. forward, backward, sideways, up, down) → levels (e.g. high, middle, low)

Quality of movement	Relationships
Includes an awareness of: → speed (e.g. fast, slow) → timing (e.g. in time, out of time) → accuracy (e.g. on target, off target) → effort (e.g. level of motivation) → force (e.g. strong, light) → fluency and flow (e.g. free, bound)	Includes an awareness of: → people (e.g. alone, with partner, with group) → equipment (e.g. bats, balls and other pieces of equipment; uniforms and supplies)

SOURCE 6 A summary of body and movement concepts.



PERFORMANCE

SKILL DRILL **2.7**

Investigate how body and movement concepts can be used to assess and improve performance

>> Turn to pages 332–333 to complete this integrated physical performance activity.

2.7 Check your learning

Engage and understand

1 **Identify** the body and movement concept related to knowing the sequence of body parts being used to perform a skill.

2 **Explain** why it's important to have body awareness when performing weight bearing exercises.

3 **Identify** the skill being used by Ashleigh Barty in Source 5 on page 74 and **describe** the quality of movement principles she demonstrates.

Apply and analyse

4 Red Rover and Tiggy are games from primary school that develop a range of body and movement concepts. **Create** a list of your favourite games from primary school. **Analyse** the body and movement concepts used in each of your favourite games.

5 Ashleigh Barty is a successful athlete at an elite level in tennis, and is also very proficient at cricket. **Determine** the body and movement concept that you believe has enabled her to achieve success in both sports.

Evaluate and justify

6 Manipulating the ratio of attackers and defenders on each team during practice has an impact on the relationships that players experience. **Evaluate** the impact of this type of manipulation on on your performance in your physical education classes.

7 'Children learning sports should specialise in a single activity rather than learning a wide variety of movement skills.'

Discuss your thoughts on this statement in a written response of 200 words. Use your knowledge of the body awareness concepts, together with examples, to **justify** your position.

8 Try to **predict** a sport that Ashleigh Barty might struggle to perform well in. **Justify** your response using relevant body and movement concepts.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  2.7 Check your learning
- **» Video**
  Planes of movement
- **» Student worksheet**
  2.7 Body and movement concepts worksheet
- **» Skill Drill worksheet**
  2.7 Investigate how body and movement concepts can be used to assess and improve performance

CHAPTER 2 REVIEW

Sum it up!

2.1 **Motor learning** is a field of science that studies and explains many aspects of human movement. It aims to understand how humans learn (acquire) and remember (retain) the skills required to perform specialised movements.

Motor skills are voluntary movements that involve the use of specific muscles with the goal of achieving a specific purpose or goal (e.g. catching a ball, doing a push up, running a race).

Motor programs are movement plans (i.e. plans of action) that contain all the commands from the brain to the muscles that are needed to perform complex motor skills.

2.2 There are three categories of motor skills. They include **fine and gross** motor skills; **open and closed** motor skills; **discrete, continuous and serial** motor skills.

There are five characteristics used to assess the development of motor skills. These characteristics provide a framework for analysing skill level and give direction for modifying movement sequences and strategies. They include **improvement**, **consistency**, **stability**, **persistence** and **adaptability**.

2.3 Scientists have investigated the process of learning and developed many different theories that attempt to explain exactly how we learn and remember motor skills and complex movement sequences. One framework is the **cognitive systems approach**. According to this approach, the brain acts as the central command centre for the body. It creates action plans for movements based on information it receives from the body's senses and instructs the muscles to perform these actions in a linear order (i.e. step-by-step). Within the broader cognitive systems approach to learning, there are two main models (i.e. theories) that are used to explain how we process and learn motor skills – **the information processing model** and **Fitts and Posner's (1967) stage model of motor learning**.

2.4 Another framework used to explain how we learn and remember motor skills is the **dynamic systems approach**. According to this approach, the intelligence that coordinates and controls body movements is the result of complex interactions between the individual, the environment, and the task. The dynamic systems approach suggests that motor skills are produced and learnt in response to **constraints** (i.e. task constraints, environmental constraints and individual constraints). **Rate limiters** are a type of constraint that have a negative impact on learning and restrict performance.

2.5 Practice is an essential part of learning and refining a motor skill. There are several different types of practice. They include **massed practice** and **distributed practice; whole practice** and **part practice; blocked practice, serial practice** and **random practice; constant practice** and **varied practice; drills** and **problem solving; specificity** and **variability practice**.

2.6 **Feedback** is a term used to describe all of the information an individual receives about their performance of a skill. Feedback is organised into two categories: **intrinsic feedback** (i.e. from inside the body) and **extrinsic feedback** (i.e. from outside the body).

2.7 **Body and movement concepts** are approaches that can help individual athletes or teams to be more aware of their bodies and adapt their movements in order to achieve specific goals. There are four body and movement concepts. They include **body awareness**; **space awareness**; **quality of movement**; **relationships**.

Dig deeper!

Exam-style revision questions and tasks

SECTION A

→ Ten multiple-choice questions

QUESTION 1

Which statement best describes motor learning?

(A) Motor learning is a field of science that requires a minimum practice of 300 to 500 repetitions to learn a skill.

(B) Motor learning is a field of science that studies the nervous system, muscular system and biomechanics in order to explain how people learn skills.

(C) Motor learning is a field of science that uses a range of body systems, practice and sport psychology to learn a skill.

(D) Motor learning is a field of science that explains how people learn skills by studying various systems of the body (such as the nervous system), and investigating practice and feedback.

QUESTION 2

A discrete motor skill is

(A) a type of motor skill that is determined by the stability of the environment.

(B) a type of motor skill that has a defined start and end.

(C) a type of motor skill that is repetitive and cyclical.

(D) a type of motor skill that is made up of many individual motor skills.

QUESTION 3

Which of the following is ***not*** a characteristic of motor skill learning?

(A) Consistency

(B) Improvement

(C) Stability

(D) Variability

QUESTION 4

At which stage of the information processing model does parallel processing take place?

(A) Stimulus Identification

(B) Stimulus execution

(C) Response execution

(D) Response selection

QUESTION 5

Which of the following practice methods reflects the dynamic systems approach to learning new skills?

(A) blocked practice, constant practice, random practice, varied practice

(B) random practice, specificity practice, problem-solving drills, variability practice

(C) massed practice, random practice, varied practice, problem-solving drills

(D) massed practice, specificity practice, varied practice, problem-solving drills

QUESTION 6

Which of the following includes the main types of intrinsic feedback?

(A) auditory, proprioceptive, tactile, visual

(B) auditory, proprioceptive, visual, knowledge of results

(C) auditory, proprioceptive, visual, knowledge of performance

(D) auditory, tactile, visual, knowledge of performance

QUESTION 7

Different degrees of speed, power and intensity are factors for which body and movement concept?

(A) body awareness

(B) quality of movement

(C) relationships

(D) space awareness

QUESTION 8

According to Fitts and Posner's (1967) stage model of learning, a learner who cannot identify all relevant environmental cues might never progress from which stage of learning?

(A) the cognitive stage

(B) the associative stage

(C) the autonomous stage

(D) the information processing stage

QUESTION 9

Lacking the strength required to propel the ball to the basket is an example of what type of rate limiter?

(A) Physical

(B) Tactical

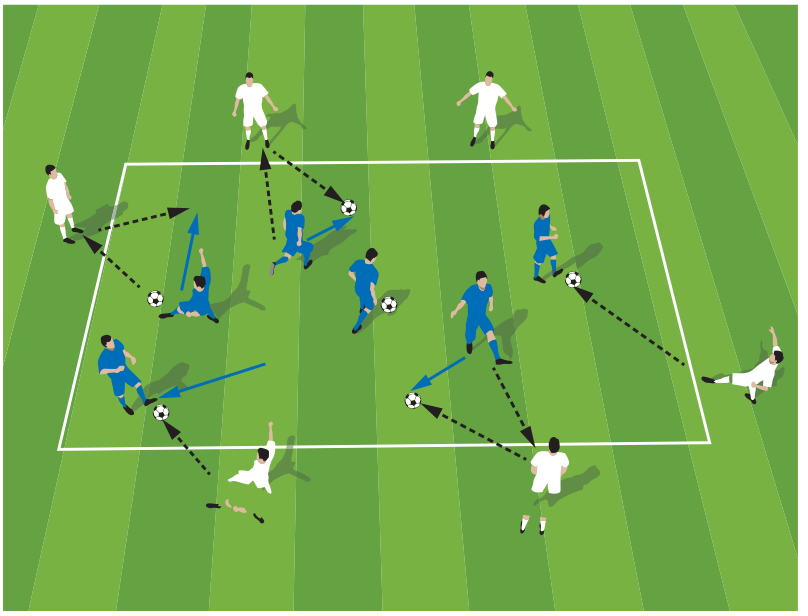
(C) Perceptual

(D) Physiological

QUESTION 10

The following diagram shows a soccer drill that will last for approximately five minutes before players change positions. The drill requires each player inside the square (i.e. those in blue) to pass the ball to an outside player (i.e. those in white) and move into a different position to receive the pass back. The size of the square can be changed depending upon the skill level of the players. This is an example of which type of practice?

(A) Massed practice
(B) Specificity practice
(C) Part practice
(D) Problem-solving practice



SECTION B

→ Two short-response questions
→ One extended written response question

QUESTION 11 (150 words)

There are five characteristics of motor skill learning – stability, persistence, improvement, consistency and adaptability. Identify a motor skill from your selected physical activity for this unit and apply the five characteristics to evaluate how well you have learnt that skill. Provide examples to justify your response.

QUESTION 12 (150 words)

Reflect on your current physical activity, and identify two rate limiters from two different categories (perceptual, technical, tactical, physical, physiological or psychological) that might impact your performance during the game. Justify a strategy for each rate limiter that will enable you to overcome (or work with) it and thus optimise your performance during authentic game play.

QUESTION 13 (400 words)

Justify which motor learning approach has the greatest potential to optimise your performance – the cognitive systems approach or the dynamic systems approach? In your response, make reference to the following concepts:

→ stages of learning
→ types of practice
→ feedback
→ body and movement concepts.

Check your obook assess for the following additional resources and more:

» **assess quiz**
Test your skills with this auto-correcting multiple-choice quiz for Chapter 2

» **Revision notes**
Make your own revision notes for assessment tasks with this handy template

» **Data analysis worksheet**
Chapter 2 review – Practice your data analysis skills with this worksheet

» **Practice assessment task ISMG**
Instrument-specific marking guide for the practice assessment task in Chapter 2

Practice assessment task

Subject	Physical Education	**Instrument number**	
Technique	Project – folio		
Unit	1 Motor learning, functional anatomy, biomechanics and physical activity		
Topic	1 Motor Learning		

Conditions			
Duration	5 hours of class time		
Mode	Multimodal (visual and written or spoken)	**Length**	7–9 minutes
Individual / Group	Individual	**Other**	Examples of multimodal folios include: → a pre-recorded presentation submitted digitally → a presentation conducted in front of an audience (class or teacher) → a digital portfolio of video, images and diagrams with annotations or commentary → a multimedia movie or slideshow that may combine images, video, sound, text and a narrative voice.

Context

In this unit, you have engaged in integrated learning experiences, applying motor learning strategies to improve your performance of a specialised movement sequence from your selected physical activity. To optimise your performance (movement strategies), you have applied specific motor learning strategies that can lead to improvements based on the four body and movement concepts.

Task

Justify which training method was most effective in developing a movement strategy for your selected physical activity. Evaluate how this training method enhanced one of the four body and movement concepts.

To complete this task, you must:

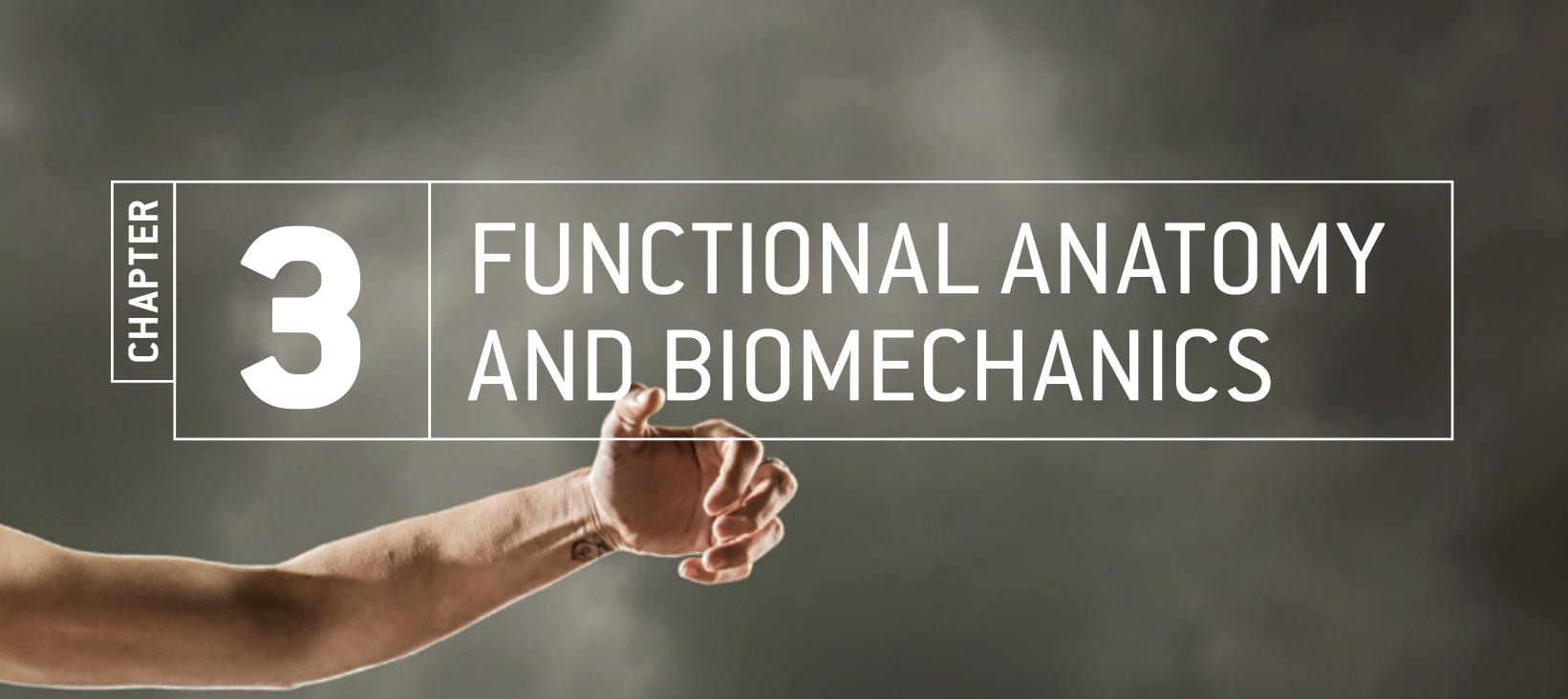
- → Recognise and explain:
  - → that performance can be analysed using stages of learning, relevant training methods and by considering the application of either the cognitive systems approach or dynamic systems approach
  - → body and movement concepts about the specialised movement sequences
    - quality of movement (speed, accuracy, direction of movement, force and flow)
    - body awareness (balance, transfer of body weight, flight)
    - space awareness (use of space, direction of movement, planes of movement, pathways)
    - relationships (court position in relation to other players, equipment).
- → Analyse primary data and secondary data to show how motor learning concepts influence performance.
- → Evaluate the effectiveness of:
  - → the selected training method and any modifications to optimise personal performance of the specialised movement sequence
  - → the selected training method and any modifications to enhance one body movement concept (quality of movement, body awareness, space awareness and relationships).

You can find a detailed instrument-specific marking guide (ISMG) for this task on your obook assess.

‘We’re all playing with Newton’s laws. And whoever can navigate those laws the best, wins the race.’

Elana Meyers Taylor (1984–present)

US Olympic bobsled world champion and two-time Olympic medallist



CHAPTER 3

FUNCTIONAL ANATOMY AND BIOMECHANICS

KEY TERMS

By the end of this chapter, you should understand the meanings of the following key terms. They are defined throughout the chapter, as well as in the glossary. Use this handy checklist to test your understanding.

- ☐ acceleration
- ☐ agonist
- ☐ anatomy
- ☐ angle of release
- ☐ angular motion
- ☐ antagonist
- ☐ appendicular skeleton
- ☐ axial skeleton
- ☐ balance
- ☐ base of support
- ☐ Bernoulli's principle
- ☐ biomechanics
- ☐ cardiac muscle
- ☐ cartilage
- ☐ cartilaginous joints
- ☐ central nervous system
- ☐ centre of gravity
- ☐ concentric isotonic contraction
- ☐ conservation of momentum
- ☐ contact force
- ☐ curvilinear motion
- ☐ drag force
- ☐ eccentric isotonic contraction
- ☐ fibrous joints
- ☐ first-class levers
- ☐ flat bones
- ☐ force
- ☐ force multipliers
- ☐ friction force
- ☐ functional anatomy
- ☐ gravitational force
- ☐ ground reaction force
- ☐ height of release
- ☐ impulse
- ☐ inertia
- ☐ inertial force
- ☐ irregular bones
- ☐ isometric contraction
- ☐ isotonic contraction
- ☐ lift force
- ☐ ligament
- ☐ linear motion
- ☐ long bones
- ☐ lever
- ☐ leverage
- ☐ Magnus force
- ☐ mass
- ☐ mechanics
- ☐ momentum
- ☐ motion
- ☐ muscular system
- ☐ musculoskeletal system
- ☐ newton (N)
- ☐ Newton's laws of motion
- ☐ non-contact force
- ☐ optimal angle of release
- ☐ phase
- ☐ primary data
- ☐ projectile
- ☐ projectile motion
- ☐ qualitative analysis
- ☐ quantitative analysis
- ☐ reciprocal inhibition
- ☐ secondary data
- ☐ second-class levers
- ☐ sesamoid bones
- ☐ short bones
- ☐ skeletal muscle
- ☐ skeletal system
- ☐ speed
- ☐ speed multipliers
- ☐ speed of release
- ☐ stabiliser
- ☐ stability
- ☐ static balance
- ☐ sub-routine
- ☐ summation of forces
- ☐ sutural (or Wormian) bones
- ☐ synovial joints
- ☐ tendon
- ☐ third-class levers
- ☐ velocity
- ☐ weight

SUBJECT MATTER OUTCOMES COVERED IN CHAPTER 3

The following tables list all of the subject matter dot points you are required to cover in **Unit 1 – Topic 2** of the Physical Education General Senior Syllabus. They also show you exactly where that subject matter is provided in this Student book.

Unit 1 – Topic 2: Functional anatomy and biomechanics integrated with a selected physical activity

In Unit 1 – Topic 2, students engage in learning that involves the integration of functional anatomy and biomechanics subject matter and the subject matter from a selected physical activity.

Stage 1: Engage and understand

Subject matter	Section/s	Page/s
In this area of study, students will: → recognise and explain that functional anatomy is the study of the function of muscles and bones in movement	3.1	86–89
→ recognise and explain that biomechanics is the study of the laws of mechanics related to movement	3.5	112–115
→ recognise and explain that specialised movement sequences in the selected physical activity are comprised of phases and sub-routines that can be investigated as part of a biomechanical analysis	3.5	114
→ recognise and explain that force is any interaction (e.g. a push or pull) that, when unopposed, will change the motion of an object. Force is comprised of – internal forces, which are the structures of the body that interact to produce movement, e.g. muscles and tendons that act together to produce forces that cause movement – external forces, which result from the interaction between the body and the environment; these can include ▪ contact forces, e.g. friction, a ball being struck by a bat ▪ non-contact forces, e.g. gravity	3.6	116–121
→ recognise and explain that motion is movement that occurs when an object has changed position in space and in time, due to the application of forces. Motion can be – linear, where movement is along a straight line, there is no rotation and all body parts move in the same direction at the same speed – curvilinear, where movement is along a curved path – angular, where all the parts of a body move through a rotational pathway, through the same angle, in the same direction and at the same time. It is the rotary movement about an axis – a combination, which recognises that most movements in biomechanics are a combination of linear and angular motion	3.8	130–135
→ identify and explore the components of projectile motion in a suitable physical activity, including speed, angle and height of release	3.10	140–147
→ recognise and explain that momentum describes a quantity of motion and considers the mass of an object and its velocity	3.7	122–124
→ recognise and explain biomechanical concepts such as – summation of forces, which is the sequential combination of forces produced by different parts of the body, acting together to maximise force	3.7	125–127
– speed, which is the distance travelled per unit of time – velocity, which is the rate at which an object changes position – displacement, which is a quantity used to describe the extent of a body's motion – acceleration, which is the rate at which an object changes its velocity	3.8	133–135
→ identify and explore the concepts of Newton's three laws of motion in the selected physical activity	3.9	136–139

Subject matter	Section/s	Page/s
→ 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	3.11	148–153
→ identify and explore first-, second- and third-class levers in the selected physical activity, including force multipliers and speed multipliers	3.12	154–161
→ recognise and explain Bernoulli's principle in a suitable physical activity, including topspin, backspin, sidespin and lift forces, where applicable	3.13	162–169
→ identify and explore the critical anatomical and joint movements in the selected physical activity, e.g. flexion, extension, abduction, adduction, pronation, supination, rotation, circumduction, dorsiflexion, plantar flexion, eversion and inversion	3.3	94–101
→ identify and explore the two types of isotonic muscle contractions: concentric and eccentric, in the selected physical activity	3.4	109–110
→ 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	3.4	110–111
→ gather primary data about the influence of biomechanical and functional anatomy concepts and principles on personal performance of specialised movement sequences and movement strategies in authentic performance environments	Skill Drill 3.3 Skill Drill 3.7 Skill Drill 3.11 Skill Drill 3.12	334–335 336–337 338–339 340–341
→ use secondary data to analyse how biomechanical and functional anatomy concepts and principles can influence performance in the selected physical activity.	Chapter 3	80–185

Stage 2: Apply and analyse

Subject matter	Section/s	Page/s
In this area of study, students will: → analyse and synthesise primary data and secondary data about the influence of biomechanical and functional anatomy concepts and principles on specialised movement sequences and movement strategies in the selected physical activity	Skill Drill 3.3 Skill Drill 3.7 Skill Drill 3.11 Skill Drill 3.12	334–335 336–337 338–339 340–341
→ devise personal biomechanical strategies to optimise performance in the selected physical activity that considers the – relevant biomechanical and functional anatomy requirements of the specialised movement sequences and movement strategies – individual's biomechanical strengths and limitations		
→ implement the biomechanical strategies to gather primary data about the outcomes, implications and limitations of the decisions		
→ analyse primary data and secondary data to ascertain relationships between the biomechanical strategies, concepts and principles, and personal performance.		
→ implement the biomechanical strategies to gather primary data about the outcomes, implications and limitations of the decisions.		

Stage 3: Evaluate and justify

Subject matter	Section/s	Page/s
In this area of study, students will: → reflect on primary data and secondary data to evaluate the effectiveness of the biomechanical strategies to achieve a determined outcome that – meets the biomechanical requirements of the individual and the specialised movement sequences and movement strategies – optimises performance of specialised movement sequences and movement strategies	Skill Drill 3.3 Skill Drill 3.7 Skill Drill 3.11 Skill Drill 3.12 Chapter 3 review –Practice assessment task	334–335 336–337 338–339 340–341 182–185
→ make decisions to maintain or modify the biomechanical and movement strategies		
→ justify the development of biomechanical and movement strategies using evidence from primary data and secondary data		
→ justify maintenance or modification of the biomechanical and movement strategies using evidence from primary data and secondary data		
→ make decisions about and use language, conventions and mode-appropriate features for particular purposes and contexts.		

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Check your obook assess for the following additional resources and more:

» **Chapter glossary**
Learn key terms from Chapter 3

» **Flashcard glossary**
A digital interactive to help you test your knowledge of key terms

» **Weblink**
QCAA Physical Education General Senior Syllabus

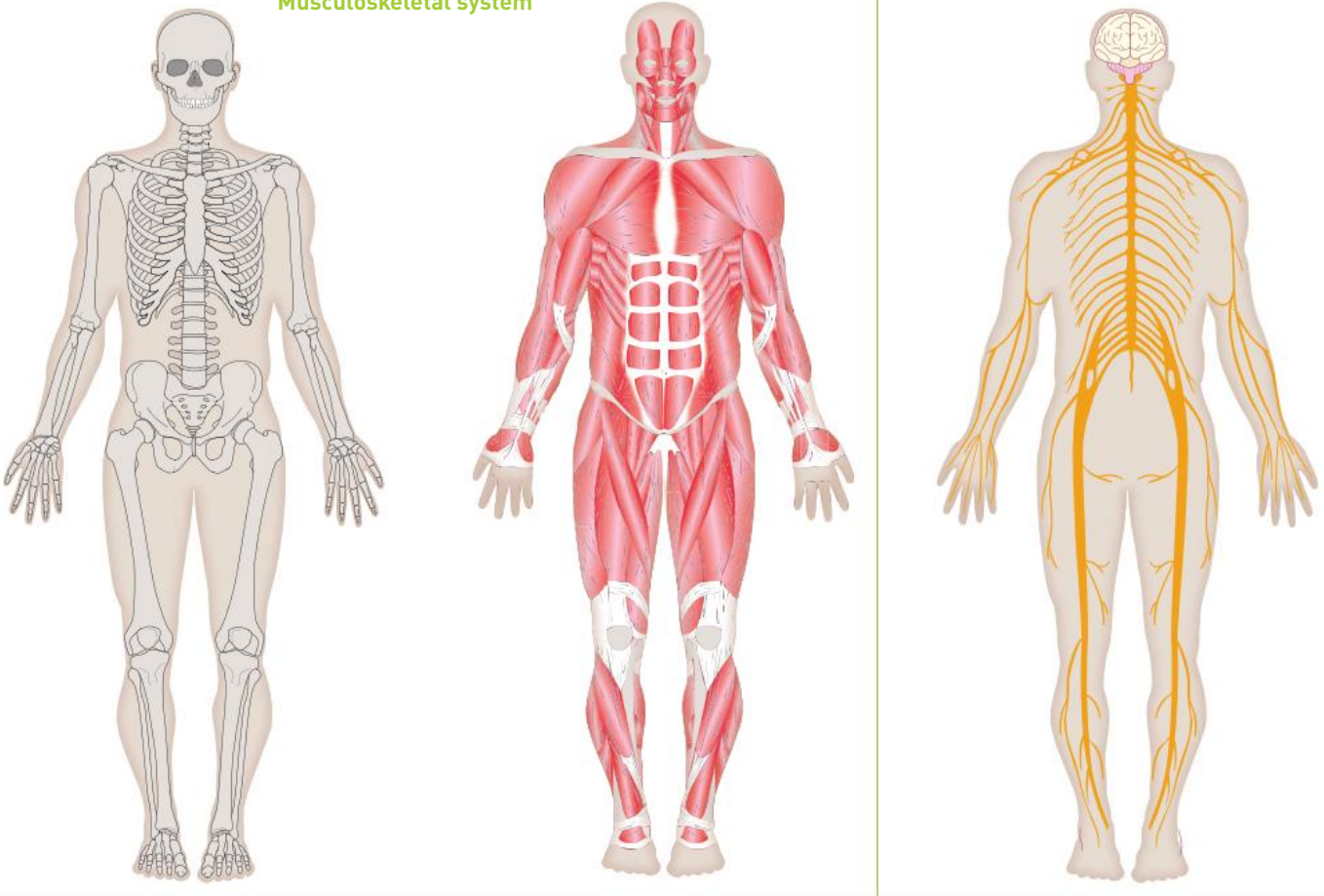
3.1 Introduction to functional anatomy

That's a goal!

By the end of Section 3.1, you should be able to:

→ **define** the term 'functional anatomy'

→ **explain** how an understanding of functional anatomy can help in the treatment and prevention of injuries suffered during physical activity.



Skeletal system

- Includes all bones, including spine, skull, pelvis and ribs
- Gives the body its structure and supports and protects internal organs; provides attachment for muscles

Muscular system

- Includes all muscles and tendons
- Enables movement through connection to the skeleton
- Helps maintain temperature in the body

Nervous system

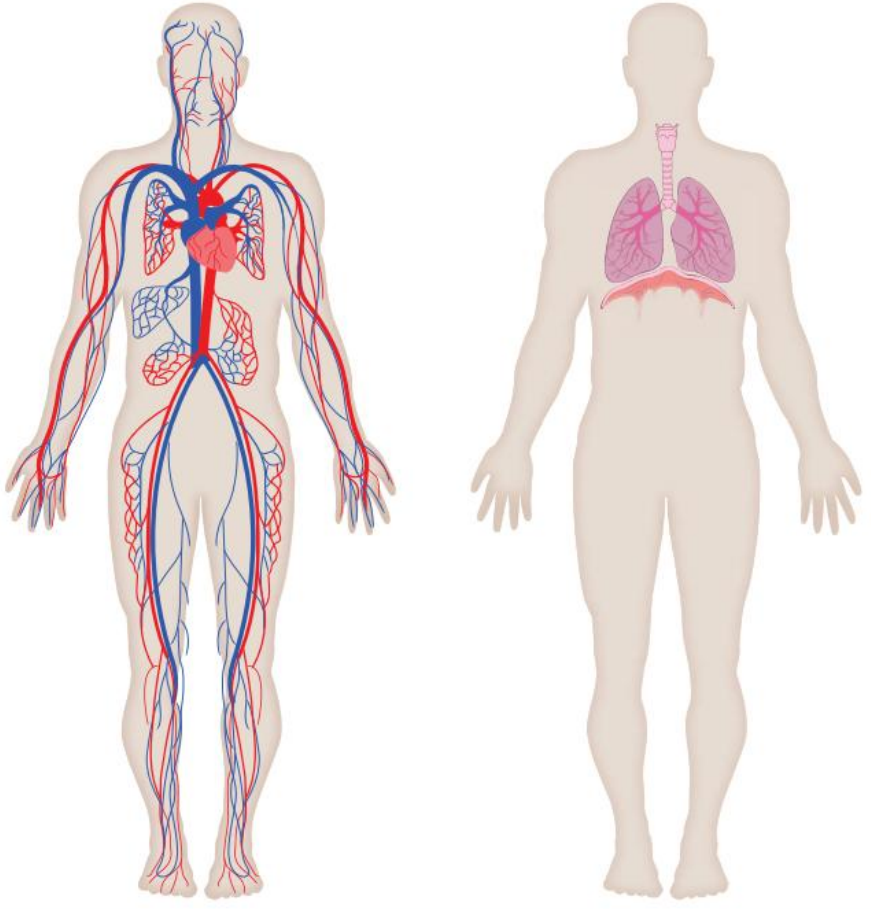
- Includes the brain, spinal cord, nerve cells and fibres
- Collects information from different parts of the body (via nerves) and processes that information (via the brain) to activate responses in the muscles

SOURCE 1 Functional anatomy is the study of how the muscles and bones in our bodies interact to produce movement. An understanding of the skeletal system and the muscular system are key to the study of functional anatomy. These two body systems are studied as a single system – known as the musculoskeletal system.

Defining functional anatomy

Functional anatomy is a field of science that studies how muscles and bones in the body work together to produce movement. Functional anatomy is a specialised branch of **anatomy** – a larger field of science that investigates the bodily structures of humans, animals and other living organisms often by dissecting (i.e. cutting up), and examining the muscles, bone and internal organs.

The primary focus of functional anatomy is understanding how the **skeletal system** and the **muscular system** interact in order to produce movement. As such, these two body systems (see Source 1) are integral to functional anatomy. Because functional anatomy seeks to understand the interaction between these systems, they are often thought about and studied as a single system – the **musculoskeletal system**. You will learn more about each of these systems over the course of this chapter.



Circulatory system

- Includes the heart, veins and arteries
- Carries oxygen and nutrients to cells (via blood)
- Carries waste materials away from cells (via blood)

Respiratory system

- Includes the lungs, windpipe and diaphragm
- Absorbs oxygen from the air and transfers it to the blood so that it can be transported to muscles and organs throughout the body
- Removes carbon dioxide from cells (via blood) and transports it back to the lungs to be exhaled

functional anatomy
a specialised branch of anatomy that studies how muscles and bones in the human body produce and affect movement

anatomy
a field of science that investigates the bodily structures of humans, animals and other living organisms often by dissecting and examining the muscles, bone and internal organs of the organisms being studied

skeletal system
a body system consisting of bones which gives the body its structure and supports and protects internal organs; provides attachment for muscles

muscular system
a body system consisting of muscles and tendons which enables movement through connection to the skeleton; helps maintain temperature in the body

musculoskeletal system
a body system that is a combination of both the muscular system and the skeletal system; the musculoskeletal system provides support, stability, structure and movement in the body through the bones and muscles

Why study functional anatomy?

A basic understanding of functional anatomy can have many benefits – both for athletes and health professionals. Doctors, physiotherapists and other health professionals (such as chiropractors, exercise physiologists and occupational therapists) use their extensive knowledge of functional anatomy to help athletes:

- recover from injuries during rehabilitation
- reduce the risk of being injured in the first place.

An understanding of functional anatomy can also benefit people outside the medical profession. For example, when athletes understand how their bones, muscles and joints function, they can:

- more easily understand and follow advice given by health professionals
- engage in movement sequences that are more effective and efficient
- increase the chance of a quick recovery
- reduce the risk of injury
- reduce the likelihood of relapse after injury.

The Theory in action below further explores how functional anatomy principles aided in the prevention of injuries in soccer.

SOURCE 2 Athletes with a thorough understanding of functional anatomy can reduce their risk of injury and speed up the rehabilitation process.

FOR THE RECORD!

While minor sporting injuries like sprains or strains often result in an athlete being out of action for 1 to 2 weeks, more serious injuries like Achilles tendonitis (i.e. an injury of the Achilles tendon, which connects the calf muscle to the heel bone), fracture dislocations of the ankle joint, patella tendonitis or anterior cruciate ligament (ACL) tears often result in longer recovery times of around 6 months. A basic understanding of functional anatomy can help prevent injuries like this!

Theory in action — A structured warm-up to prevent injury

In 2008, FIFA (the international governing body of football) funded a research study to investigate if lower limb injuries could be reduced through the implementation of a warm up program. The program was designed with many of the central principles of functional anatomy in mind. It became known as FIFA 11+.

The research study was carried out with a group of approximately 2500 participants who were members of the Norwegian amateur female football league. All participants were between the ages of 13 and 17 years. Participants in the study were divided into two groups:

- Around 1900 players became part of an intervention group. These players performed the FIFA 11+ program.
- Around 600 players became part of the control group. These players followed their normal warm up program.

The intervention group followed a comprehensive warm up program to improve strength, awareness and neuromuscular control during static and dynamic movements. The warm up activities included:

Part 1: Running exercises

Part 2: Plyometric, strength and balance exercises (using many movements typically experienced in game play)

Part 3: Further running exercises.

The program was performed during one season and injuries were tracked throughout.

SOURCE 3 The FIFA 11+ warm up program results in fewer injuries during training and matches.

When performed twice a week, the intervention group reported 37% fewer injuries during training and 29% fewer injuries during matches than the control group.

Severe injuries (i.e. those that required at least 28 days of recovery before athletes returned to play) reduced by almost 50%, and the incidence of acute, overuse, ankle and knee injuries also reduced significantly.

3.1 Check your learning

Engage and understand

1 **Define** the term 'functional anatomy'.

2 In addition to preventing injuries, **identify** two benefits of a basic understanding of functional anatomy.

Analyse and apply

3 **Analyse** 'A structured warm up to prevent injury' and **critique** the effectiveness of the FIFA 11+ warm up procedure.

4 Read 'A structured warm up to prevent injury'. **Compare** and **contrast** the FIFA 11+ warm up with a traditional warm-up, such as running a few laps of an oval and stretching.

Evaluate and justify

5 **Conduct** some additional research to learn about the term 'neuromuscular control'. **Justify** its importance in the prevention of musculoskeletal injuries.

Check your obook assess for the following additional resources and more:

- **Student book questions**
  3.1 Check your learning
- **Video weblink**
  Introduction to functional anatomy
- **Weblink**
  FIFA 11+ Injury prevention program

3.2 The structure and function of bones

skeleton
the internal framework of the body, which in adults is made up of around 206 bones

tendon
a flexible but inelastic cord of strong fibrous collagen tissue attaching a muscle to a bone

ligament
a short band of tough, flexible fibrous connective tissue which connects two bones or cartilages or holds together a joint

cartilage
firm, flexible connective tissue found in many parts of the body, particularly on the articulating surfaces of joints

axial skeleton
the part of the skeleton consisting of the skull, vertebral column, ribs, sternum and coccyx. The axial skeleton is so named because it forms the long axis of the body

appendicular skeleton
the part of the skeleton consisting of the pectoral (shoulder) girdle and the upper extremities, the bones of the pelvic (hip) girdle and the lower extremities. The appendicular skeleton is so named because it supports the body's appendages (i.e. arms and legs)

That's a goal!

By the end of Section 3.2, you should be able to:

→ **describe** the human skeleton and **identify** the five main functions of the skeletal system
→ **recognise** and **recall** the major bones of the axial and appendicular skeletons
→ **classify** six types of bones.

The skeletal system

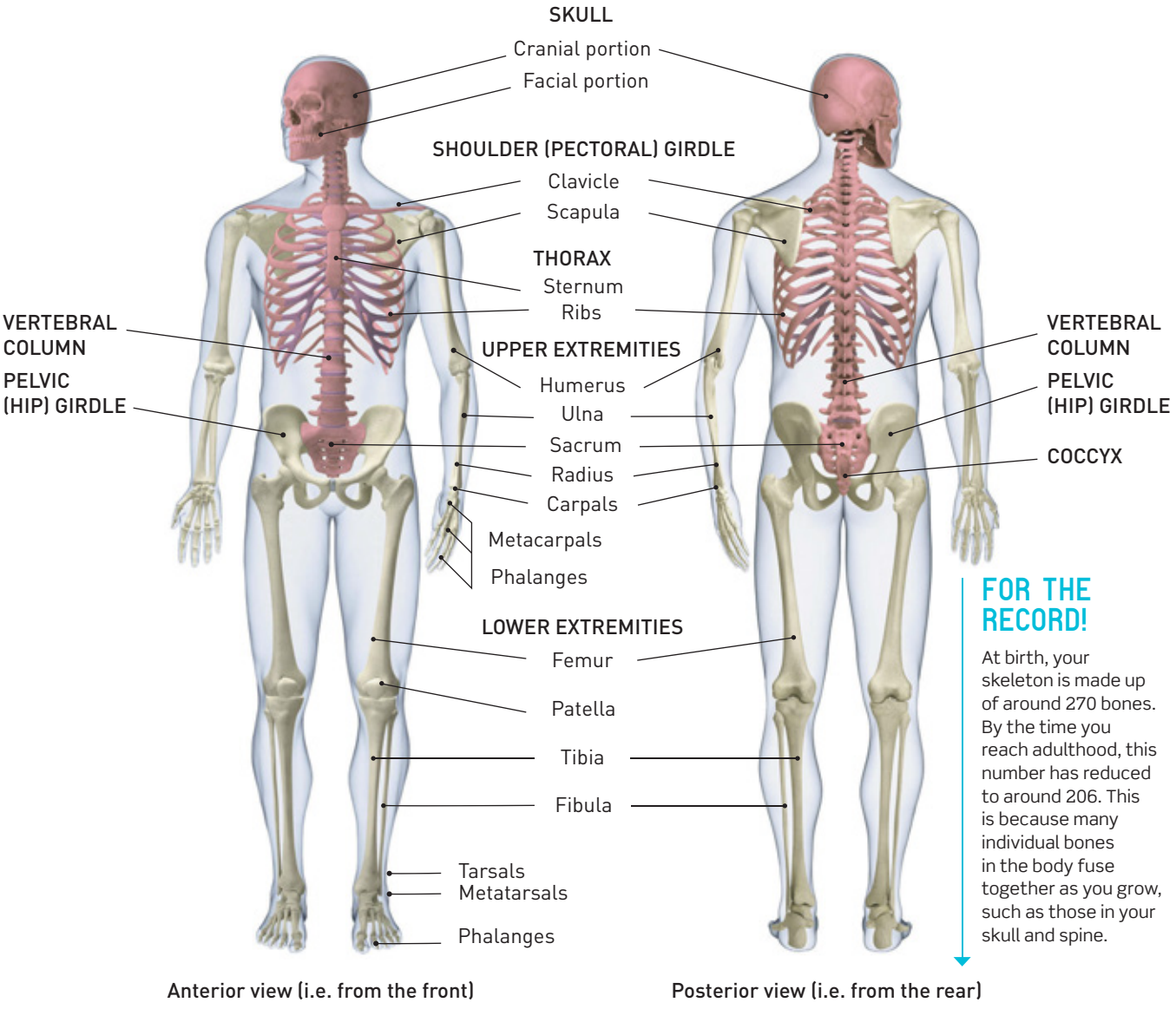
The **skeleton** is the internal framework of the body. There are 206 bones in the skeleton of an adult human (see Source 1). The bones of the skeleton, together with the anatomical structures that hold them together (such as **tendons**, **ligaments** and **cartilage**), are referred to as the skeletal system. The skeletal system performs a number of important functions, including:

- **support** – it provides a framework (like a scaffold) for the soft connective tissue of the body (e.g. muscles and organs)
- **protection** – it protects internal soft organs (e.g. the ribs protect the heart and lungs and the skull protects the brain)
- **movement** – when muscles in the body contract, they pull on bones in the skeleton to produce movement
- **storage** – bones in the skeleton store important minerals such as calcium and phosphorus, which are released when needed
- **blood cell production** – the creation of most new blood cells happens in the red marrow of the bones in the skeleton.

Parts of the human skeleton

There are two main parts to the human skeleton. They are the:

- **axial skeleton** – which forms the long axis of the body, hence the name axial. It includes the skull, vertebral column, ribs, sternum and coccyx. The axial skeleton is shaded pink in Source 1
- **appendicular skeleton** – which is attached to the axial skeleton and forms the support for the body's appendages (i.e. arms and legs), hence the name appendicular. It includes the bones of the pectoral (shoulder) girdle and the upper extremities, as well as the bones of the pelvic (hip) girdle and the lower extremities. The appendicular skeleton is shaded white in Source 1.



SOURCE 1 The human skeleton is made up of 206 bones. It has two main parts – the axial skeleton (shaded pink) and the appendicular skeleton (shaded white).

FOR THE RECORD!

At birth, your skeleton is made up of around 270 bones. By the time you reach adulthood, this number has reduced to around 206. This is because many individual bones in the body fuse together as you grow, such as those in your skull and spine.

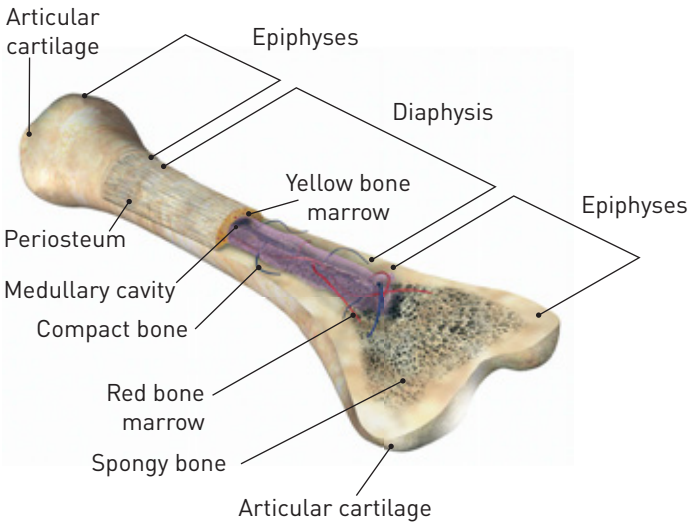
The structure of bones

All bones contain two forms of bone tissue:

- **compact bone** – a solid mass of bone tissue that has a smooth appearance. Compact bone forms the hard outer shell of most bones.
- **spongy bone** – a lightweight mass of bone tissue that has a spongy, honeycomb appearance and is filled with marrow, nerves and blood vessels. Spongy bone is located inside bones, where it takes on the least stress, and allows for nutrients to be carried in and out of the bone.

compact bone
a solid mass of bony tissue that has a smooth appearance; this forms the solid outer shell of most bones

spongy bone
a lightweight mass filled with marrow, nerves and blood vessels; this forms the soft spongy centre of most bones



SOURCE 2 The structure of a long bone

We will now look at the structure and function of bones, using long bones as an example. The most common long bones are in the arms and legs. They typically have the following features:

- diaphysis (i.e. a long shaft) – which is covered by a membrane called the periosteum
- epiphyses (i.e. two end sections) – which are covered by an articular cartilage (a smooth white tissue) to reduce friction and absorb shock at the joint.
- the medullary cavity – which is the space within the diaphysis that contains red bone marrow in childhood and yellow bone marrow in adulthood

The function of bones

Most bones in the human body can be classified into four main categories according to their shape (see Source 3).

The unique shape of each bone in the human body allows it to perform a specific function. The four main categories of bones are:

- **long bones** – these bones have a long shaft and a curved shape to absorb force and distribute it. Long bones are most commonly found in the arms and legs
- **short bones** – these bones are often shaped for strength. Short bones can be found in the wrists and ankles
- **flat bones** – these bones are often wide and flat to offer protection to internal organs or area for muscles to attach to. Flat bones can be found in the skull, sternum and pelvis
- **irregular bones** – these bones don't easily fit into any of the other categories. They are unusually-shaped bones that are designed to fit into a variety of positions and perform a wide range of functions. Irregular bones can be found in the vertebral column (i.e. vertebrae), facial portion of the skull and in the shoulders.

There are two additional types of bones that are classified according to their location in the body rather than their shape. These are:

- **sesamoid bones** – these bones are embedded in tendons where pressure develops. The patella (kneecap) is an example of a sesamoid bone
- **sutural bones** – these bones (also known as Wormian bones) are located between the joints of some cranial bones in the skull.

long bones
bones that have a long shaft and a curved ends to absorb and distribute force

short bones
bones that are often cube shaped for strength

flat bones
bones that are often wide and flat to offer protection to internal organs or area for muscles to attach

irregular bones
bones that are unusually-shaped and designed to fit into different positions and perform different functions

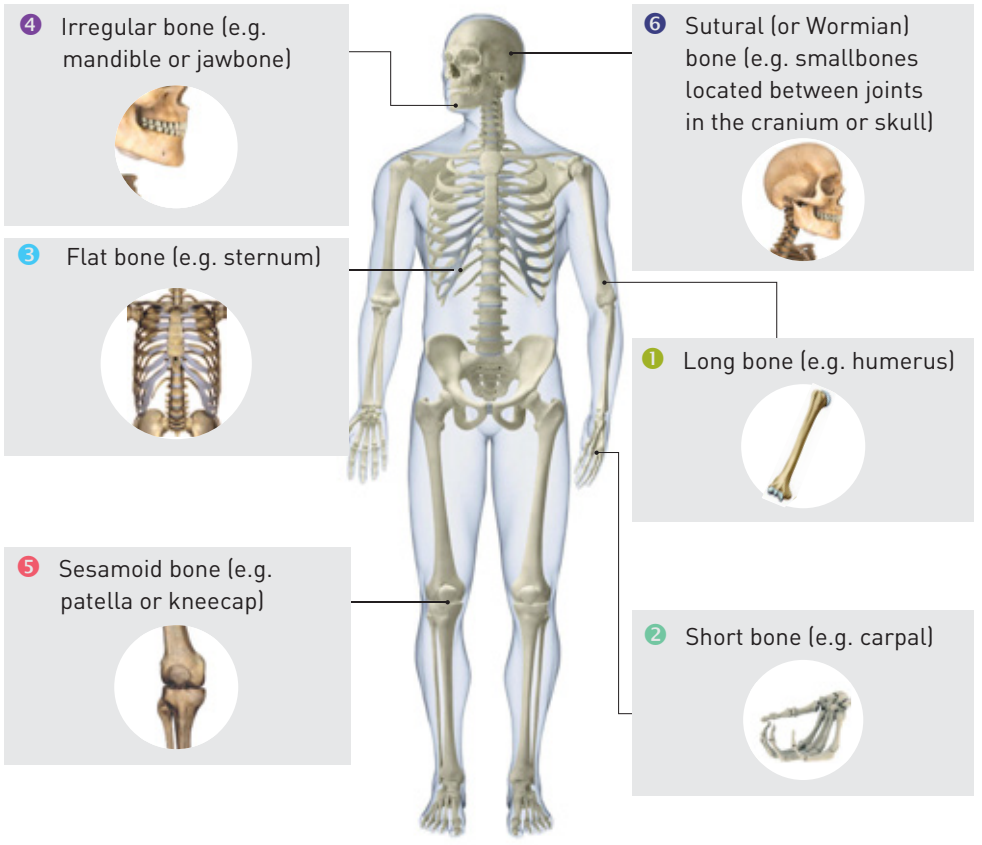
sesamoid bones
bones that are small and develop in tendons where pressure develops

sutural bones (also known as Wormian bones)
small bones that are located between the joints of cranial bones in the skull

FOR THE RECORD!

The long and short of it…

- The shortest bone in the human body is the stapes (or stirrup), which is located inside the ear. It is about 3 mm long.
- The longest bone in the human body is the femur (or thigh bone). It is generally one-quarter of the height of an adult.



SOURCE 3 Most bones in the human body can be classified into four main categories according to their shape and function. They include: 1 long bones; 2 short bones; 3 flat bones; 4 irregular bones. There are two other categories of bones that are classified according to their location in the body rather than their shape: 5 sesamoid bones; and 6 sutural (or Wormian) bones.

3.2 Check your learning

Engage and understand

1 **Describe** the main functions of the human skeleton and skeletal system.

2 Refer to Source 1 and **identify** whether the following bones are part of the axial or appendicular skeleton.

- **a** Fibula
- **b** Coccyx
- **c** Clavicle
- **d** Sternum

Analyse and apply

3 **Categorise** the following bones into long, short, flat or irregular:

- **a** femur
- **b** pelvis
- **c** humerus
- **d** carpals
- **e** scapula.
- **f** tarsals
- **g** rib
- **h** mandible
- **i** vertebra

Evaluate and justify

4 **Investigate** which bones face a higher risk of injury or stress during physical activity. In one paragraph, **justify** the need for shock absorbent protective gear or footwear.

5 **Assess** the impact that things like gender, nutrition, physical activity and lifestyle can have on bone health. In a 150-word written response, **discuss** a range of potential changes you could make to your life (e.g. diet, lifestyle, etc.) in order to improve the health of your bones.

6 **Conduct** independent research to trace the development of bone generation and loss over a person's lifetime. **Present** your response in a series of sketches, graphics and dot points.

7 **Hypothesise** why the hand (including the wrist) is made up of 27 bones. Use a physical example in your response.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  3.2 Check your learning
- **» Student worksheet**
  3.2 Structure and function of bones worksheet
- **» Video weblink**
  The structure and function of the human skeleton
- **» Weblink**
  Interactive: The human skeleton

3.3 The structure and function of joints

That's a goal!

By the end of Section 3.3, you should be able to:

→ **identify** the three categories of joints
→ **explain** the structure of a synovial joint
→ **classify** synovial joints into six categories
→ **differentiate** tendons from ligaments
→ **identify** and **explain** the 17 types of joint movements
→ **apply** joint movements to your selected physical activity.

Joints in the human body

joints
the points at which bones meet and articulate with each other

Joints are formed where two or more bones meet. To be more precise, joints – also called articulations – are formed where the surfaces of two or more bones meet and 'articulate' with each other (i.e. connect together in joined segments), allowing movement. The fact that most bones in the human body are very rigid – and cannot bend without breaking – means that we depend on our joints to help us move. Joints can allow movement and flexibility, and provide support.

STUDY TIP

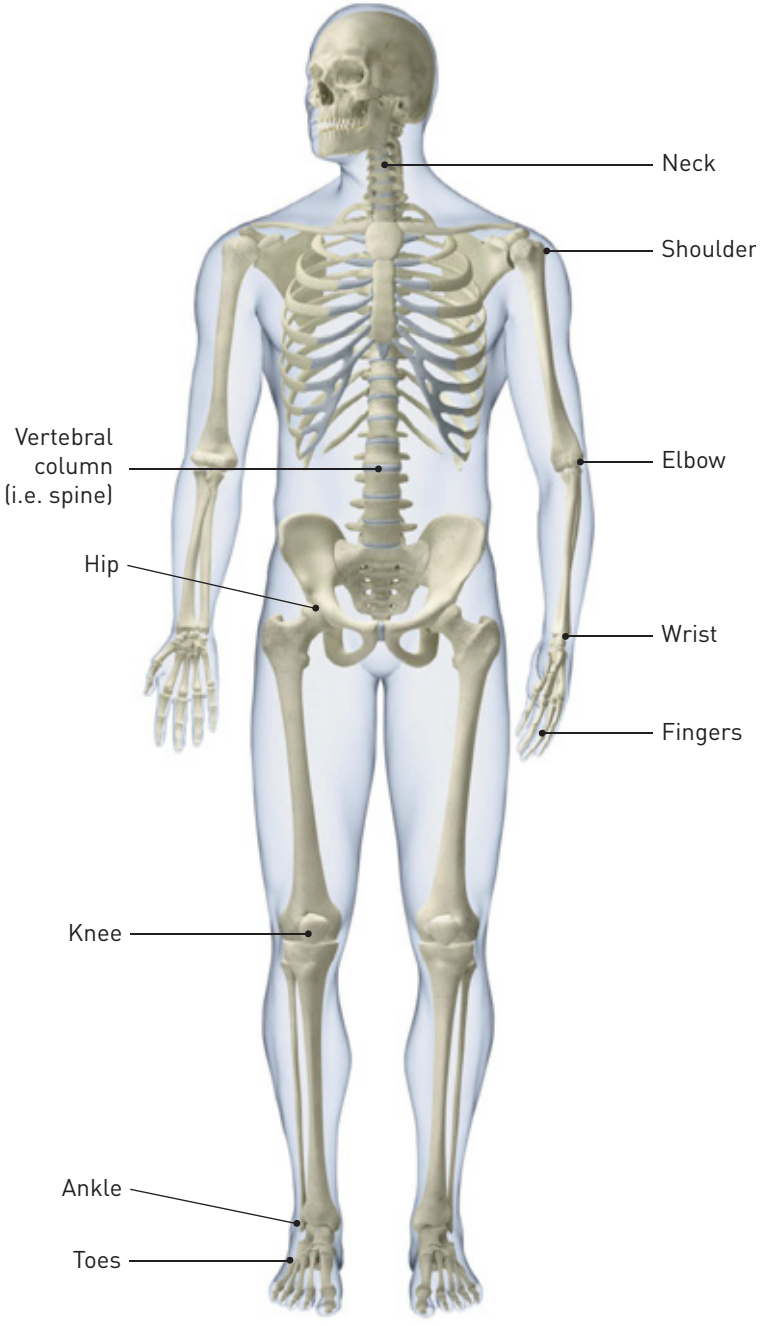
Being able to recall and apply the terminology used to describe joint movements quickly and correctly will improve your ability to describe various specialised movement sequences efficiently and accurately. It's also likely to improve your performance on assessment tasks!

For example, instead of saying 'My tennis volley technique is pretty good', the correct terminology will enable you to say 'I am generating accuracy and power in my forehand volley by focusing on elbow extension during the punching phase.'

Major joints involved in movement

In total, there are around 360 joints in the human body. The majority of these joints are involved in movement, but some are not. The major joints that support movement include the:

- neck – where the cervical vertebrae meet the skull
- shoulder – comprised of two parts; where the clavicle meets the scapula and where the humerus meets the scapula
- elbow – where the humerus meets the radius and ulna
- wrist – where the ulna and radius meet the carpal bones
- fingers – comprised of many joints where the carpals meet the metacarpals, the metacarpals meet the phalanges and between phalanges
- vertebral column – made up of 33 interlocking vertebrae
- hip – where the pelvis meets the femur and vertebral column
- knee – where the femur meets the tibia
- ankle – where the tibia and fibula meet the talus
- toes – where the metatarsals meet the phalanges and between phalanges.



SOURCE 1 There are around 360 joints in the human body. The major joints that allow movement are shown here.

FOR THE RECORD!

While most of the joints in the human body help us to move, some do not! These include some joints that connect bones in the skull and other joints that connect our teeth to sockets in the jaw.

The structure and function of joints

Joints are categorised according to how much movement they allow (i.e. their function) and what they are made of (i.e. their structure). The function and structure of a joint is determined by:

- the way in which the articulating bones fit together
- the flexibility of the connective tissue that holds the joint in place
- the position of the muscles, tendons and ligaments around the joint.

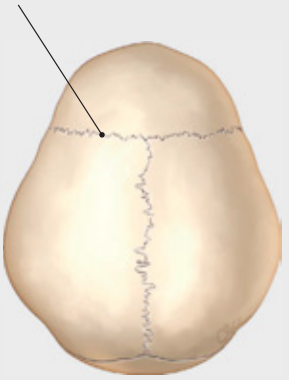
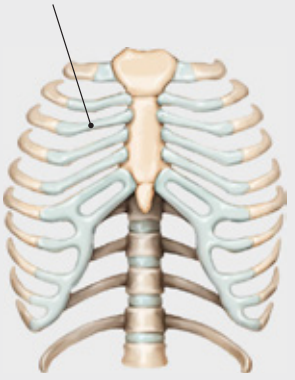
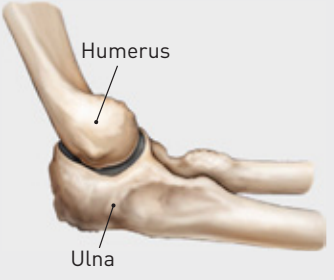
Types of joint movements

On the basis of joint movements, joints can be classified into three categories according to their structure or function (as shown in Source 2).

fibrous joints
where the bones have no joint cavity and are connected via fibrous connective tissue

cartilaginous joints
where the bones have no joint cavity and are held together by cartilage

synovial joints
where the bones have a joint cavity and are held together by ligaments and separated by synovial fluid in the joint cavity

Type of joint	Description	Range of movement
❶ **Fibrous joints** (e.g. where the bones of the skull join) 	• The bones have no joint cavity and are held together by strong connective tissue	• Fixed (i.e. no movement)
❷ **Cartilaginous joints** (e.g. where the manubrium joins the body of the sternum) 	• The bones have no joint cavity and are held together by cartilage • Fibrous and cartilaginous joints are more prominent in infancy and childhood; they fuse and are replaced by bone growth during adulthood	• Slight (i.e. limited movement)
❸ **Synovial joints** (e.g. where the humerus meets the ulna) 	• The bones have a joint cavity, and they are held together by ligaments and separated by synovial fluid in the joint cavity	• Free (i.e. full range of movement)

SOURCE 2 Categories of joints in the human body

Synovial joints

As synovial joints are the most important in terms of movement, we will now look more closely at their structure and function.

Successful performance in most sporting activities relies heavily on the structure and function of synovial joints. Stability is provided by a number of important physical structures. These structures are shown in Source 3 and Source 4. They include:

- the articular capsule – a capsule that encloses the joint cavity
- articular cartilage – a smooth connective tissue covering the surface of articulating bones
- synovial fluid – a secretion that lubricates and nourishes the articular cartilage
- the synovial membrane – a connective tissue that lines the inner surface of the articular capsule
- the synovial cavity – the space created within the enclosed articular capsule, filled with synovial fluid
- the fat pad – fatty tissue that provides cushioning for the articular capsule
- the bursa – a small sac containing synovial fluid, located at friction sites between bones and tendons.

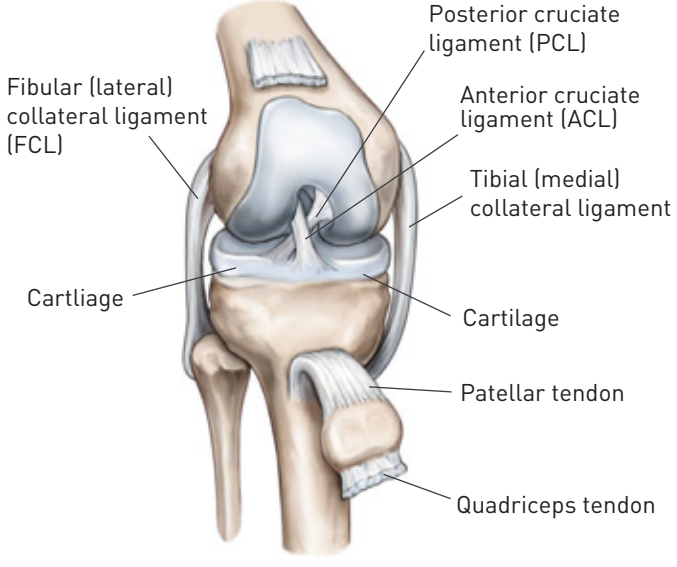
The structures that provide support and function around the joint are:

- tendons – fibrous cords of dense connective tissue that attaches muscle to bone
- ligaments – dense connective tissue that attaches bone to bone.

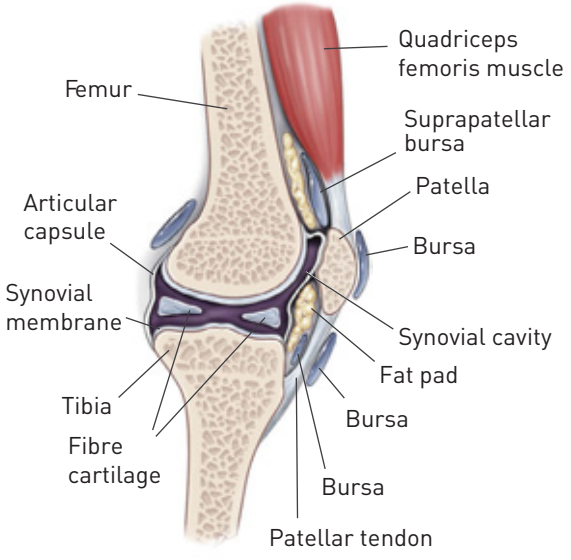
These structures inside and around joints determine the types of movements that are possible. Synovial joints are the only joints that allow true mobility. This level of mobility can vary depending on the joint's function, position, the state of the ligaments, tendons and muscles, or the presence of diseases (such as arthritis).

FOR THE RECORD!

Australia holds the record for the highest rate of anterior cruciate ligament (ACL) injuries in the world! Each year, more than 10 000 surgical knee reconstructions are carried out in Australia to address these injuries, and this rate is rising by 5 to 6% per annum. The majority of these operations are performed on 15- to 25-year-olds. Sport injuries have become so common that they now result in more hospital admissions than road trauma.

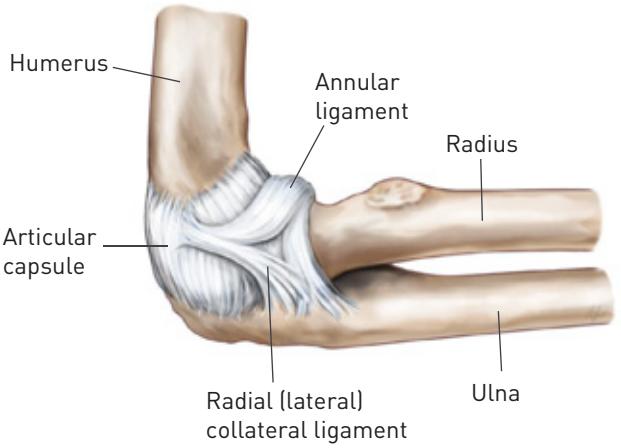


Structural view of the knee joint, showing ligaments

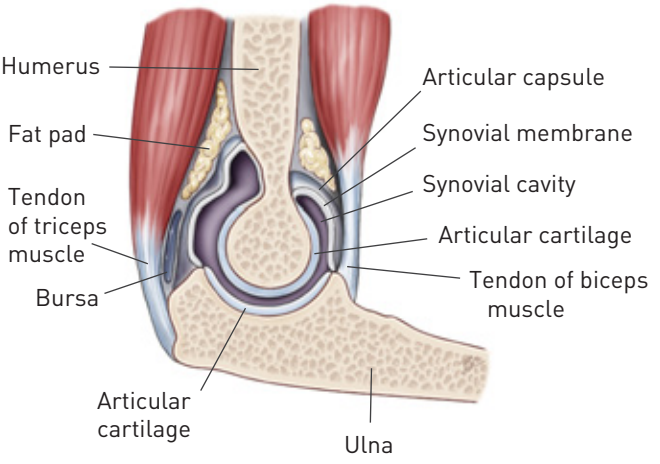


Cross-section view of the knee joint

SOURCE 3 The internal structural view of a knee joint



Structural view of the elbow joint, showing ligaments



Cross-section view of the elbow joint

SOURCE 4 The internal structural view of an elbow joint

Theory in action — The devastation of a torn ACL

At 19, Shenae Ciesolka was playing professionally as a member of the Australian women's rugby sevens squad when she suffered the bitter disappointment of an anterior cruciate ligament (ACL) tear. In a grand final game, Shenae was twisted awkwardly during a tackle. She heard three loud 'snaps' and felt intense pain in her knee.

'The first thing that entered my mind was "this is not good"', said Ciesiolka. 'I knew I had done some serious damage to my knee and in that split second, shock and disappointment set in – probably more than the pain of the injury itself. I was absolutely devastated and before any scans could confirm the damage, I had come to the conclusion that all my hard work would be unravelled. My goals would be placed on hold for many months.'

Shenae was right. Specialists confirmed that not only had she torn her ACL, but her MCL, LCL and meniscus too. With these ligaments torn, Shenae's knee had lost all stability. She was facing a year-long absence from the sport. 'I was in a knee brace for 8 weeks, unable to walk or put any weight on the joint. That was followed by a further 6 weeks of partial weight bearing, and I eventually progressed from two crutches to one. By this time, I had completely lost all muscle tone.'

'One of the hardest things was trying to get the range of movement back into my leg. I wasn't allowed to run, and my first slight jog was at 6 months post-operation.' In addition to the physical strain, Shenae's experience took a huge mental toll. 'The first 6 months of the injury were extremely difficult. I suddenly went from being a professional athlete with a distinct purpose to inactivity and it devastated me.'

The road to recovery has been long and arduous but Shenae is making progress. Twelve months on, she has resumed training with the Queensland Reds and Queensland University team, and her sights are firmly set on a successful future in rugby.

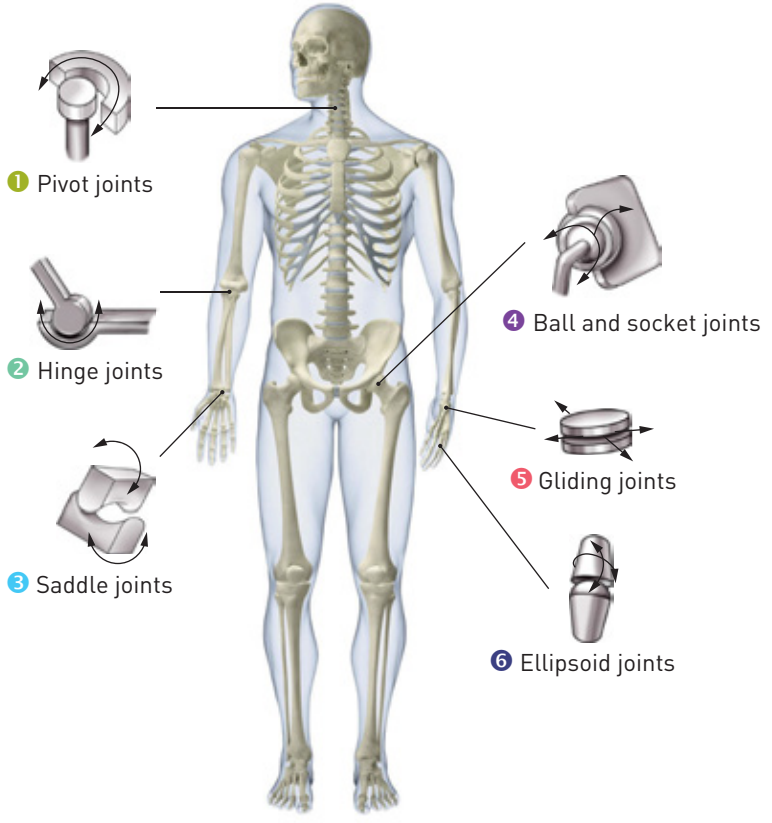
SOURCE 5 Shenae Ciesolka tore her ACL while playing rubgy.

Types of synovial joints

There are six different types of synovial joints. They permit particular types of movement, according to the shape of the bones and the structures around them. They are shown in Sources 6 and 7.

Type of synovial joints	Description	Example
❶ Pivot joints	→ Form when the rounded (or pointed) surface of one bone articulates with the depression (or opening) of another. These joints support rotational movement (as the rounded bone moves around its own axis).	Joint of the first and second vertebrae of the neck
❷ Hinge joints	→ Form when the slightly rounded bump (i.e. convex) of one bone fits into the slightly rounded hollow (i.e. concave) of another. These joints support movement back and forth in the same direction.	Elbow joints and knee joints
❸ Saddle joints	→ Form when the ends of each bone resemble a saddle (i.e. with concave and convex sections) that fit together. These joints support angular movements (i.e. similar to ellipsoid joints) but with a greater range of motion.	Thumb joint
❹ Ball and socket joints	→ Form when the rounded surface of one bone (i.e. the ball) fits into a rounded cup-like hollow of another (i.e. the socket). These joints support a large range of motion with movement possible in all directions.	Shoulder joints and hip joints
❺ Gliding joints	→ Form when the flat (or slightly curved) surfaces of two bones meet. These joints support a limited range of motion (i.e. side to side and back and forth movements) that do not include rotation.	Intercarpal joints (in the hand)
❻ Ellipsoid joints (also known as condyloid joints)	→ Form when an elliptical condyle (i.e. oval-shaped bump) of one bone fits into the elliptical depression (i.e. oval-shaped hollow) of another. These joints support angular movements along two axes (i.e. both side to side and up and down).	Wrist joints and finger joints

SOURCE 6 There are six types of synovial joints.



SOURCE 7 Synovial joints are the only joints that allow true movement

STUDY TIP

Anatomical position
Joint movements are always described assuming the body is in the anatomical position. The anatomical position for humans assumes the body is in an upright standing position with the face looking forward, the feet facing forward, the arms at the side, and the palms of the hands facing forward.

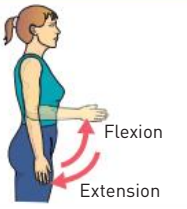
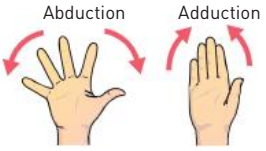
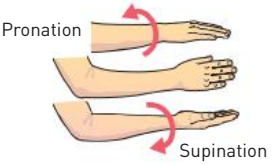
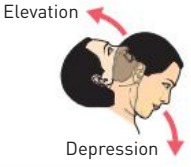
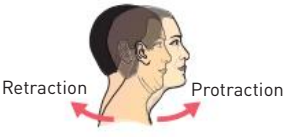
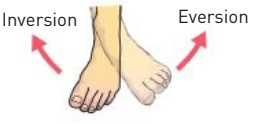
It is very important to use the anatomical position to avoid confusion – especially when using terms like left/right, anterior/posterior, flexion/extension.

midline
an imaginary line that runs vertically down the middle of the body (or through the middle of a body part) used as a reference to describe the angle and direction of joint movements

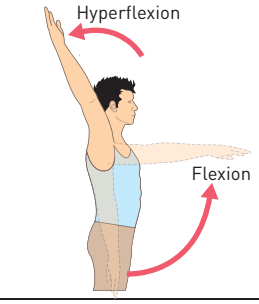
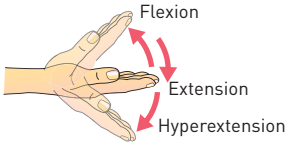
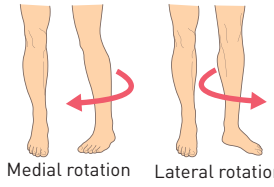
Types of joint movements

As we have learnt, joints help to support movement by acting as the meeting point between bones and muscles. As discussed, most of the joints in our bodies are synovial joints. There are six types of synovial joints. The types of movements that can occur at joints depend on the type of joint (as shown in Source 7). Not all joints have the same possible movements for this reason, experts developed a specialised vocabulary to accurately describe every type of movement that can be produced by synovial joints.

As shown in Source 8, most movement types are paired (meaning one is the opposite of the other), but some are unpaired (meaning they have no opposite).

Paired joint movements		
	**FLEXION** Decreasing the angle between two bones	**EXTENSION** Increasing the angle between two bones
	**ABDUCTION** Moving a body part (e.g. arm) away from the **midline** of the body	**ADDUCTION** Moving a body part (e.g. arm) towards the midline of the body
	**PRONATION** Rotating a body part (e.g. the forearm) so that palm is posterior (i.e. facing backwards) or inferior (i.e. facing downwards)	**SUPINATION** Rotation of forearm so that palm is anterior or superior
	**ELEVATION** Raising of a body part	**DEPRESSION** Lowering of a body part
	**RETRACTION** Pulling a body part backwards	**PROTRACTION** Pushing a body part forward
	PLANTAR FLEXION Bending of foot away from the shin	**DORSIFLEXION** Bending of foot towards shin
	**INVERSION** Rotation of sole of foot inwards	**EVERSION** Movement of the bottom (sole) of the foot away from the midline of the body

SOURCE 8 Paired joint movements

Unpaired joint movements	
	**HYPERFLEXION** The abnormal or excessive flexion of a joint beyond its normal range of motion (usually resulting in injury)
	**HYPEREXTENSION** The abnormal or excessive extension of a joint beyond its normal range of motion (usually resulting in injury)
	**ROTATION** Movement of a bone around its longitudinal axis. This movement can be medial (i.e. movement that brings the anterior surface of the limb toward the midline of the body) or lateral (i.e. movement that brings the anterior surface of the limb away from the midline of the body)

SOURCE 9 Unpaired joint movements

PERFORMANCE | SKILL DRILL 3.3 | Evaluate the impact of joint movement on optimal physical performance

>> Turn to pages 334–335 to complete this integrated physical performance activity.

3.3 Check your learning

Engage and understand

1 **Identify** the three types of joints in the human body. In your own words, explain the difference between each of these.

2 **Select** and **sketch** one type of synovial joint. Provide an example of where it can be found in the body and label its key parts.

Analyse and apply

3 Read 'The devastation of a torn ACL'. **Determine** what type of joint movement resulted in Shenae's ACL tear. Explain whether this was a paired or unpaired movement.

4 **Select** an important skill or movement sequence from your selected physical activity this term. **Determine** each of the discrete movements required to complete the skill successfully (i.e. by breaking it down into phases and sub-routines). Record each of these in a table and:

- **identify** the type of synovial joints involved
- **describe** the type of joint movements involved.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  3.3 Check your learning
- **» Video**
  The role of ligaments
- **» Student worksheet**
  3.3 The structure and function of joints worksheet
- **» Skill Drill worksheet**
  3.3 Evaluate the impact of joint movement on optimal physical performance

3.4 The structure and function of muscles

That's a goal!

By the end of Section 3.4, you should be able to:

→ **define** the term 'muscular system'

→ **identify** the three types of muscles in the body and **explain** their basic functions

→ **explain** the various types of muscle contractions and apply them to movement sequences

→ **explain** the concept of reciprocal inhibition.

The muscular system

The muscular system is made up of all of the muscles in our body that are directly responsible for movement. These muscles are referred to as skeletal muscles. There are over 600 named skeletal muscles in the human body. Skeletal muscles are attached to the bones of the skeletal system and usually make up about half a person's total weight. Each of the muscles in the human muscular system is a discrete (i.e. separate) organ made up of muscle fibres, blood vessels and nerves.

Types of muscles in the body

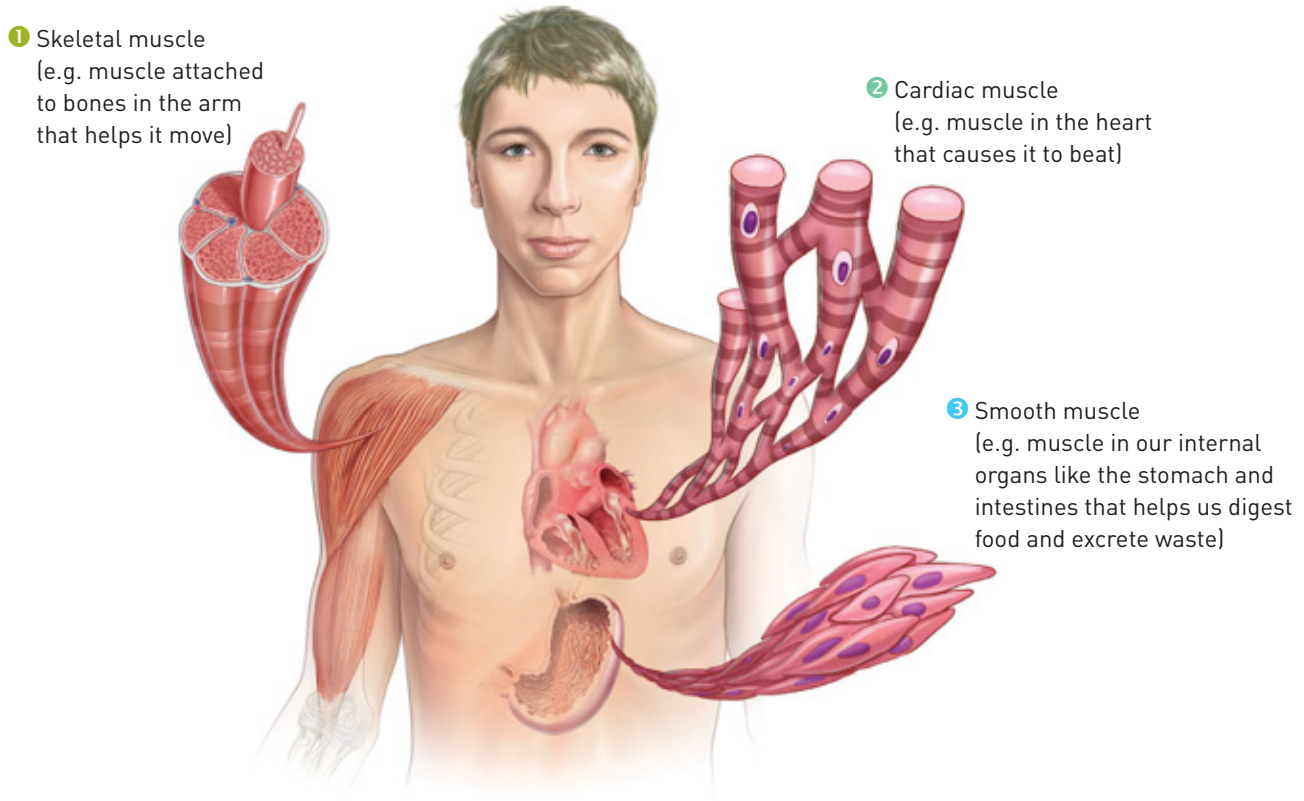
skeletal muscle
a type of muscle that is usually attached to bones and is responsible for moving the skeleton; it is a striated (i.e. striped), voluntary muscle (i.e. one that we have control over)

cardiac muscle
a type of muscle that is found in the walls of the heart; it is a striated (i.e. striped), involuntary muscle (i.e. one that we have no control over)

smooth muscle
a type of muscle that is found in the walls of our internal structures (such as the stomach, blood vessels and intestines); it is non-striated (i.e. not striped), involuntary muscle (i.e. one that we have no control over)

Before we learn more about the muscular system, it is useful to understand that there are three main types of muscles in the human body (as shown in Source 1). These muscles vary in size, shape and appearance depending on their purpose and where they are located in the body. The three types of muscle include:

- **skeletal muscle**
  This type of muscle is usually attached to bones and is responsible for moving the skeleton. Skeletal muscle is said to be **striated** (i.e. streaked) because of its striped appearance. We have direct control over how and when we move skeletal muscles. For this reason, the movement of skeletal muscle is said to be **voluntary**.
- **cardiac muscle**
  This type of muscle is found in the walls of the heart. Cardiac muscle is said to be **striated** (i.e. streaked) because of its striped appearance. We have no direct control over how and when we move cardiac muscles. For this reason, the movement of cardiac muscle is said to be **involuntary**.
- **smooth muscle**
  This type of muscle is found in the walls of our internal structures (such as the stomach, blood vessels and intestines). Smooth muscle is said to be **non-striated** (i.e. not streaked) because – unlike skeletal and cardiac muscle – it does not have a stripy appearance. We have no direct control over how and when we move smooth muscles. For this reason, the movement of smooth muscle is said to be **involuntary**.



SOURCE 1 Most muscles in the human body can be classified into three main categories: 1 skeletal muscle; 2 cardiac muscle; and 3 smooth muscle.

The structure of skeletal muscles

As the goal of functional anatomy is understanding how muscles and bones work together to produce movement, we will be learning exclusively about **skeletal muscles** for the remainder of this chapter. The skeletal muscles of the human body can be categorised into five groups, depending on where they are located in the body. These include:

- **muscles of the head** – this includes the face muscles (i.e. those that control facial expressions), jaw muscles, tongue and eye muscles
- **muscles of the neck** – this includes all the muscles responsible for the movement of the head and neck (i.e. sternocleidomastoid and the trapezius)
- **muscles of the torso** – this includes the deep muscles of the back and the muscles of the thorax, abdomen, pelvis and perineum (i.e. an area near the rectum)
- **muscles of the upper extremities** – this includes the muscles connecting the upper limbs with the vertebral column, the muscles connecting the upper limbs with the anterior and lateral thoracic walls (i.e. the upper rib cage area) and the muscles of the shoulder, upper arm, forearm and hand
- **muscles of the lower extremities** – this includes the muscles of the iliac region (i.e. the hips and lower abdomen), thigh, leg and foot.

STUDY TIP

It is important to remember that the term 'human muscular system' refers only to skeletal muscles. It does not include the many other muscles in our body that are not responsible for movement (e.g. muscles in the heart, stomach and lungs).

FOR THE RECORD!

The long and short of it ...

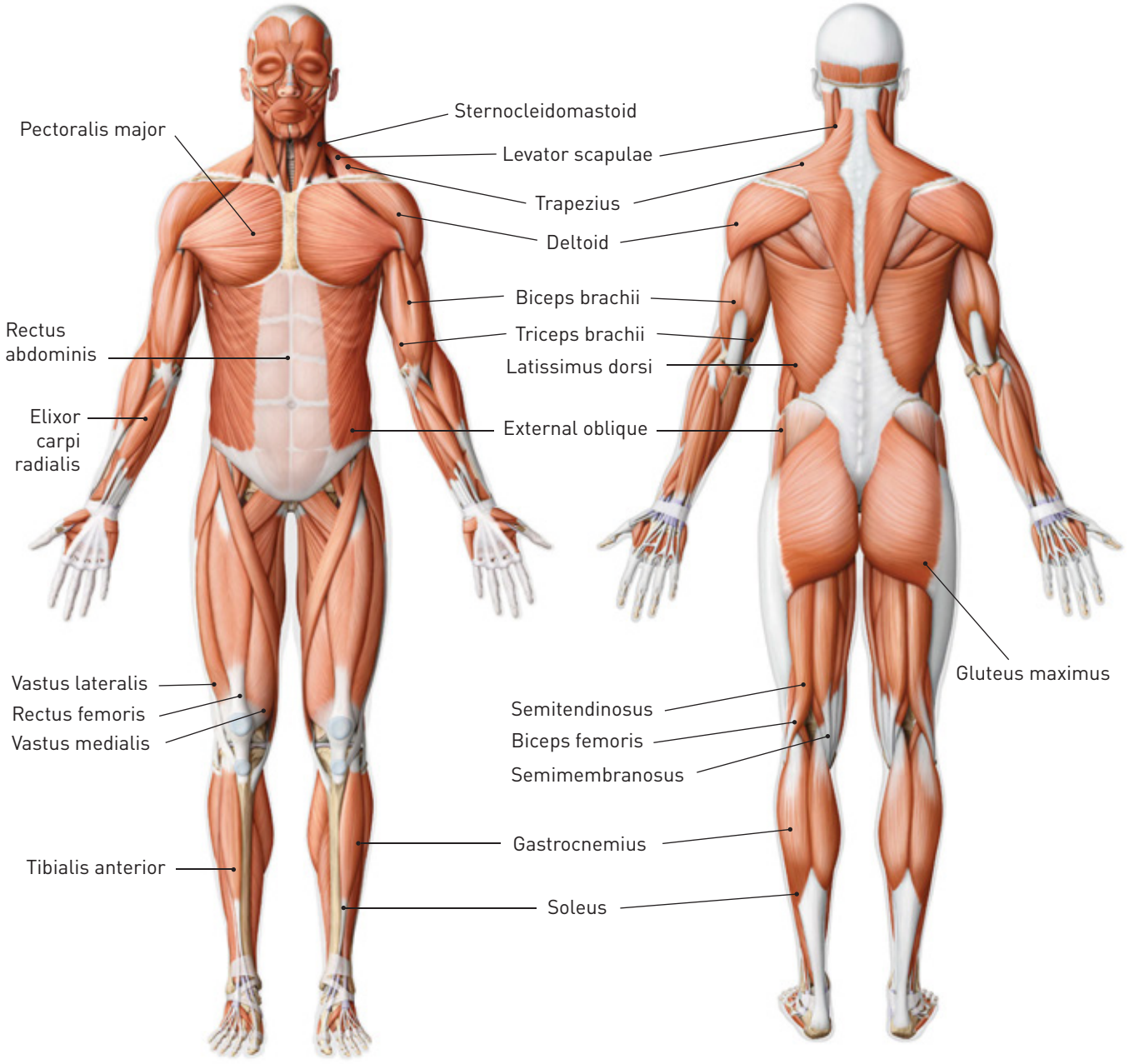
- The sartorius muscle is the longest muscle in the human body. It runs from the outside of the upper thigh down and across the leg to the inside of the knee and can be up to 60 centimetres long.
- The stapedius is shortest muscle in the human body. It is located in the middle ear and is around 2 millimetres in length.

Names of the major skeletal muscles

The names of skeletal muscles can be difficult to remember and understand to begin with, so it's helpful to know that muscles are named according to:

- **their size** – muscles come in a variety of different sizes. They can be large or small, short or long, narrow or wide. As a result, the names of some muscles reflect this. For example, larger muscles are called major (e.g. pectoralis major) and smaller muscles are called minor (e.g. pectoralis minor). Likewise, the largest muscle in a group is called maximus (e.g. gluteus maximus) and the smallest muscle in a group is called minimus (e.g. gluteus minimus).
- **their shape** – muscles come in a variety of different shapes. As a result, their names can reflect this. There are four main shapes of muscles in the body: trapezoids, triangles, saw tooth and flat. For example, a trapezoid is like a rectangle, but with only two sides that are parallel as opposed to all four. The trapezius is the large muscle that sits on the upper portion of the back.
- **their location** – muscles are located in specific parts of the body. They can be located on the sides of the body or more towards the midline. They can also be towards the front or back of the body, or above or below other muscles. As a result, the names of some muscles reflect this. For example, the latissimus dorsi muscle is a large, flat muscle on the back that stretches to the sides. Dorsum is a Latin word meaning back.
- **the action they perform** – muscles are designed to perform a variety of different actions (or functions) in the body. They flex, extend, rotate around a joint, or move body parts up and down. As a result, the names of some muscles reflect this. For example, the flexor carpi radialis is a muscle in the forearm that acts to flex the hand.
- **the direction of their fibres** – muscles are designed to run in different directions (relative to the midline of the body). As a result, the names of some muscles reflect this. Some run up and down the body (i.e. parallel with the midline) and are called rectus, others run perpendicular (i.e. at 90° to the midline) and are called transverse, and some run diagonally (i.e. at 45° to the midline) and are called oblique. For example, the external oblique runs diagonally across the abdomen.
- **the fact that they have multiple points of origin** – some muscles in the body have more than one points of attachment at their origin. As a result, the names of these muscles reflect that. For example, the biceps brachii has two attachment points at its origin. Brachii is a Latin word meaning branches.
- **their origin and/or insertion points** – some muscles in the body have more than one point of attachment at their origin. As a result, the names of these muscles reflect that. For example, the sternocleidomastoid muscle in the neck takes its name from *sterno* and *cleido* (at its origin point at the sternum and clavicle) and *mastoid* (at its insertion point at the mastoid process).

SOURCE 2 Knowledge of the structure and function of muscles will prevent injuries.



SOURCE 3 The muscles in the human body that are responsible for movement are referred to as skeletal muscles. There are over 600 named skeletal muscles in the human body. This diagram only shows a simplified view of a range of skeletal muscles. There are many more muscles beneath these major surface muscles.

FOR THE RECORD!

It's all Greek (and a bit of Latin) to me ...

When early anatomists in the 1600s were naming many of the organs, bones and muscles in the human body, they assigned words from Latin and Greek. As a result, it is possible to find clues to the size, location, shape, and function of many muscles from their names. Take the levator scapulae muscle:

- levator sounds like the English word 'elevate'. That's because they both come from the Latin word 'levare' meaning 'to raise'.

Combine this knowledge with the fact that the scapula is a bone, and you'd be right to conclude that the primary function of the levator scapulae muscle is used to lift the scapula bone.

The function of skeletal muscles

There are three basic functions that skeletal muscles carry out in the body. They:

- produce the movement required to walk, run, jump, breathe, digest food and excrete waste
- stabilise the position of the body and internal organs (i.e. maintain posture)
- generate heat to maintain body temperature.

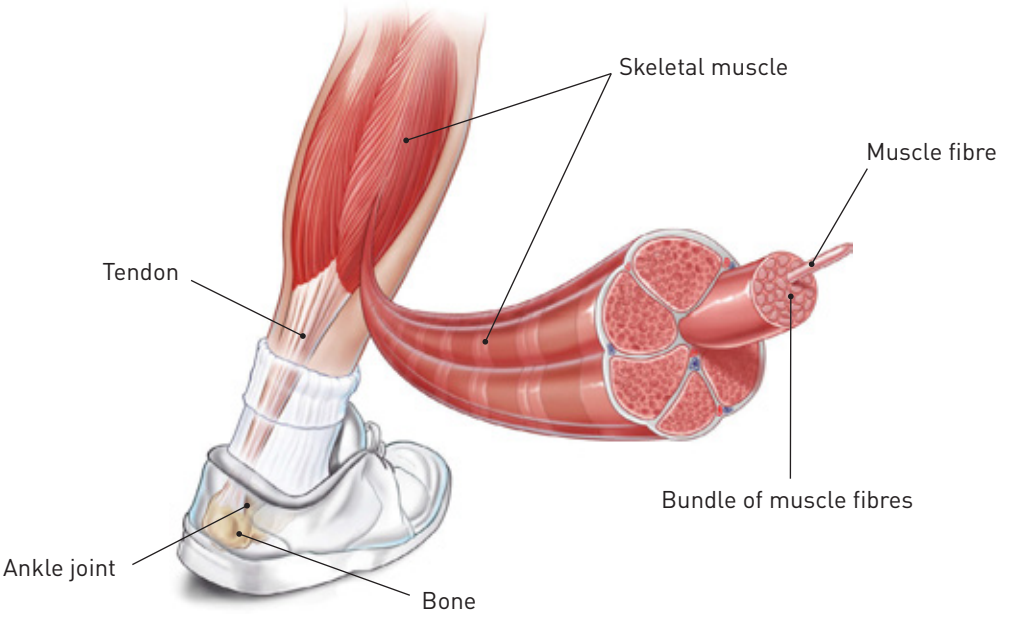
Once again, as the goal of functional anatomy is understanding how muscles and bones work together to produce movement, we will now learn in more detail about the first point listed above.

How muscles produce movement

In order to produce movement, muscles must convert chemical energy to mechanical energy to enable force to be produced. It is this force that ultimately creates movement. The movement that a muscle produces is called its action. Each muscle in the body is only capable of two actions:

- **contraction** – i.e. a state in which tension in the muscle fibres increases, making them shorter and tighter
- **relaxation** – i.e. a state in which tension in the muscle fibres decreases, making them longer and looser.

As shown in Source 4, skeletal muscles are attached to bones by tendons. When a muscle exerts force on a tendon, the tendon pulls on the bone to create a movement. Because most bones in the human body are very rigid (and cannot bend without breaking), we also depend on our joints to help us move.



SOURCE 4 If you examine a skeletal muscle, you will find that it is constructed of many smaller bundles of muscle fibres. Muscles attach to tendons, which attach to bone. Movements (such as raising your heel off the ground) are produced when muscles (made up of bundles of muscle fibres) contract and exert force on tendons. Tendons pull on articulating bones (such as those in the ankle joint), resulting in a movement.

Muscle relationships

When it comes to moving our bodies around or performing complex motor skills, there are often hundreds of muscles moving in unison (i.e. in harmony and agreement) with one another. In fact, it is almost always the action of muscles working in groups that causes us to move. Muscles are arranged to work with each other – or against each other – to produce movement.

Agonists, antagonists and stabilisers

Skeletal muscles can be classified into three groups depending on the relationships they have with each other. These include:

- **agonists** (also known as prime movers) – these muscles provide the main force that causes a particular movement
- **antagonists** – these muscles oppose (or reverse) the main force that causes a particular movement
- **stabilisers** – these muscles support the movement by promoting the same movement or reducing unnecessary movement. There are two types of stabiliser muscles:
  - synergists – these muscles stabilise the joint where movement is occurring
  - fixators – these muscles stabilise the area where the agonist originates.

agonist
a muscle that provides the main force to cause a particular movement

antagonist
a muscle whose action opposes (or reverses) that of the agonist muscle

stabiliser
a muscle that supports movement by promoting the same movement as the agonist or by reducing unnecessary movement (or undesired action)

Muscle origin, insertion and action

We have already learnt that skeletal muscles are attached to bones on each end by tendons but, in order to understand and explain how precise movements are produced, we need to look at this in more detail.

In order to create a movement, most muscles cross over at least one joint and the tendons at each end of the muscle attach to different bones. Movements are produced when a muscle exerts force (i.e. pulls) on a tendon, which in turn pulls on an articulating bone. During a muscle contraction, one bone (to which one end of the muscle is attached) moves, while the other bone (to which the other end is attached) does not.

The different ends of the muscle where the tendon attaches to a bone are known as the:

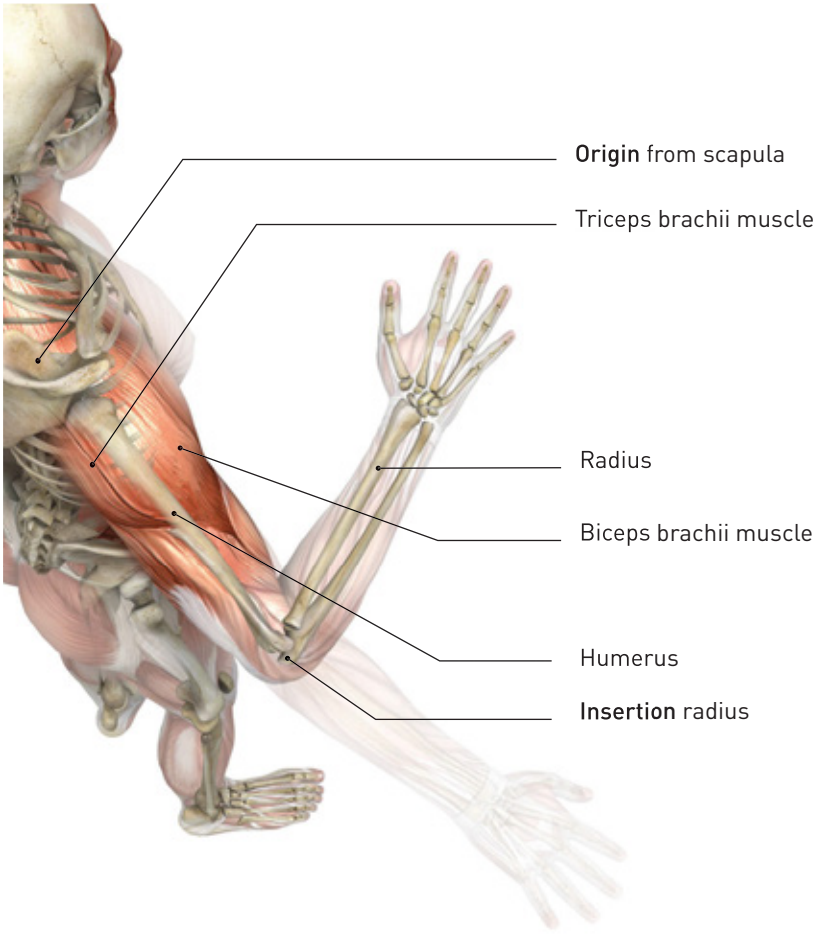
- origin – the origin of the tendon is on the most stationary bone
- insertion – the insertion of the tendon is on the most moveable bone.

During a simple movement, when the muscle contracts, it creates the:

- action – the movement that a muscle produces in the fleshy portion between the origin and insertion of the tendons (known as the muscle belly).

Let's now look at an example of these concepts at work. As shown in Source 5 (page 108), flexion of the forearm at the elbow involves a group of muscles working together to achieve a movement. These include:

- the **agonist** – in this case the biceps brachii muscle acts as the agonist, carrying out the primary movement (i.e. pulling the forearm upwards)
- the **antagonist** – in this case the triceps brachii muscle acts as antagonist, carrying out the opposing movement (i.e. a downward pull on the forearm)
- the **stabilisers** – in this case, muscles around the elbow joint act as synergists (i.e. stabilising the elbow joint) and the muscles of the shoulder act as fixators (i.e. preventing any unnecessary movement in the arm). These are further explored in the Theory in action on the next page.
- the **origin** of the agonist at the scapula and the **insertion** at the ulna – when the biceps brachii contracts, it exerts force on the tendons, which pull on the scapula and ulna. The scapula remains stationary as it is anchored to the axial skeleton, but the ulna is movable and therefore the force exerted pulls the forearm upwards.



STUDY TIP

Putting theory into action can help consolidate your understanding. For example, this section explains how the biceps brachii pulls on the ulna to create movement.
Try this exercise now.

Hold out your right forearm at a right angle:

- complete a series of slow, controlled bicep curls
- while completing the bicep curls, gently rest your left finger tips on the inside of your right elbow (i.e. at the base of your bicep)
- feel the tendon contract (pulling on the radius) and relax (releasing the radius).

SOURCE 5 Muscles are arranged to work in groups to produce movement. Often they work with each other – or against each other – in order to do this. For example, flexion of the forearm at the elbow occurs when the agonist (i.e. the biceps brachii) contracts and the antagonist (i.e. the triceps brachii) opposes the movement.

Theory in action | The importance of stabiliser muscles

Your performance at the gym is often more focused on the volume and the load you intend on lifting and less on the way you perform weight exercises. You may have heard your gym peers talk about having 'proper form' when weight training.

Incorrect weight training techniques can hinder your weight training efforts and result in fractures, sprains and strains.

An important part of doing weight lifting exercises the right way – using proper form – is being able to stabilise your body to maximise the available strength and energy of the movement.

The muscles you use to stabilise your body are called stabiliser muscles. They spread the work of training and movement throughout your body instead of putting all the stress onto one or two primary movers.

For example, when performing a Barbell Back Squat your hamstrings and gluteus maximus are doing the majority of the work (i.e. they act as the primary movers). The abductor muscles then work to keep the hips and thighs stable (i.e. they act as the stabiliser muscles). Underdeveloped and inactive stabilisers muscles can result in the knees collapsing inwards.

SOURCE 6 Your stabiliser muscles work to stabilise your body as you work your larger muscle groups. A lack of strength in your stabilisers muscles can result in improper form and injury.

Stabiliser muscles make movements safer and more efficient while preventing primary movers from getting overworked. They allow you to become a more powerful, efficient athlete both inside and outside the weight room.

Types of muscle contractions

When muscles are in a relaxed state, they are soft and loose. When they contract to produce a force, they become hard and elastic.

Muscle tension is the force that is produced when a muscle contracts; the load is the force exerted on a muscle by a weight. In the case of a bicep curl with a dumbbell, the load is the weight of the dumbbell (see Source 7).

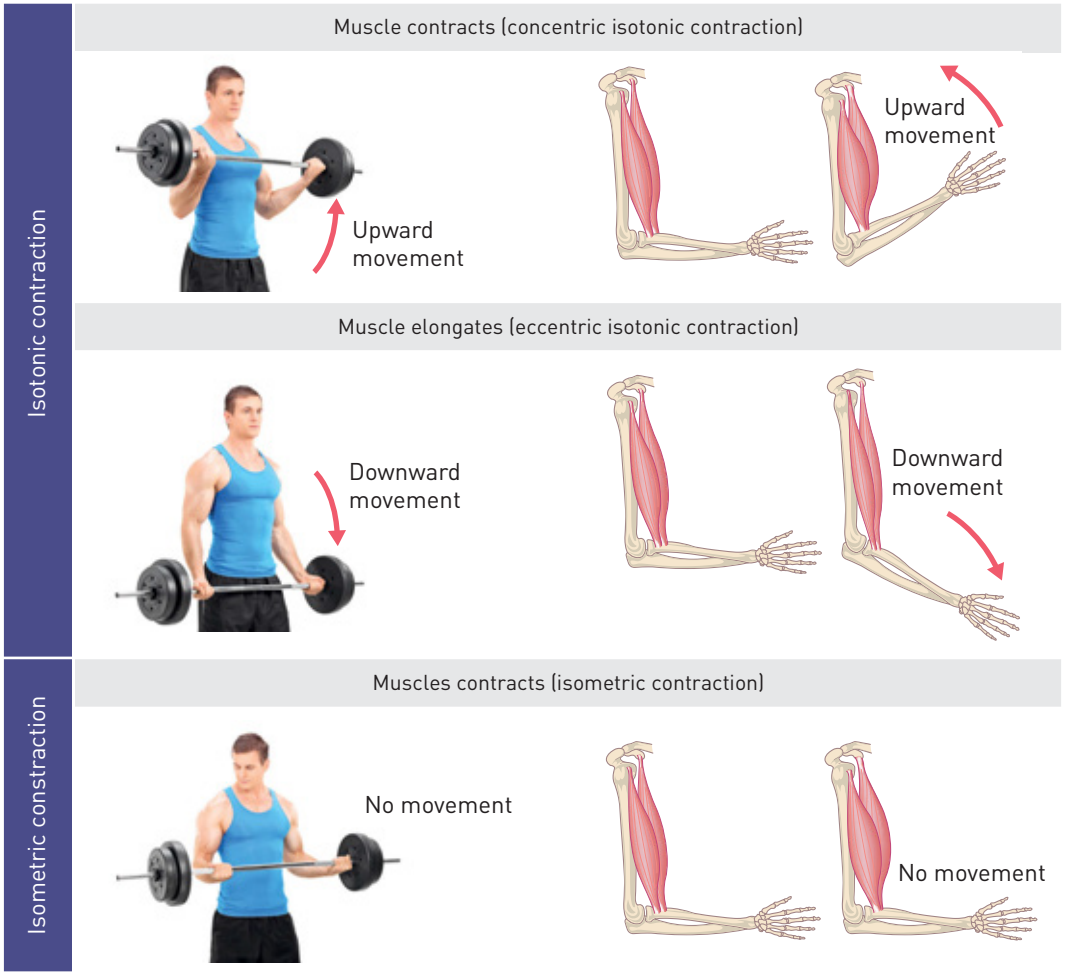
Two main types of contractions are possible within muscles:

- **isotonic contractions**
- **isometric contractions**.

Isotonic contraction

During an isotonic contraction, the muscle fibres produce a tension, or force, as they lift the load through the range of movement. The muscle length changes (i.e. either shortens or lengthens) as tension develops, therefore two possible types of isotonic contractions exist; when the muscle shortens it is known as a concentric **isotonic contraction** and when it lengthens, it is known as an **eccentric isotonic contraction**.

For example, a squat uses both types of isotonic contractions.



SOURCE 7 Two main types of contractions are possible within muscles: isotonic contractions and isometric contractions.

isotonic contraction
a process in which the muscle fibres produce tension (i.e. force), as they shorten or lengthen and there is a range of movement across the joint (i.e. the joint moves)

isometric contraction
a process in which the muscle fibres produce tension (i.e. force), but they neither shorten nor lengthen and there is no movement across the joint (i.e. the joint does not move)

concentric isotonic contraction
a process in which the muscle shortens to pull on bones and bring them closer together

eccentric isotonic contraction
a process in which the muscle lengthens to release the bones and move them further apart

STUDY TIP

As you complete the movement sequences of your chosen physical activity, keep in mind the major muscles involved. For instance, you may wish to explain to a friend the key agonists, antagonists and stabilisers involved. Alternatively, you could do a sketch in your workbook and label the muscles. Use specific and accurate terminology to enhance your communication.

central nervous system
part of the larger body system known as the nervous system, the central nervous system consists only of the brain and spinal cord (i.e. the central part of the system). It does not include the network of nerves that run throughout our bodies (referred to as the peripheral nervous system)

reciprocal inhibition
a process during which the muscle (or muscles) on one side of a joint relax in order to accommodate the muscle (or muscles) on the other side of that joint that are contracting

Isometric contraction

During an isometric contraction, tension develops in the muscle, but it neither shortens nor lengthens. There is also no movement across the joint. Isometric contractions produce energy but no movement.

Combining muscle contractions

Most sporting skills involve a combination of both isotonic and isometric contractions. Consider the tennis backhand topspin shot. The isometric contraction required of the muscles gripping the racquet in the eastern orientation (which allows for greater generation of spin) is of equal importance to the concentric and eccentric isotonic contractions occurring through the biceps and triceps muscles. The same applies to the softball batting action. The batter must withstand the force of the oncoming ball impacting the bat by using isometrically contracted muscles in the forearm, otherwise the isotonic contractions required to swing the bat are irrelevant.

Reciprocal inhibition

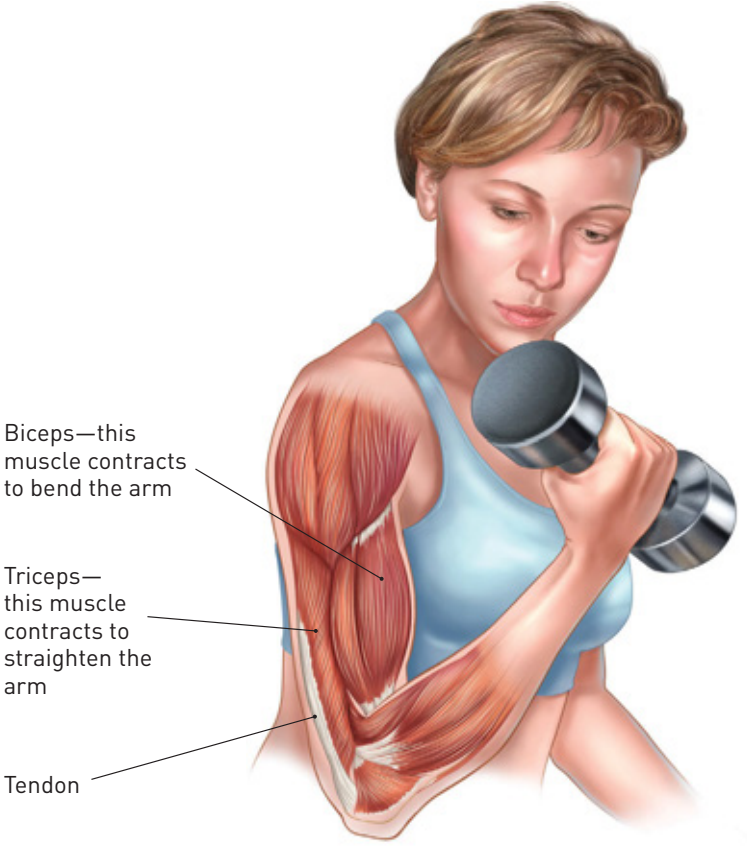
It is important to know that muscles play multiple roles. A certain muscle may act as an agonist in one movement, an antagonist in another movement and a stabiliser in another movement.

When the **central nervous system** sends a message for a muscle on one side of a joint to contract (i.e. the agonist), it sends a message for the muscle on the other side of the joint to relax (i.e. the antagonist). This process is called **reciprocal inhibition.**

Reciprocal inhibition is crucial because it allows movement at the joint and prevents injury. If agonists and antagonists contracted at the same time, movement would be negatively affected and injuries (i.e. muscle tears) would occur. The combined functions of agonists, antagonists and stabilisers are important in creating coordinated, smooth, precise and injury-free movements.

The paired muscles of the shoulder girdle can be used as another example to further explain these concepts. The shoulder girdle is the anatomical structure that allows for all movements of the upper arm and shoulder.

- When the shoulder girdle is in action the pectorals and latissimus dorsi work to create flexion and extension at the shoulder joint.



SOURCE 8 Completing a bicep curl involves a numbers of muscle contractions. Raising and lowering the dumbbell involves isotonic contractions – concentric contractions to raise it and eccentric contractions to lower it. Gripping the dumbbell and holding it steady at the beginning and end of each set involves an isometric contraction.

- When the pectorals (agonist) contract, flexion of the arm occurs and the latissimus dorsi (antagonist) is relaxed. In this movement, the deltoid, biceps brachii and trapezius act as stabilisers.
- During extension, the latissimus dorsi (agonist) contracts and pectorals (antagonist) relax. The triceps and trapezius act as stabilisers.

Examples of sporting actions that require the use of the muscles of the shoulder girdle include the baseball pitch, discus throw, volleyball spike, tennis serve, freestyle stroke and static strength hold on the rings (in artistic gymnastics).

SOURCE 9 In this example of reciprocal inhibition, the quadriceps (antagonist) relaxes to accommodate the contraction of the hamstring (agonist) in order to produce movement.

3.4 Check your learning

Engage and understand

1 In your own words, **define** what is meant by the 'muscular system'.

2 **Define** the roles of agonist, antagonist and stabiliser in the production of movement.

3 **Identify** the seven characteristics used to name muscles.

4 **Explain** the two types of isotonic muscle contractions. Provide an example of each using a skill from your selected physical activity this term.

5 **Describe** what is meant by the term 'reciprocal inhibition'. Explain why is it crucial, using examples from your selected physical activity.

6 **Identify** a sub-routine within a movement sequence in your selected physical activity.

- **a** **Sketch** a simple diagram to illustrate the movement of the major muscles and bones during the completion of the skill (or part of it).
- **b** Label the major muscles and bones you have drawn.
- **c** Now **identify** each one as agonist, antagonist, stabiliser, origin, insertion.

Analyse and apply

7 **Compare** and **contrast** the three main types of muscle tissue in the body by completing the following table.

	Purpose	Appearance	Degree of control over movement
Skeletal			
Cardiac			
Smooth			

8 **Differentiate** between isotonic and isometric contractions. Provide an example of each using a skill from your selected physical activity this term.

Evaluate and justify

9 Read 'The importance of stabiliser muscles'. **Select** a weight bearing movement sequence (other than a barbell squat or military press) and **investigate** the agonists, antagonists and stabilisers that are important for the safe completion of that activity.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  3.4 Check your learning
- **» Video**
  Types of muscle contractions
- **» Student worksheet**
  3.4 The structure and function of muscles worksheet
- **» Weblink**
  Interactive: Muscles of the human body

3.5 Introduction to biomechanics

That's a goal!

By the end of Section 3.5, you should be able to:

→ **define** the term 'biomechanics'

→ **explain** how biomechanics can be used to improve performance and prevent injury in sports

→ **explain** how an understanding of biomechanics can assist in the analysis of specialised movement sequences.

biomechanics
a field of science that studies the body systems responsible for movement (i.e. the musculoskeletal system) using concepts from a specialised branch of mathematics known as mechanics

mechanics
a branch of applied mathematics that deals with motion (and the forces that produce motion)

Defining biomechanics

Biomechanics is a field of science that studies how the laws of **mechanics** relate to movement. In other words, biomechanics is the study of the body systems responsible for movement (i.e. the musculoskeletal system) using concepts from a specialised branch of mathematics known as mechanics.

Biomechanics takes into account a range of different forces (such as the internal and external forces) that act on the human body (and other objects) and measures the effects of these forces. By applying some basic concepts from biomechanics, athletes and coaches can begin to develop a better understanding of how the human body operates as a machine. This kind of insight can help athletes think about their training and technique in new ways.

SOURCE 1 By applying some basic concepts from biomechanics, we can develop a better appreciation for how our bodies function mechanically.

Why study biomechanics?

The study of biomechanics can be a very useful tool in achieving sporting success as it enables athletes to:

- identify better, more effective techniques (see Source 2)
- break specialised movement sequences down into specific phases and sub-routines so that they can be investigated and analysed
- correct technical errors
- reduce injury
- understand the importance of equipment design.

Biomechanical analysis

Biomechanical analysis can benefit all athletes by helping to improve their techniques. Every sport has techniques, based on the physics of movement, which are considered ideal for optimal performance. By applying some basic concepts from the field of biomechanics to their training:

- a recreational runner may be able to run longer distances with less risk of repetitive strain-type injuries
- a high-performance track star may be able to shave milliseconds off their personal best time
- a cricket bowler may be able to make small adjustments to the rotation of their arm to reduce the stress loads on their shoulder joints and potentially increase the length of their playing career
- a soccer player may be able to improve the accuracy and effectiveness of their kicks.

In fact, biomechanics can assist almost every athlete by analysing motor skills or movement sequences in order to identify more effective and efficient outcomes.

SOURCE 2 The application of biomechanics led to the evolution of high jump over the past 200 years. The original scissor jump (above left) was popular in the mid 1800s. It was replaced by the Western roll (above right) in the early 1900s. This was replaced again by the Fosbury Flop (below) in 1968.

Applying biomechanics to different sports and physical activities

For the remainder of this chapter, we will be discussing some of the general principles of biomechanics and demonstrating how these apply to different sports and physical activities. These general principles of biomechanics include the study of:

- force (including force production)
- motion (including Newton's laws of motion and projectile motion)
- balance and stability
- levers
- Bernoulli's principle.

To make sure you get the most out of the biomechanical concepts you will be studying in this chapter, we will be providing relevant examples from a variety of sports and physical activities. As you work through the remainder of the chapter, try to think about how the concepts apply to your selected physical activity. Try to identify specialised movement sequences and think about the desired outcome or goal of each one.

Once you have identified a specialised movement sequence, you can begin to break it down into its **phases** and **sub-routines** and apply biomechanical concepts to hopefully improve your technique and performance. Section 3.14 of this chapter – Analysing specialised movement sequences – will provide a step-by-step example of how to conduct a biomechanical analysis of a movement sequence of your choice.

phase
a distinct, observable period within the execution of a motor program or specialised movement sequence (e.g. a tennis serve or volleyball spike could be organised into preparation, action and follow-through phases or, similarly, into pre-impact, impact and post-impact phases).

sub-routine
a simple motor skill that – when combined with a number of other simple motor skills and sequenced in a specific order – is part of a motor program

FOR THE RECORD!

Some of the first people to benefit from the application of biomechanics to human movement were US war veterans. After World War I, thousands of soldiers were left with missing limbs. They needed more effective aids than the traditional wooden 'peg leg'. Mechanical engineers began to study the functional movement of limbs to design prosthetics that closely matched the natural motion of an arm or a leg.

SOURCE 3 Biomechanics applies the laws of mechanics to human movement.

3.5 Check your learning

Engage and understand

1 In your own words, **define** what is meant by the term 'biomechanics'.

2 **Identify** three ways in which the study of biomechanical principles can be useful to athletes.

Analyse and apply

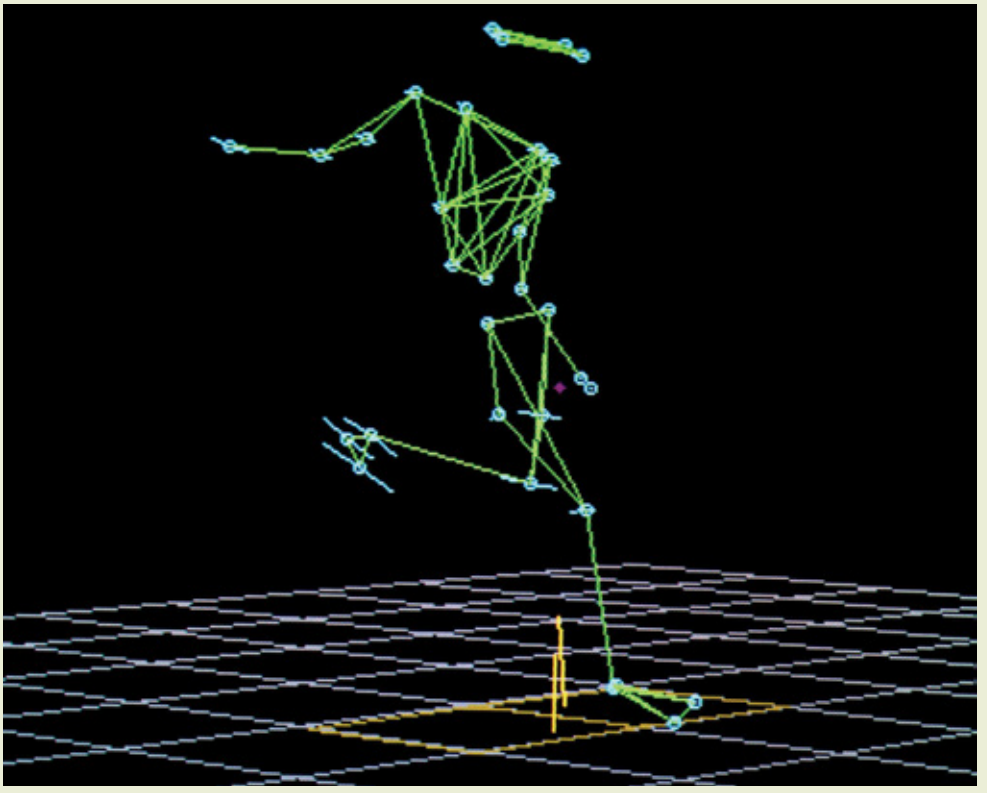
3 'Biomechanical analysis has benefits for all athletes.' **Consider** this statement and prepare a 150-word written response outlining whether you agree or disagree with it. Include examples from your selected physical activity to support your opinion.

Evaluate and justify

4 **Conduct** some additional research into the application of biomechanical principle in your selected physical activity.

- **a** **Identify** and **explain** at least one example or case in which the application of a biomechanical principles has led to a change (i.e. either positive or negative) in the way your chosen sport is played or performed (e.g. the evolution of high jump techniques).
- **b** Design a poster or presentation to communicate your findings to your class.

5 **Examine** a sub-routine within a movement sequence in your selected physical activity (e.g. drawing the lower leg back in the kicking action in football). **Predict** what would happen if the stabiliser muscles needed for this movement sequence were underdeveloped.



SOURCE 4 Biomechanical analysis studies allow techniques in sport to be analysed to improve performance and reduce injuries.

Check your obook assess for the following additional resources and more:

- **» Student book questions** 3.5 Check your learning
- **» Video weblink** High jump through the years
- **» Video weblink** New developments in biomechanics
- **» Weblink** What is biomechanics?

3.6 Force

That's a goal!

By the end of Section 3.6, you should be able to:

- → **define** the term 'force'
- → **identify** and **explain** the difference between internal forces and external forces
- → **identify** and **explain** the difference between contact forces and non-contact forces
- → **recognise** how force can impact performance in your selected physical activity.

Defining force

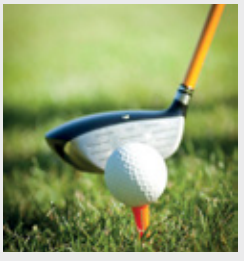
force
a push or pull that happens when two objects interact; an interaction that (when unopposed) causes (or has the potential to cause) a change in the motion of an object

In the simplest terms, a **force** is a push or pull that happens when two objects interact. In slightly more complex terms, a force is defined as an interaction that (when unopposed) causes (or has the potential to cause) a change in the motion of an object.

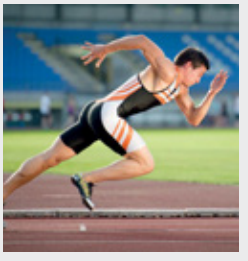
Regardless of how you define the term, forces are at work on everything around us all the time. Forces cannot be seen, but their *effects* can be seen and felt. Whether an object or body is at rest or in motion, forces are acting on it. Whether you're sitting at your desk, running around a track, sleeping in your bed, or jumping out of an aeroplane – forces are acting on your body.

Forces can cause objects to:

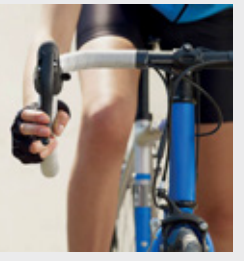
- → **begin to move** – e.g. force from the golf club is transferred to the golf ball, causing it to move



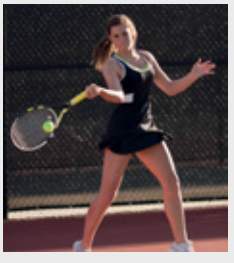
- → **speed up** – e.g. force from the muscles is transferred to the ground causing the sprinter to accelerate



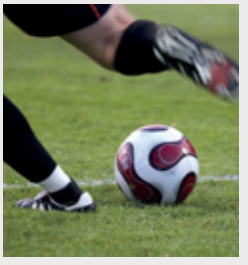
- → **slow down or stop** – e.g. force from the brakes of the bicycle are transferred onto the rim of the wheel slowing it down or bringing it to a stop



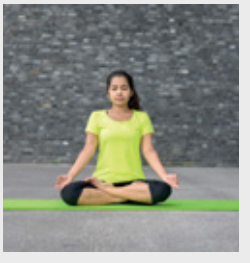
- → **change direction** – e.g. force from the tennis racquet is transferred to the ball causing it to change direction



- → **change shape** – e.g. force from the leg of the soccer player is transferred to the ball causing it to change shape momentarily (as it absorbs the force) and begin to move



- → **stay still** – e.g. forces from gravity and the weight of the air pulling down on the athlete are in balance with the force of the ground pushing up against her



SOURCE 1 Whether an object or body is at rest or in motion, forces are acting on it. The many effects that forces can have on objects are explained here.

Internal and external forces

Forces can be separated into two broad categories based on where and how they are generated. These include:

- **internal forces** – these forces are generated inside the body. They include movements and reactions that are the result of muscles inside the body contracting and relaxing to pull on tendons and joints. They also include the movements of other internal organs and systems, such as the beating of the heart or the movement of blood through the circulatory system
- **external forces** – these forces are generated outside the body (or are the result of an interaction between the body and the external environment). They include things like gravity, resistance (from the air or water), or contact with other objects or people.

A player taking a mark in a game of Australian football exemplifies internal and external forces at work (see Source 2). Internal forces generated by the player's muscles propel him into the air and help him move into position while external forces such as gravity, air resistance and other players are all interacting with his body.

internal force
a type of force that is generated inside the body (e.g. muscles inside the body contracting and relaxing to pull on tendons and joints to generate movement)

external force
a type of force that is generated outside the body or through an interaction with the body and the external environment (e.g. gravity, resistance from the air or water, contact with other objects or people)

SOURCE 2 Taking a mark in Australian football demonstrates a number of internal and external forces at work.

Types of external forces

There are two main types of external forces. These include:

- **contact forces** – these forces act on objects that come into direct contact with each other
- **non-contact forces** – these forces act on objects without coming into contact with them.

We will now learn about these types of forces in more detail.

contact force
a type of force that acts on objects that come into direct contact with each other (e.g. friction force, drag force)

non-contact force
a type of force that act on objects without coming into contact with them (e.g. gravitational force)

Contact forces

Most of the forces encountered during sport and physical activity are contact forces. This is because every sport involves some kind of contact between objects and bodies.

There are many different contact forces. Six of the most common forces are introduced in Source 3.

ground reaction force
a type of contact force exerted by the ground on a body or object that is in contact with it

joint reaction force
a type of contact force that is generated by two bones acting on each other across a joint

friction force
a type of contact force that is generated by the surface of an object rubbing against the surface of another object

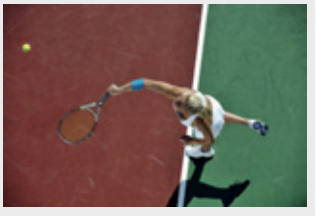
drag force
a type of contact force that is generated by a fluid (e.g. air or water) opposing the movement of an object

inertial force
a type of contact force that is generated by a resistance to change in the velocity of an object

velocity
a measure of the distance and direction an object travels over time taken (e.g. 30 kilometres per hour north)

speed
a measure of the distance an object travels over time (e.g. 30 kilometres per hour)

elastic force
a type of contact force that is generated by the resistance of an object to change shape

Type of contact force	Description	Example	
Ground reaction force	A force exerted by the ground on a body or object that is in contact with it	A person standing still on the ground is exerting a contact force on it that is equal to the person's weight. At the same time, an equal and opposite ground reaction force is exerted by the ground on the person.	
Joint reaction force	A force that is generated by two bones acting on each other across a joint	A volleyball player jumping to spike the ball places pressure on their knee joints during take-off. The upper and lower leg bones push against each other through the cartilage in the knee and generate a joint reaction force.	
Friction force	A force that is generated by the surface of an object rubbing against the surface of another object	A lawn bowl travelling across a bowling green slows down as it approaches the jack. This is because the surface of the bowl is rubbing against the surface of the green. This slowing is due to friction force.	
Drag force	A force that is generated by a fluid (e.g. air or water) opposing the movement of an object	As a freestyle swimmer moves their body through the water, they are being slowed down by the contact between their body and the water. As their arms move through the air to complete each stroke, they are also being slowed down by the air. This slowing effect is due to drag force.	
Inertial force	A force that is generated by the resistance to change in the **velocity** of an object	A rugby league player who is tackled while running at full **speed** drops the ball on impact. The ball continues to move forward due to inertial force.	
Elastic force	A force that is generated by the resistance of an object to change shape	A tennis ball that is hit hard during a serve is instantly deformed as it absorbs the impact from the racquet. The ball returns to its original shape due to elastic force.	

SOURCE 3 The six most common contact forces include: ground reaction force; joint reaction force; friction force; drag force; inertial force; and elastic force.

An example of how force can be used to increase the effectiveness of training and proper technique is discussed in the Theory in action below.

Theory in action How swimmers use drag force for training

While minimising drag force is critical when competing, some swimmers prefer to train with equipment and/or conditions that create small amounts of drag. For example, a swimmer might practise without a swimming cap or without shaving to create resistance and increase the difficulty of the workout.

Other more extreme examples include training while towing a parachute-like object (see Source 4), wearing a drag suit or simply swimming in boardshorts! When competition time approaches, swimmers switch back to a minimal drag routine and move faster in the water.

The research suggests that drag suits, while a valuable training tool, are best used for shorter, higher intensity sets, and that ample rest time is important to allow swimmers to maintain proper technique and form. Any drag equipment should be used sparingly and as just one part of a training regime to increase speed and improve technique.

SOURCE 4 Swimmers can use drag force during training to improve their strength and technique. Increasing drag force can be achieved in a number of ways, including wearing a special drag suit or using equipment such as a swim parachute.

Non-contact forces

Although the majority of the forces experienced by athletes during sport and physical activity are contact forces, there are also a small number of non-contact forces acting on athletes. The most important of these is introduced in Source 5.

Type of non-contact force	Description	Example
Gravitational force	A force that attracts a body or object towards the centre of the Earth (or towards any other body that has **mass**)	Gravitational force gives every person on Earth their **weight**. When a gymnast applies their weight to the ground, the ground responds by applying a ground reaction force that propels them into the air during a routine.

SOURCE 5 The most common non-contact force in sport and physical activity is gravitational force.

gravitational force
a non-contact force that attracts a body or object towards the centre of the Earth (or towards any other body that has mass)

mass
a measure of how much matter (i.e. particles and atoms) there are in a body or object

weight
a measure of how much gravitational force is pulling on a body or object

FOR THE RECORD!

Weight and mass are not the same thing!

Weight is a measure of how much gravitational force is pulling on an object.

Mass is a measure of how much matter (i.e. particles and atoms) there are in an object.

On the Moon, a human body would have the same mass (in kilograms) as it has on Earth, but a much lighter weight (in newtons). That's because weight is a measure of force and the gravitational force of Earth is much higher than the gravitational force of the Moon.

On Earth
Gravitational force = 9.8 m/s²
Mass: 100 kg
Weight: 980 N

On the Moon
Gravitational force = 1.6 m/s²
Mass: 100 kg
Weight: 160 N

Forces in action

For any movement to occur in a sport or physical activity, the internal force applied by an athlete needs to be greater than the sum of the external forces acting on their body. For example, in order to change direction quickly to avoid an opponent, a footballer needs to generate enough internal force to overcome the external forces acting against them. These include contact forces (such as ground reaction force and friction force), as well as non-contact forces (such as gravitational force).

Using the same logic, a long jumper will jump further by generating enough internal force to accelerate to the board faster and apply a greater force on take-off, than if they were to run slowly to the board and apply less force on take-off.

Gravity is a constant external force acting on the human body. As a result the body adapts to it in every action it completes. While gravity can serve to restrict our movement in some circumstances, there are many occasions where the force of gravity acting upon us enhances our performance.

For example, in the case of friction force between a foot and the ground, the downwards force of gravity gives athletes their weight. The body applies this weight force to the ground and the ground responds by exerting a ground reaction force up on the body. Friction force is directly proportional to the ground reaction force, and this provides the grip that enables athletes, such as sprinters, to propel themselves forward when running.

SOURCE 6 Internal and external forces are acting on a sprinter's body in order to enable movement.

3.6 Check your learning

Engage and understand

1 In your own words, **define** the term 'force'.

2 **Explain** the key features of an internal and external forces. Provide an example of each at work in your selected physical activity.

Analyse and apply

3 Source 7 shows a basketball player preparing to perform a jump shot. **Analyse** the image and explain where the following contact forces are occurring.
   - **a** ground reaction force
   - **b** joint reaction force
   - c elastic force

4 'How swimmers use drag force for training' provides an example of how drag force can be used in the pool to enhance training. **Determine** how contact and non-contact forces could be used in your selected physical activity to enhance training and optimise performance. Provide three examples and include simple diagrams if required.

Evaluate and justify

5 **Assess** how force has an impact on your performance in your current sport.

6 **Propose** recommendations to modify any aspect of the specialised movement sequences within your sport based on optimising the use of force in your performance (e.g. consider friction force and drag force). What changes can you make to optimise the impact of these forces on you or your equipment? Remember that specialised movement sequences are comprised of phases and sub-routines which can be analysed to refine technique.

SOURCE 7 A basketballer about to perform a jump shot.

Check your obook assess for the following additional resources and more:

- **» Student book questions** 3.6 Check your learning
- **» Student worksheet** 3.6 Force worksheet
- **» Interactive** Introduction to forces
- **» Weblink** Force in sport

3.7 Force production

That's a goal!

By the end of Section 3.7, you should be able to:

→ **define** the term 'force production'

→ **define** the terms 'summation of force', 'momentum' and 'impulse' and **explain** how they work together to affect force production

→ **synthesise** primary data relating to the impact of the summation of force on a specialised movement sequence in your selected physical activity

→ **develop** techniques to improve force production in your selected physical activity.

Defining force production

force production
a general term used to describe the ability of the body to produce internal force (i.e. movement) in order to overcome one or more external forces (e.g. gravitational force, drag force, friction force etc.)

momentum
a term used to describe the tendency of a moving object to continue moving (in a straight line); the mass (e.g. in kilograms) of an object multiplied by its velocity (e.g. metres per second)

summation of forces
a term used to describe the sequential combination of forces produced by different parts of the human body acting together to maximise force production

impulse
a term used to describe the change in momentum that occurs over time when force is applied to an object

Force production is a general term used to describe the ability of the body to generate internal force (i.e. movement) against an external force (i.e. resistance). The ability of the body to produce force is one of the most defining aspects of being alive. It is also an essential part of every type of sport and physical activity.

It's important to note, however, that most sports require athletes to not only produce force, but also to control it. For example, in sports where success is measured in terms of achieving the greatest distance or speed (e.g. shot put, weight lifting, or swimming), it can be beneficial for athletes to produce as much force as possible. However, in sports where success is measured in terms of achieving the greatest accuracy (e.g. lawn bowls, archery, or darts), it can be beneficial for athletes to carefully control the production of force.

Internal force production also needs to be balanced with a number of other, external factors. In fact, force production is often the combined result of a number of different biomechanical concepts. These include:

- **momentum**
- **summation of forces**
- **impulse**.

We will now look at each of these concepts in more detail.

Momentum

Momentum is a term used to describe the tendency of any object in motion to continue moving. In other words, it is a measure of the quantity (i.e. amount) of motion that an object possesses.

The momentum of any object (measured in kilogram metres per second) is equal to the mass (measured in kilograms) of an object multiplied by its velocity (measured in metres per second). It can be expressed as:

momentum (p) = mass (m) × velocity (v)

or

$p = mv$.

SOURCE 1 Momentum is a measure of the quantity (i.e. amount) of motion that an object possesses. Each of the sprinters competing in this race has a certain mass and a certain velocity. This makes it possible to calculate their momentum.

If an object has zero velocity (i.e. it is not moving), then it has zero momentum. The higher the mass and the higher the velocity, the greater the momentum.

For example, each of the sprinters competing in a race (see Source 1) has a certain mass and a certain velocity, making it possible to calculate their momentum (see Source 2).

Sprinter	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)
Lane 3	55	10	550
Lane 4	50	9	450
Lane 5	60	10	600
Lane 6	65	9	585

SOURCE 2 The higher the mass and the higher the velocity, the greater the momentum. Based on the mass and velocity of each sprinter, the athlete in lane 6 has the greatest momentum (i.e. 600 kg m/s).

While the example above is useful to illustrate how momentum can be calculated, in many ways it is not that relevant to the performance or outcome of the race because the real goal is to reach the finish line first. However, there are many sports in which momentum can have a significant impact on the result. For example, in sports such as rugby league, ruby union and Australian football, where impact and collision situations (e.g. in the form of tackles) are part of the game, momentum plays an important role in the performance of individual athletes and the overall result.

SOURCE 3 In sports such as rugby union, collision situations (in the form of tackles) are a big part of the game. As a result, momentum plays an important role in the performance of individual athletes and often influences the overall result.

conservation of momentum
a biomechanical principle (i.e. law) that states that momentum cannot be lost. Instead, whenever two objects collide, their combined momentum will be the same after the collision as it was before

Conservation of momentum

Energy can only be transferred or changed from one form to another. **Conservation of momentum** is a similar principle (i.e. law) that states that momentum cannot be lost. Instead, whenever two objects collide, their combined momentum will be the same after the collision as it was before (i.e. it will be conserved).

For example, in ten-pin bowling, when a bowling ball travels down the lane towards the pins it does so with a certain momentum (i.e. the product of its mass and velocity). By contrast, the pins at the end of the lane have zero momentum because they are not moving (i.e. they have zero velocity).

SOURCE 4 Conservation of momentum is a biomechanical principle (i.e. law) that states that momentum cannot be lost – instead, it is just transferred from one object to another. Here, momentum is transferred from the bowling ball to the pins.

According to the principle of conservation of momentum, the quantity of momentum possessed by the bowling ball before the collision will be the same as the total momentum after the collision. Instead of being lost, some of the momentum will simply be transferred to the pins at the point of collision. As a result of the collision, the pins move – increasing their velocity and gaining momentum. At the same time, the bowling ball slows down – decreasing velocity and losing the exact same amount of momentum. Overall, the momentum remains the same (i.e. is conserved).

Summation of forces

Summation of forces is a term used to describe the sequential combination of forces produced by different parts of the human body acting together to maximise force production. In other words, when a person is moving their body or an object, several different parts of the body all act together (in a particular order) to maximise the force that is being produced and/or being transferred to the object.

Elite athletes in all sporting disciplines spend years practising the relevant range of movements required to perform specialised movement sequences in their chosen sports. This practice helps to ensure their timing and the order of the various sub-routines is efficiently transferring appropriate force to perform the movement sequence.

FOR THE RECORD!

The terms **force** and **momentum** are sometimes used interchangeably, but they're not the same!

- **Force** = the mass of an object multiplied by its **acceleration**
- **Momentum** = the **mass** of an object multiplied by its **velocity**

SOURCE 5 The summation of forces generated by all parts of the body allows long jumpers to propel themselves further through the air.

Simultaneous summation of force

In some sports and physical activities, producing the greatest amount of force possible is the goal. For example, athletes competing in events such as long jump or high jump aim to produce maximal force and use it to propel themselves as far or as high as possible. They do this by harnessing the power of almost every part of their body at the same time to maximise force production. This is referred to as simultaneous summation of force.

Sequential summation of force

In other sports and physical activities, producing smaller, more controlled amounts of force is the goal. For example, a netball or basketball player shooting to score will aim to produce a carefully controlled amount of force to propel the ball with high accuracy. They do this by primarily using their arms, with their wrists and fingers used to make fine accuracy adjustments to shoot the ball. This is referred to as **sequential summation of force**.

In reality, summation of forces occurs when all body parts act together sequentially rather than simultaneously (see Source 6). Generally, the strongest and lowest body parts around the **centre of gravity** (such as the torso and thighs) move first, followed by the weaker, lighter and faster extremities (such as arms, hands and fingers). This process helps to maximise force by transferring momentum and energy from one body part to another.

centre of gravity
the central point of an object, around which all of its weight is evenly distributed and balanced

Summation of force is influenced by a number of factors. These include:

- **the number of body parts used in the movement** – e.g. using as many body parts as possible enables force to be generated over a greater time
- **the order and timing of the body parts involved in the movement** – e.g. activating the stronger and larger muscles first, and weaker, lighter muscles last
- **the force and velocity generated** – e.g. transferring momentum from one body part to another when it is at its maximum velocity
- **the way in which the body and each body part is stabilised and balanced** – e.g. ensuring that a stable base for maximal **acceleration** of body parts is present so that momentum can be transferred successfully from one body part to another.

acceleration
a measure of how quickly or slowly the velocity of an object changes over time

1	2	3	4	5
Discus rotated far behind the body to generate maximum momentum.	Bent legs store force to be transferred to the upper body.	Trunk rotates forward, having received momentum from the leg muscles.	Left arm pulls back and locks in place, stabilising the upper body so momentum can be transferred to the throwing arm.	Throwing arm and hand rotates around the body in a whip-like motion, having received all the transferred momentum from each of the previously moving body parts.

SOURCE 6 A discus thrower combines the force generated in their legs, torso and arms to maximise the force they can apply to propel the discus as far as possible. This is referred to as sequential summation of force.

A discus thrower, for example, will use the larger muscles in their legs, followed by their torso muscles, upper arm muscles and finally their forearm and hand muscles to release the discus. The successful generation of maximum force requires that each of these body parts transfers its force to the next body part through the use of stabilisation. The order and timing of each body part's force production is crucial for the successful summation of force. For best results, movement begins with the larger, slower body parts and finishes with the smaller, faster body parts.

SOURCE 7 Force production is maximised when body parts generate and produce force sequentially, from the legs through to the hand. This is known as summation of forces and relies on the order and timing to be correct in order to maximise force.

STUDY TIP

Data is key!

As you analyse and develop your specialised movement sequences using biomechanical principles, be sure to record and document your progress.

- Record the changes you are making to the phases and sub-routines within the sequences.
- Make notes of all the techniques you have tried and compare them to your optimised technique.
- Write a brief description of how one or more biomechanical principles have helped to optimise your specialised movement sequence.
- Include specific examples, images and/or video recordings from your performances to demonstrate how your overall movement strategies have been optimised as a result of this process.

Impulse

Impulse is a term used to describe the change in momentum that occurs over time when force is applied to an object. In order to change the momentum of an object, a force needs to be applied over a certain period of time. In other words, the impulse of an object is the measurable change in the quantity of momentum over time.

Impulse (measured in newton seconds) is equal to the force applied to an object (measured in newtons) multiplied by the length of time that it was applied (measured in seconds). It can be expressed as:

Impulse (I) = force (F) × time (t)

or

$I = Ft$.

SOURCE 8 Impulse is a term used to describe the amount of force needed to change the momentum of an object. A hockey player can use an understanding of impulse when performing a push pass to generate more momentum by keeping the ball in contact with their stick for longer.

An understanding of impulse in sport and physical activity can be useful because by considering both force and time, an athlete can either minimise or maximise the transfer of momentum.

It is important to understand that the amount of force needed to change the momentum of an object varies depending on the amount of time that the force is applied to it. A small force applied over a long period of time can be just as effective as a large force applied over a short period of time. For example, in a game of hockey, a player performing a push pass generates more velocity and momentum on the ball the longer the ball stays in contact with their stick.

SOURCE 9 Some sporting techniques use impulse to reduce the amount on force of an object by increasing the time over which the force is working. Soccer players often use this technique when receiving chest passes.

Shot-putters and discus throwers also increase the time over which they apply force to their implements by using techniques (e.g. rotational technique or glide technique) that result in greater impulse being applied and a greater velocity on release.

In some striking and fielding sports, such as baseball and cricket, the time the bat is in contact with the ball is very brief. In these situations, in order to increase the amount of force transferred from the bat to the ball (i.e. in order to make it travel as far or as fast as possible), the batter can follow through to increase the contact time between bat and ball.

Alternatively, some sporting techniques use impulse to reduce the amount of force on a ball by increasing the time over which the force is working. Soccer players often move their bodies in the same direction as the ball when receiving chest passes. This reduces the force on the ball by increasing the time that the force is applied. This process results in the ball dropping to ground rather than bouncing off them.

PERFORMANCE | SKILL DRILL 3.7 | Evaluate the impact of summation of forces on force production

>> Turn to pages 336–337 to complete this integrated physical performance activity.

3.7 Check your learning

Engage and understand

1 **Identify** the missing words to complete this paragraph:
When forces are created sequentially by body parts it is known as _____.
Force and _____ are closely related. Momentum is the product of _____ and _____.
In order for the momentum generated by a body part to be transferred to another body part or to an external object, _____ must occur. _____ is the application of force over time. The greater the _____ and _____, the greater the change in momentum.

2 In your own words, **explain** the biomechanical terms 'force' and 'momentum'.

3 **Describe** the relationship between momentum, summation of forces and impulse in terms of force production. Use examples from your selected physical activity to illustrate this relationship.

Analyse and apply

4 **Identify** one specialised movement sequence from your selected physical activity.
   - **a** **Determine** the body parts used (and the order in which they are used) to produce the desired level of force to complete the skill (i.e. from start to finish).
   - **b** **Create** a simple graph (similar to Source 7) to show the order, timing and relative contribution of each body part to the total quantity of force produced.

Evaluate and justify

5 Cricket bats come in different weights to suit the needs of different players. Assuming Player A and Player B below are the same mass and hit the ball with the same force, identify which player has the potential to gain maximum momentum on the cricket ball:
   - Player A uses a 1.27 kg bat
   - Player B uses a 1.04 kg bat

   Justify your position in a 150- word response.

6 **Critique** the body position of the discus thrower shown in Source 10. Assess how effectively they appear to be applying the principle summation of forces. Make reference to the engagement and sequencing of body parts in your response.

SOURCE 10 A discus throw requires the summation of forces to propel the discuss forward.

7 When performing a spike in volleyball, a player makes a fist and hits at the ball with a short swinging action. **Evaluate** this player's technique. **Justify** changes to their technique, referring to the principle of impulse.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  3.7 Check your learning
- **» Skill Drill worksheet**
  3.7 Evaluate the impact of summation of forces on force production
- **» Video weblink**
  Strength versus force production
- **» Weblink**
  Summation of forces

3.8 Motion

That's a goal!

By the end of Section 3.8, you should be able to:

→ **define** and differentiate between the four types of motion – linear, curvilinear, angular and general

→ **analyse** primary data to evaluate personal acceleration rates

→ **justify** modifications to personal performance based on motion concepts.

Defining motion

motion
the action or process of moving or being moved; more specifically, the change in position of an object over time

Motion is the action or process of moving or being moved. To be more precise, it refers to the change in position of an object over time.

The study of motion – and the forces that contribute to this – is one of the key areas of biomechanics. For motion to occur in any object, a force must be applied to that object. This can be an:

- internal force – i.e. a force that is generated inside the body (e.g. movements and reactions that are the result of muscles inside the body contracting and relaxing to pull on tendons and joints)
- external force – i.e. a force that is generated outside the body or is the result of an interaction between the body and the external environment (e.g. gravity, resistance from the air or water, contact with other objects or people).

Motion is one of the most fundamental elements of sport and physical activity. Every sport on Earth involves motion of some kind – whether your sport involves the motion of bodies or implements (i.e. sporting equipment) or both.

Types of motion

linear motion
any movement that happens along a straight line

curvilinear motion
any movement that happens along a curved line

angular motion
any movement that happens along a circular line around an axis (i.e. central point)

general motion
any movement that combines linear motion and angular motion

There are four main types of motion. They are:

- **linear motion**
- **curvilinear motion**
- **angular motion**
- **general motion**.

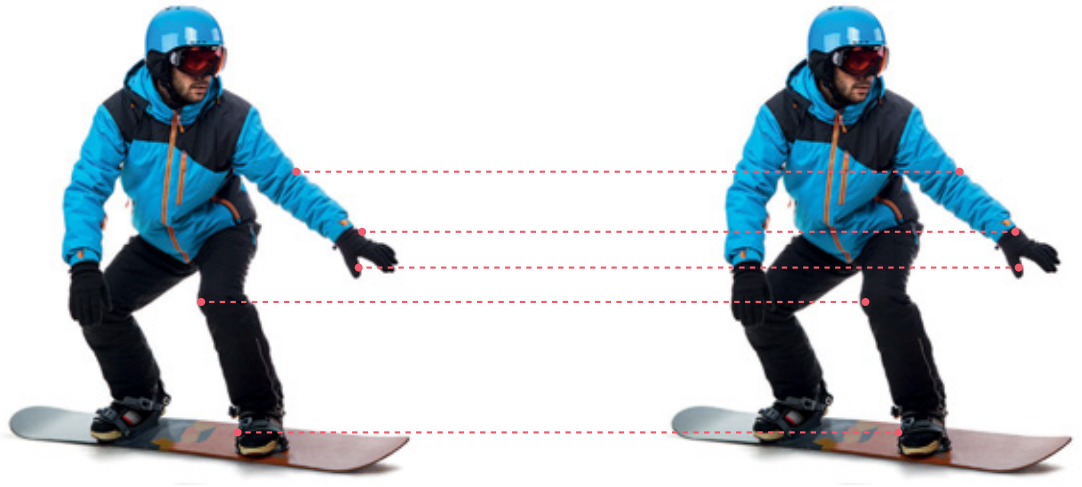
We will now look at each of these in more detail.

Linear motion

Linear motion is any movement that happens along a straight line.

Linear motion is the most basic of all types of motion. In order to be truly considered linear motion, all parts of the object (e.g. a human body) must be moving in the same direction at the same time such that if lines were drawn connecting each body part at the start of motion to the same body part at the end, the lines would all be the same length (as shown in Source 1).

A snowboarder moving down a mountain slope in a straight line holding a set position is moving in linear motion.



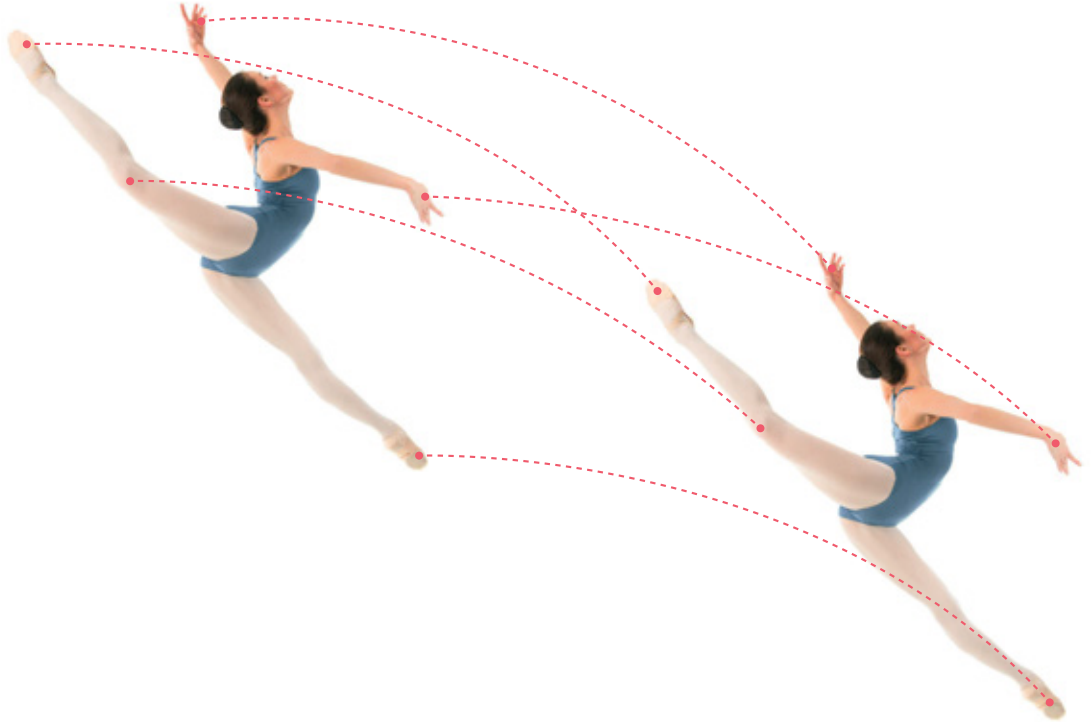
SOURCE 1 Linear motion is any movement that happens along a straight line. A snowboarder moving down a mountain slope in a straight line holding a set position is an example of linear motion.

Curvilinear motion

Curvilinear motion is any movement that happens along a curved line. In order for motion to be considered truly curvilinear, all parts of the object (e.g. a human body) must be moving in a curved line in the same direction at the same time.

Image a ballet dancer completing a grand jeté (split leap). As the dancer returns to the ground, she holds a set position, however the momentum of her body combined with the effects of gravitational force pulling her back towards the ground result in a curved line (see Source 2). This is an example of curvilinear motion.

The natural arc of a tennis ball as it travels through the air after being lobbed is another example of curvilinear motion.



SOURCE 2 Curvilinear motion is any movement that happens along a curved line. A ballet dancer completing a leap is an example of curvilinear motion.

SOURCE 3 A gymnast swinging around a high bar performing a giant swing is an example of angular motion.

Angular motion

Angular motion is any movement that happens along a circular line around an axis (i.e. central point) at the same angle, in the same direction, at the same time.

The axis around which angular motion occurs can be:

- internal – such as an arm rotating around the shoulder joint (i.e. axis) in a large circular 'windmill' movement
- external – such as a gymnast rotating around a high bar (i.e. axis) during the execution of a giant.

Implements such as balls can also possess angular motion if they are spinning.

General motion

General motion is any movement that combines linear motion and angular motion.

When an athlete moves their body to create motion, they are creating angular motion. This is because their arms and legs are all moving along a circular line around an axis (i.e. all of the joints in their body).

Although an athlete sprinting in a straight line appears to be travelling in linear motion; their arms and legs are travelling in angular motion. In other words, the sprinter is using a combination of linear and angular motion and is therefore an example of general motion.

Implements such as balls can also combine linear and angular motion in this way. A cricket ball bowled with a fast pace to a batter spins as it flies. As the ball is moving forward in a straight line while simultaneously pivoting on its own internal axis, it is also an example of general motion.

SOURCE 4 General motion is any movement that combines linear motion and angular motion. A sprinter taking part in a race is an example of general motion. Her arms and legs rotate in angular motion, propelling her forwards in linear motion.

Describing and measuring types of motion

When investigating different types of motion, researchers and sports scientists need to use a common language to describe qualities of different types of motion. They also need a common system with which to measure (i.e. calculate) them.

The most common concepts used to describe and measure different types of motion are listed in Source 5. An understanding of these concepts will help you to describe different types and qualities of motion accurately – both in your own performances and the performances of other athletes.

Concept	Definition	Formula	Unit of measure
Speed	A measure of the distance an object travels over time (e.g. 30 kilometres per hour)	$speed = \frac{distance}{time\ taken}$	Measured in metres per second (m/s) or kilometres per hour (km/h)
Velocity	A measure of the distance and direction an object travels over time (e.g. 30 kilometres per hour, due north)	$velocity = \frac{displacement}{time\ taken}$	Measured in metres per second (m/s) or kilometres per hour (km/h) usually with a direction or compass bearing attached
Acceleration	A measure of how quickly or slowly the velocity of an object changes over time	$acceleration = \frac{change\ in\ velocity}{time\ taken}$ $acceleration = \frac{final\ velocity - initial\ velocity}{time\ taken}$	Measured in metres per second squared (m/s/s)
Displacement	A measure of the distance and direction travelled between a starting point and an end point 'as the crow flies'	–	Measured in metres (m) or kilometres (km), often with compass direction
Distance	A measure of the length of space between two points	–	Measured in metres (m) or kilometres (km)

SOURCE 5 Common concepts used to describe and measure different types of motion

Motion concepts in action

We will now look at how these concepts are used to describe and measure motion. Because real-life sporting situations often involve the combination of different types of motion all taking place simultaneously, the concepts used to describe and measure them are all interrelated. The examples below are designed to illustrate this.

displacement
a measure of the distance and direction travelled between a starting point and an end point 'as the crow flies'

distance
a measure of the length of space between two points

Speed and velocity

As mentioned, speed describes how quickly an object is moving while velocity describes how quickly an object is moving in a certain direction. For example:

- the speed and velocity of a cricket batter running one run will be the same
- the speed and velocity of a cricket batter running two runs will be different.

The reason for this is the final position of the batter. A single run means they finish at the opposite end of the pitch (i.e. a different start and end point). The displacement here would be about 20 metres. Two runs means they return to the where they started (i.e. same end and start point). The displacement here would be zero.

In other words, speed and velocity are equal only if movement occurs in a straight line. The difference is movement is not in a straight line. That is because velocity also measures displacement.

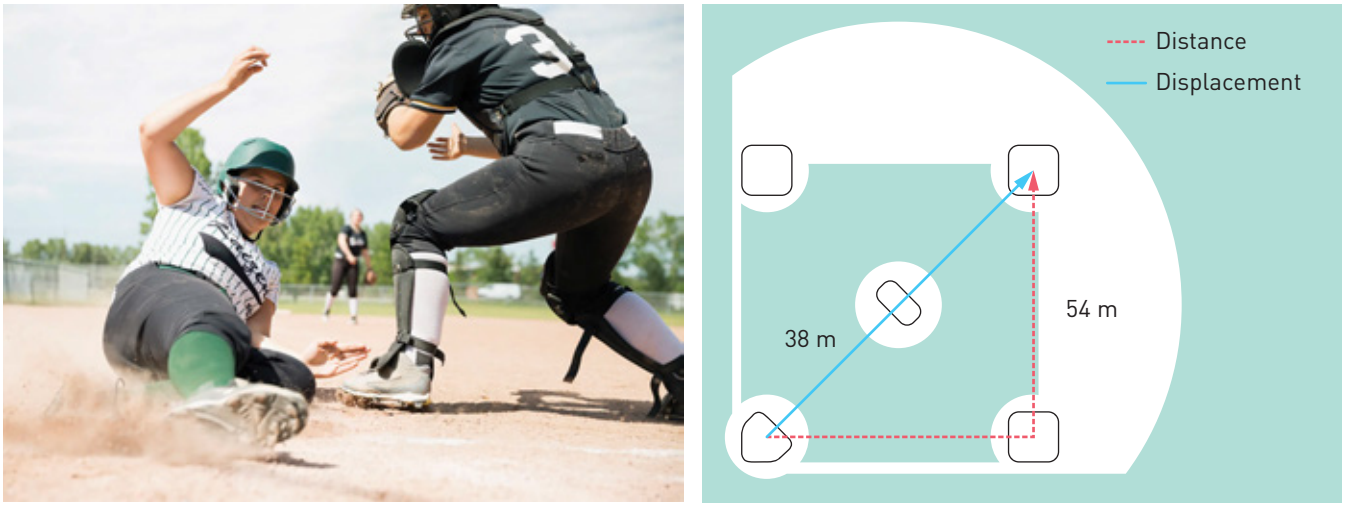
Distance and displacement

As mentioned, **distance** describes the length of space between two points, while **displacement** describes the distance travelled between a starting point and an end point 'as the crow flies'.

In a related example (see Source 6):

- a baseball player running from home to second base will travel a distance of approximately 54 metres (i.e. from home, through first base to second base)
- the same baseball player will have a displacement of 38 metres (i.e. cutting across the diamond straight from home to second base).

This difference in distance and displacement also has an effect on the player's speed and velocity. Their speed will take into account the distance they have travelled over time, while their velocity will take into account their distance and direction travelled over time; that is, their displacement.



SOURCE 6 When a baseball player runs from home to second base, their speed and velocity will differ. This is because speed is a measure of distance travelled over time, while velocity is a measure of distance travelled over time in a specific direction (i.e. the displacement).

Acceleration

As mentioned, acceleration refers to how quickly an object gains speed. In most sports, athletes need to be able to increase and decrease speed rapidly. For example:

- a rugby league player carrying the ball needs to accelerate quickly (i.e. build up as much speed as possible in a short amount of time) in order to cover ground and make it difficult to be tackled

- a basketball player on a fast break needs to both accelerate quickly in order to cover the distance to the hoop and then decelerate quickly in order to take the shot and avoid overshooting the edge of the court and running into the courtside obstacles.

These are examples of linear acceleration and linear deceleration.

FOR THE RECORD!

In 2009, Jamaican sprinter Usain Bolt ran the 100 metres sprint in a world record time of 9.58 seconds.
During the race:

- his top speed was 44.72 km/h
- his average speed was 37.58 km/h
- his acceleration (i.e. from 0 to 40 km/h) was faster than the average car!

3.8 Check your learning

Engage and understand

1 **Define** the following terms:
   - **a** speed
   - **b** velocity
   - c displacement
   - **d** acceleration.

2 **Describe** what must happen for motion to occur.

Analyse and apply

3 Identify four skills or specialised movement sequences from your selected physical activity and use the table to **analyse** the type (or types) of motion required to successfully complete each one.

	Skill 1	Skill 2	Skill 3	Skill 4
Linear motion				
Curvilinear motion				
Angular motion				
General motion				

Evaluate and justify

4 **Evaluate** your acceleration in your current sport. Are you able to produce sufficient acceleration appropriate for the situations within your sport? **Justify** your response with examples.

5 **Propose** recommendations for modifications you could make to improve your acceleration in your current sport.

Check your obook assess for the following additional resources and more:

- **» Student book questions** 3.8 Check your learning
- **» Student worksheet** 3.8 Motion worksheet
- **» Video weblink** Speed versus velocity
- **» Weblink** Types of motion

3.9 Newton's laws of motion

That's a goal!

By the end of Section 3.9, you should be able to:

→ **identify** and **explain** Newton's three laws of motion

→ **identify** and **explain** the force pairings in your selected physical activity

→ **identify** how force, mass and acceleration work together in your selected physical activity.

Newton's first law of motion
a fundamental law of the physical world; this law states that an object will remain at rest or maintain a constant velocity unless an external force acts on it; also referred to as the law of inertia

Newton's second law of motion
a fundamental law of the physical world; this law states that the force required to accelerate an object at a given rate is proportional to the product of that acceleration and the mass of the body; also referred to as the law of acceleration

Newton's third law of motion
a fundamental law of the physical world; this law states that whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first object; also referred to as the law of action and reaction

inertia
the tendency of an object at rest to remain at rest or of an object in motion to stay in motion (in a straight line) unless acted on by an external force

Defining Newton's laws

Sir Isaac Newton – an English mathematician, physicist, astronomer, theologian and author – developed a number of important theories that laid the foundations for modern physics. These include the law of universal gravitation (proposed in 1666) and the three laws of motion (proposed in 1686). These laws describe the relationship between objects and the forces acting upon them – as well as the responses of objects to those forces.

Newton's three laws of motion are as relevant and useful today as they were when they were first proposed. In the context of sport and physical activity, they can help us to understand the properties of moving objects in order to optimise the performance and execution of different skills. They include:

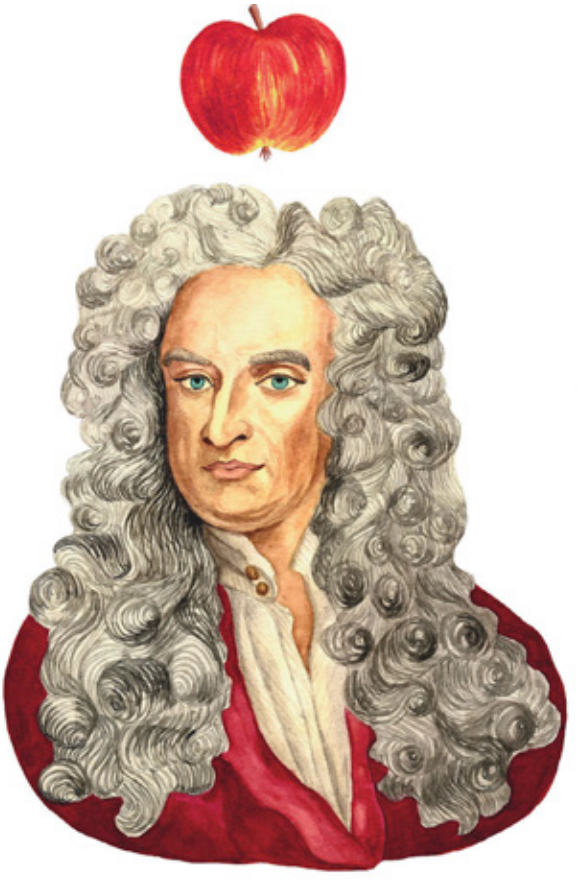
- **Newton's first law of motion** – commonly known as the law of inertia.
- **Newton's second law of motion** – commonly known as the law of acceleration.
- **Newton's third law of motion** – commonly known as the law of action and reaction.

Newton's first law of motion – inertia

Newton's first law of motion states:

> 'A body continues in a state of rest or uniform velocity unless acted upon by an external force.'

In other words, an object will either stay still or stay moving (at a constant speed in the same direction) unless an external force acts on it. This state of rest or constant velocity is referred to as **inertia**.



SOURCE 1 Sir Isaac Newton (1642–1726) was an English scientist who proposed a number of important theories that laid the foundations for modern physics. These included the law of universal gravitation and the three laws of motion.

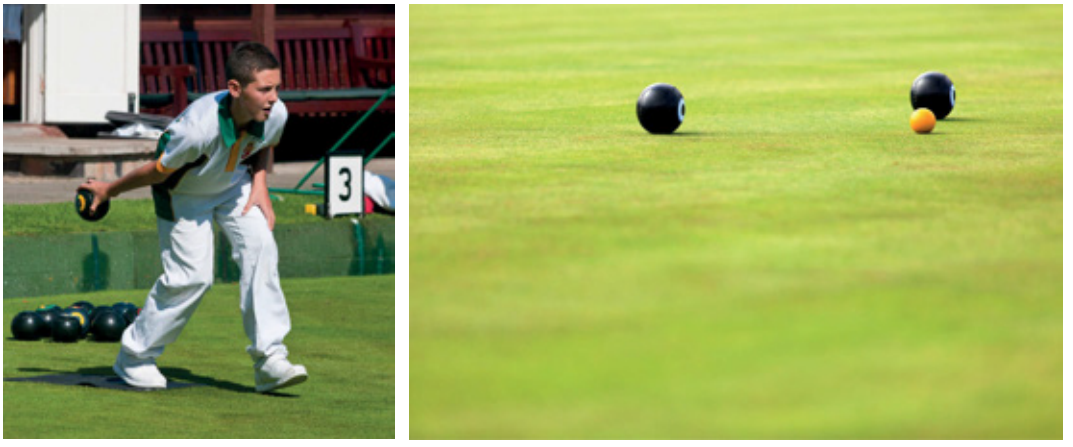
According to Newton's first law:

- a lawn bowls 'jack' (white target ball) will sit stationary on its mark unless an external force acts on it to make it move (e.g. the force of a bowl [biased black ball] hitting it)
- a soccer ball that has been kicked and is rolling along the ground will continue to move at a constant speed and in a straight line unless an external force acts on it to slow it down (e.g. frictional force from the grass) or change its direction (e.g. a teammate taking possession)

In sport, forces such as gravitational force, drag force and friction force are constantly acting on objects. This means people and objects that are in motion will always eventually slow down or change direction.

To overcome inertia and commence movement, athletes are usually required to apply a force through the use of their muscular system. The more force the muscles generate, the greater the change in movement that occurs. An athlete crouched in starting blocks ready for their 100 metre race will need to apply a strong force to overcome the inertia acting upon them and propel themselves forward once the gun fires. A defender trying to keep an opponent covered on the court will, similarly, apply muscular force to accelerate, decelerate and change direction in response to the opponent's movement.

Newton's second law of motion – acceleration



SOURCE 2 According to Newton's first law of motion, a ball will remain at rest (left) or remain moving at a constant velocity (right) unless it is acted on by an external force.

Newton's second law of motion states:

'When a force acts on an object, the acceleration experienced by the object is proportional to the size of the force and takes place in the direction in which the force acts.'

In other words:

- the acceleration of an object will be directly proportional to the amount of force applied to it (i.e. they will both increase at the same ratio)
- the acceleration of an object will be inversely proportional to the mass of the object (i.e. as one increases, the other will decrease at the same ratio).

FOR THE RECORD!

Newton's law of universal gravitation, proposed in 1666, was one of the first theories to explain the effects of gravity on bodies and objects. According to one of the most famous stories in the history of science, Newton – who was 23 years old at the time – was sitting in his garden when an apple fell from a tree onto his head. In a stroke of brilliant insight, he suddenly came up with the theory of gravity.

While Newton himself stated that the falling apple gave him inspiration for his work on gravity, there is no evidence to suggest it actually fell on his head!

acceleration
a measure of how quickly or slowly the velocity of an object changes over time

Acceleration is a measure of how quickly or slowly the velocity of an object changes.

This means that if a large force is applied to an object with a small mass (e.g. a tennis racquet hitting a tennis ball) it will produce a larger or faster acceleration. If the same force is applied to an object with a larger mass (e.g. a tennis racquet hitting a basketball) it will produce a smaller or slower acceleration.

This law can be expressed as the equation:

- Force (F) = mass (m) × acceleration (a)

  or
- $F = ma$.

SOURCE 3 According to Newton's second law of motion, an object will accelerate at a rate proportional to the amount of force applied to it.

This means that as the force acting on an object increases, the acceleration of that object will increase. It also means that as the mass of an object increase, the acceleration of that object decreases.

Newton's second law is useful because it allows performances to be analysed scientifically. If the mass of an object is known and the rate of acceleration is known, then the force can be calculated. Likewise, if the mass of an object is known and force applied is known, then the acceleration can be calculated.

According to Newton's second law:

- the force exerted on a golf ball during a drive is equal to the mass of the ball (i.e. 0.046 kg) multiplied by the rate of acceleration of the ball (i.e. around 150 000 m/s/s):

$F = 0.046 \times 150\,000$

$F = 6900$ N.

That's equivalent to the weight of around 703 kg being applied to the ball on impact.

Newton's third law of motion – reaction

Newton's third law of motion states:

'For every action there is an equal and opposite reaction.'

In other words, whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first object. In this way the forces are paired – equal in size and opposite in direction.

According to Newton's third law, when a high jumper approaches the bar, they apply a force to the ground and the ground applies a force equal and opposite to the jumper, propelling them into the air.

Although forces always act in pairs and are equal in size, the result on each object is not always the same. For example, when a softball bat hits a ball, it applies a force to that ball. The ball, in turn, applies a force that is equal and opposite to the bat, which is felt and absorbed through the athlete's hands and arms. In this example, the ball moves a great distance but the bat doesn't really slow down that much. The relative effect on the ball is much greater than on the bat. This is due to the difference in mass of each object and the momentum of the bat at the point of impact.

SOURCE 4 According to Newton's third law of motion, one object exerts a force on a second object, and the second object exerts an equal and opposite force on the first object but the result on each object is not the same.

3.9 Check your learning

Engage and understand

1 **Identify** Newton's three laws of motion and **explain** each one in your own words.

2 **Explain** why an object does not 'continue moving at the same speed and in the same direction' indefinitely on Earth.

3 According to Newton's second law of motion, the force produced is a product of two variables. **Identify** both variables.

Analyse and apply

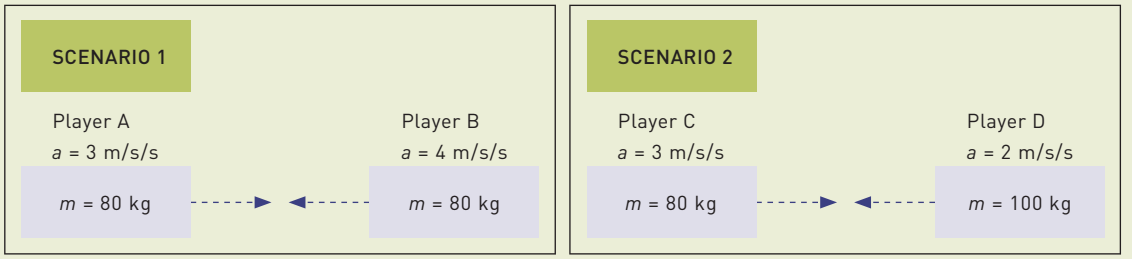
4 With reference to Newton's third law of motion, **determine** as many paired forces as you can from your selected physical activity. For example: 'When I take off to move, my foot applies a downwards and backwards force to the ground. In response, the ground pushes forwards and upwards on my foot.'

5 **Compare** the concepts of velocity and acceleration. Explain the difference between velocity and acceleration when throwing a 400 g and 600 g javelin.

Evaluate and justify

6 Source 5 below depicts two separate rugby league tackles between opposing players. **Apply** Newton's second law of motion to **predict** which player in each scenario is more likely to gain ground during the tackle. **Justify** your prediction.

7 **Evaluate** your performance of one specialised movement sequence from the sport which is the focus of your studies. **Justify** which phase within your specialised movement sequence has to overcome inertial forces to improve one of the body and movement concepts (body awareness; space awareness; quality of movement; relationships). Make specific links to the sub-routines you would need to modify in order for improvement to occur.



SOURCE 5 Rugby league tackles

Check your obook assess for the following additional resources and more:

- **» Student book questions** 3.9 Check your learning
- **» Video** Newton's first law of motion – inertia
- **» Video** Newton's second law of motion – acceleration
- **» Video** Newton's third law of motion – reaction

3.10 Projectile motion

That's a goal!

By the end of Section 3.10, you should be able to:

→ **define** the term 'projectile motion'

→ **identify** the factors that affect the line of motion (i.e. the trajectory)

→ **identify** and **explain** three factors affecting projectile motion (i.e. angle of release, height of release and speed of release)

→ **devise** strategies to optimise the trajectory of projectiles in your selected physical activity.

Defining projectile motion

projectile motion
a term used to describe the movement of any object that has been launched, hurled or thrown into the air

projectile
any object (i.e. sporting implement or human body) that is launched, hurled or thrown into the air

Projectile motion is a term used to describe the movement of any object that has been launched, hurled or thrown into the air. As soon as any object is released into the air, it is referred to as a **projectile**.

In a sporting context, there are two main types of projectiles:

- implements – these include any objects or pieces of sporting equipment that have been thrown or hit into the air (e.g. balls, javelins, shot puts, shuttlecocks)
- bodies – these include the bodies of athletes that have been launched or propelled into the air (e.g. a gymnast performing a somersault, an alpine ski jumper flying through the air, a badminton player jumping for a shot).

SOURCE 1 Projectile motion is a term used to describe the movement of any object (i.e. projectile) that has been launched, hurled or thrown into the air. In a sporting context, there are two main types of projectiles – implements and human bodies. Both are shown in flight here.

Factors affecting projectile motion

The line along which a projectile travels is known as a **trajectory**. The trajectory of every projectile is affected by two external forces:

- gravitational force – this non-contact force pulls a projectile down towards the centre of Earth. Gravitational force affects all projectiles equally, regardless of their size, shape or mass
- drag force – this contact force (i.e. air resistance) opposes the movement of a projectile and slows it down. Air resistance will have different effects on projectiles depending on their size and shape (i.e. surface area). For example, air resistance will have a greater effect on a soccer ball than it will on a javelin because of its larger surface area.

In addition to the effects of these external forces, three other factors influence the trajectory of every projectile. They are important to know about because each one can have a direct impact on the distance that a projectile travels. When it comes to sports where maximising the distance a projectile travels is key (e.g. javelin, shot put, long jump) these factors are essential. They include:

- **angle of release**
- **height of release**
- **speed of release**.

We will now look at each of these factors in detail.

trajectory
the line along which a projectile travels

angle of release
the angle at which an object is launched into the air relative to the ground

height of release
the height at which an object is launched relative to the ground (or the landing point)

speed of release
the speed at which an object is travelling at the moment it is launched into the air

SOURCE 2 In addition to the effects of external forces (such as gravity), angle, height and speed of release influence the trajectory of every projectile. Each can have a direct impact the distance that a projectile travels. In sports like javelin, this means the difference between success and failure.

Angle of release

Angle of release refers to the angle at which an object is launched into the air relative to the ground. The angle of release is an important factor affecting the flight path of a projectile because it determines:

- the time the projectile stays in the air
- the horizontal distance (i.e. the distance on the ground) that the projectile travels.

Vertical force and horizontal velocity

As soon as a projectile is released into the air, its trajectory cannot be changed. This means that the distance it will travel and the time it will spend in the air are set after take-off. At the moment of release it possess two kinds of velocity:

- vertical velocity – this affects the time a projectile spends in the air. The vertical velocity of a projectile is constantly changing due to the influence of gravity. This means the projectile travels unequal distances in a vertical direction in equal intervals of time
- horizontal velocity – this affects the distance over the ground that the projectile will travel. The horizontal velocity of a projectile is constant. This means the projectile travels equal distances in a horizontal direction in equal intervals of time.

These forces will cause a projectile to move in both a vertical direction (i.e. height) and horizontal direction (i.e. distance) while it experiences the forces of gravity. The combination of horizontal and vertical velocity results in a flight path in the shape of a curve known as a parabola (see Source 3).

The gravitational pull applied to the vertical and horizontal force of the projectile affects how long a projectile will stay in the air and how far it will travel. For example:

- if a soccer ball is kicked vertically (i.e. straight up into the air), it will stay in the air for a long time but travel only a short distance from the point of release (i.e. where the person who kicked it is standing). This type of projectile possesses high vertical force and low horizontal force
- if the same soccer ball is kicked horizontally (i.e. more or less parallel to the ground), it will travel further from the point of release, but its flight time will be short. This type of projectile possesses high horizontal force and low vertical force.

Maximising and controlling distance through the angle of release

In some sports (or sporting situations), *maximising* the distance that a projectile travels is the ultimate goal. In order to do this, athletes need to find the **optimal angle of release**. This angle allows them to minimise the effects of both gravity and air, and help ensure that the projectile travels as far as possible.

In theory, the optimal angle of release required to maximise distance is around 45°. However, this is only considered optimal for projectiles released from the ground (e.g. a soccer ball). For most activities that require maximum distance to be achieved, the object is thrown with an arm (i.e. it is thrown from a height above the ground) and therefore the optimal angle is usually between 35° and 45°.

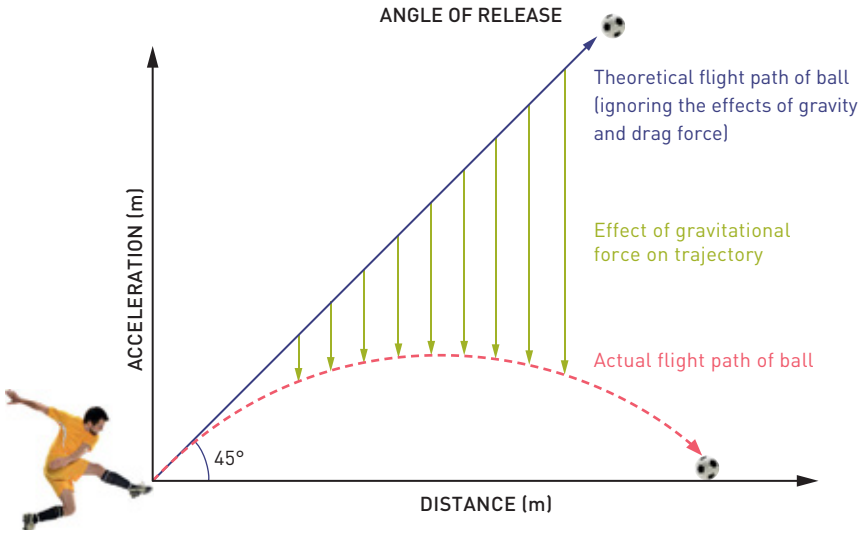
In other sports (or sporting situations), carefully *controlling* the distance that a projectile travels (i.e. by controlling its trajectory) provides the best chance of success. Golf is a good example of this. Some shots are designed for maximum distance, whereas others are designed for controlled distance. Each has its place depending on

FOR THE RECORD!

In the 1970s biomechanical researchers suggested that the optimal angle of release for shot putters was somewhere between 41° and 43°. However, this was updated by Alexander Lens and Florian Rapple in their study of the world's best shot putters. Their analysis suggested that the optimal angle was in fact between 37° and 38°.

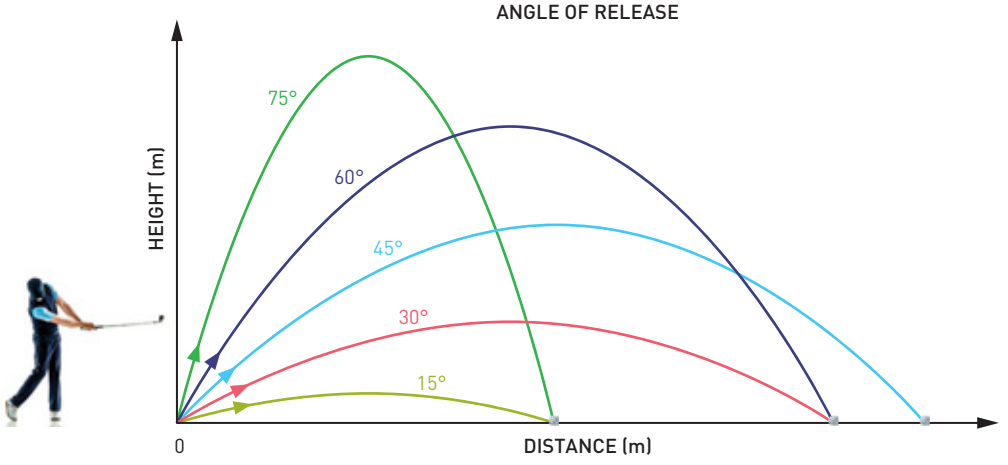
optimal angle of release
the angle at which both vertical and horizontal forces are equally applied to the projectile (in order to maximise the distance it will travel); the optimal angle of release required to maximise distance is generally considered to be around 45°, but varies depending on different situations and sports

the situation. As shown in Source 4, the angle of release can affect the 'hang' time (i.e. time the ball spends in the air) and distance travelled. A ball launched at 60° will spend longer in the air due to its vertical force, but will travel the same horizontal distance as an object released at 30° (which spends less time in the air).

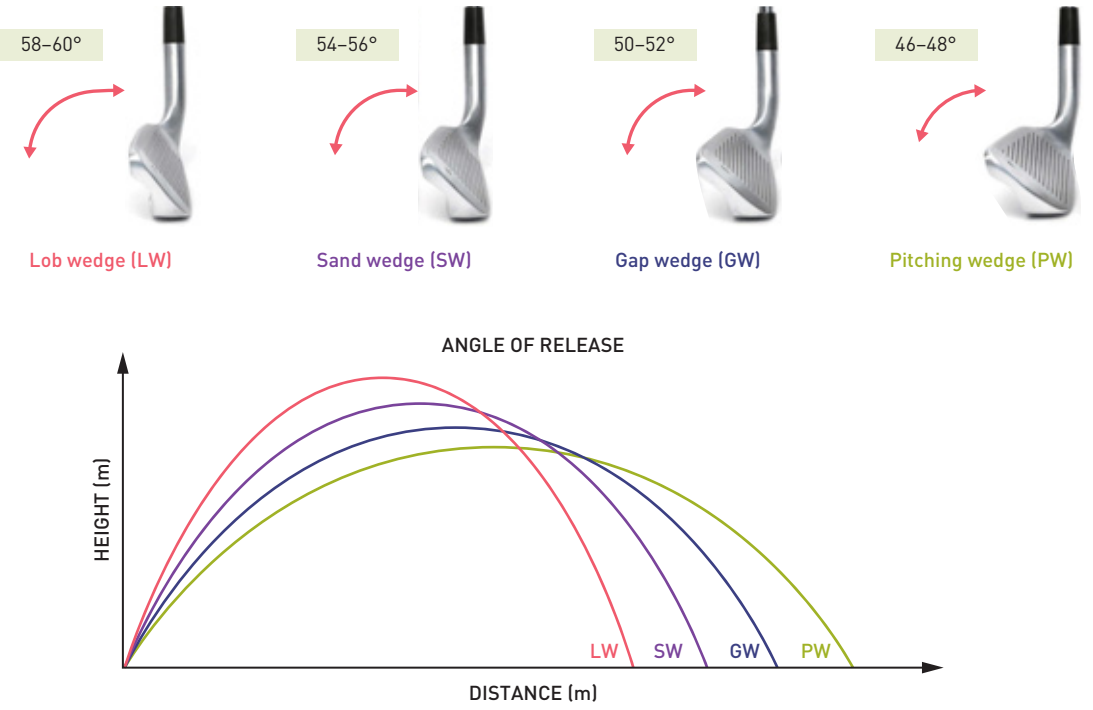


SOURCE 3 Angle of release refers to the angle at which an object (e.g. a soccer ball) is launched into the air, relative to the ground. In sports (or sporting situations) where maximising the distance that a projectile travels is the ultimate goal, athletes need to find the optimal angle of release.

The faces of golf clubs are designed with different lofts (i.e. angles) for this precise reason. Each loft produces a different angle of release that creates different trajectories for specific shots. A shot demanding plenty of height and not so much distance may require a club with a higher loft (e.g. 60°), while a shot played for greater distance will use a lower loft (e.g. 46°).



SOURCE 4 In sports (or sporting situations), carefully controlling the distance that a projectile travels (i.e. by controlling its trajectory) provides the best chance of success. In golf, the angle of release can affect the 'hang' time (i.e. time the ball spends in the air) and distance travelled. For example, a ball launched at 60° will spend longer in the air due to the vertical force but will travel the same horizontal distance as an object released at 30°.



SOURCE 5 Golf clubs have different lofts (i.e. angles) for different shots. A lob wedge (LW) is designed to hit the ball high into the air over short distances while a pitching wedge (PW) is designed to hit the ball lower into the air over longer distances.

The difference between theory and practice can be explained by other variables such as:

- the height of release and speed of release (to be discussed next)
- the effects of drag force (i.e. air resistance)
- differences in technique
- differences in the physical attributes of individual athletes (e.g. height, weight, strength, etc.).

If an athlete can get a higher velocity at a lower angle, then there is a trade-off between the optimum release angle and maximum release velocity. In the following examples we will not take into account the effects of drag force.

Height of release

Height of release refers to the height at which an object is launched relative to the ground (or the landing point). The height of release is an important factor affecting the flight path of a projectile because: (assuming the angle of release and the speed of release are constant), a projectile launched from a greater height will travel further than one launched from a lower height.

For example, if a tall athlete and a short athlete were both to throw a basketball at the same speed and angle, the taller athlete's ball would travel further than the shorter athlete's ball (see Source 6). This is due to the fact that the height of release is greater for the taller athlete, meaning that the ball will spend more time in the air.

The height of release of a projectile has a direct effect on the optimal angle of release. For example, when performing a free throw in a basketball, different players will adjust the angle at which they release the ball in order to take their height of release into account. This means that shorter players will choose a higher angle of release and taller players will choose a lower angle of release when shooting a free throw.

According to Professor John Fontanella – author of a book called *The Physics of basketball* – based on the heights of release, a:

- 163 cm (5'4") player should launch the ball at a 52.2°
- 173 cm (5'8") player should launch the ball at a 51.5°
- 183 cm (6'0") player should launch the ball at a 50.8°
- 193 cm (6'4") player should launch the ball at a 50.1°
- 203 cm (6'8") player should launch the ball at a 49.4°
- 213 cm (7'0") player should launch the ball at a 48.7°.

SOURCE 6 Height of release refers to the height at which an object is launched relative to the ground (or the landing point). If two basketball players of different heights each throw a ball from identical positions at the same angle and speed, the ball thrown from a greater height will travel further.

FOR THE RECORD!

Basketball shots travel through the air in a parabola (which differ in size depending on the basketball's angle of release). According to data from the NBA's SportVU motion tracking, top shooter Stephen Curry shoots with a 58.1° launch angle.

This is higher than the average angle of release of 51° and gives him more margin for error a major factor in his outstanding shooting skills.

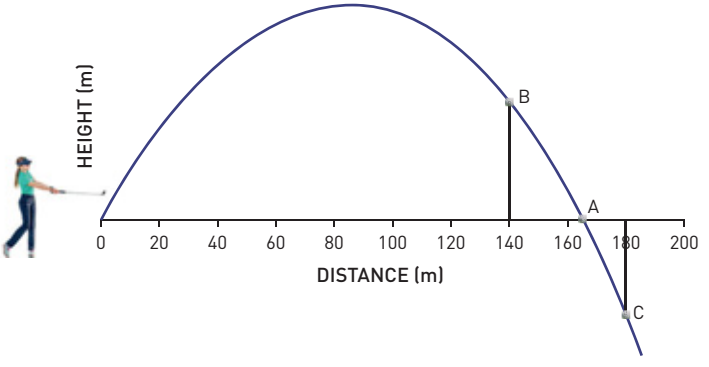
Relative height of release

When physical activities are performed on a level surface (e.g. soccer), the impact of an object's height of release is generally less of a factor. However, in some sports (e.g. volleyball) the release point for the projectile is often higher or lower than the landing point of the projectile.

Golf is a sport that can have greater height of release variations due to the uneven surfaces it is played on. Sometimes a golfer will need to hit a ball towards the putting green that is higher than the release point they are shooting from. At other times the putting green will be lower than the release point they are shooting from. Golfers need to be aware of how these variations in height will affect the distance a ball will travel, and consequently, which club to hit for a successful outcome.

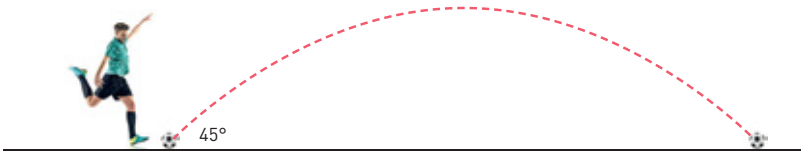
Source 7 shows how the same club can be used for three different distances given three different relative heights of release. In this example:

- a 6 iron has been used to hit a ball 165 meters when the height of release is the same as the landing height (A).
- when the green is above the height of release, the same 6 iron will only travel 140 meters (B).
- when the green is lower than the height of release, the ball will travel an extra 15 meters, or 180 meters in total (C), because the ball will continue on its parabolic flight path for longer.

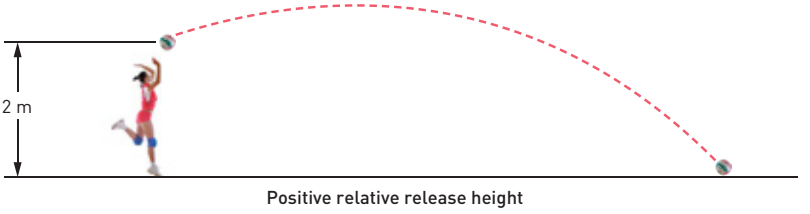


SOURCE 7 A golfer uses the same club for three different distances.

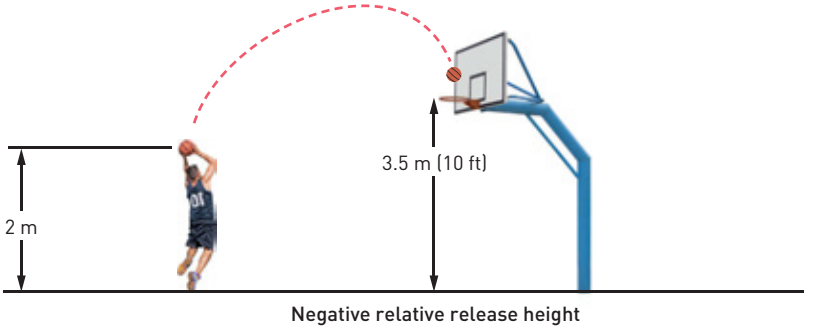
- When a projectile is released from a point above the landing height it is referred to as a **positive relative release height**. This means the projectile will have a longer 'hang' time in the air – therefore, a lower trajectory may be required for maximum distance.
- When a projectile is released from a point below the landing height it is referred to as a **negative relative release height**. This means the projectile will have a shorter 'hang' time in the air – therefore, a higher trajectory may be required for maximum distance.
- When a projectile is released from a point equal the landing height, the optimal angle of release for maximum distance is 45°. This occurs in soccer, when the ball is kicked from the ground and lands on the ground.



SOURCE 8 Zero relative release height occurs when a soccer ball is kicked from the ground and lands on the ground.



SOURCE 9 Positive relative release height occurs when a volleyball is shot across the court.



SOURCE 10 Negative relative release height occurs when a basketball is thrown into the hoop.

FOR THE RECORD!

One of the most effective ways to maximise the distance a golf ball travels is to increase its speed of release.

To hit a golf ball as far as Ryan Winther – the current world record holder for the longest drive, with a distance of 426 m – your club will need to hit the ball at a speed of 378 km/h.

In practice, for an athlete to achieved the desire outcome when dealing with projectiles they must take into account all three factors – angle of release, relative height of release and speed of release – as well as the other previously-discussed external factors. Changing factors together, for example taking a basketball free throw at a higher angle with greater velocity, can lead to more accurate results and improved performances.

Speed of release

Speed of release refers to the speed at which an object is travelling at the moment it is launched into the air. The speed of release is an important factor affecting the flight path of a projectile because (assuming the angle of release and the height of release are constant), a projectile launched at a greater speed will travel further than one launched at a lower speed.

Speed of release it is the most effective of all three factors when it comes to maximising the distance that a projectile travels once a projectile has been released, its horizontal velocity remains constant for the duration of its flight (without taking into account the effects of drag force). In sports that require projectiles to travel a great distance, athletes try to generate as much velocity as possible by releasing the projectile with the greatest possible amount of force.

3.10 Check your learning

Engage and understand

1 **Define** the term projectile in the context of biomechanics.

2 **Explain** the two external forces that impact on a projectile.

3 **Identify** the three factors that affect the trajectory of a projectile.

4 **Explain** why the optimal angle of release of 45° does not apply for many sport skills.

5 **Explain** how increasing the height of release when throwing affects the angle of release.

Analyse and apply

6 When using a projectile, there are many factors that can impact on the success of the skill. **Consider** how a shorter athlete can apply their knowledge of projectiles to increase their success in:

- **a** shooting skills
- **b** increasing distance.

7 The optimal angles of release for the three different sports are provided in the table below:

Sport	Optimal angle of release
High jump	60°
Long kick in soccer	45°
Javelin throw	32°

- **a** **Sketch** a graph to visually represent each skill. Be sure to label both axes and include all necessary information.
- **b** In a written response of 150 words, **compare** the angles of release.

8 A gymnast performing a vault needs to carefully consider their angle of release off the board. Studies have recommended an angle between 30° and 40°. **Determine** why an angle greater than this would not be advantageous.

9 **Complete** the following table to identify situations that rely on manipulating projectiles for a strategic advantage. An example has been completed for you.

Sport	Strategy	Application of projectile factors
Badminton	Hit the shuttlecock deep into the court to provide more time to get back into the rally.	Angle of release needs to be greater than 45° to clear opponent. Overhead clear requires lower angle than underhand clear due to height of release. Speed of hit increases as angle of release increases.
Touch football		
Soccer		
Volleyball		
Softball		

Evaluate and justify

10 **Evaluate** your application of projectile motion in your current physical activity. Refer to the optimal angle, height and speed of release for at least one specialised movement sequence and make an assessment of your performance.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  3.10 Check your learning
- **» Video weblink**
  Projectile motion in sport
- **» Weblink**
  Angle, height and speed of release

3.11 Balance and stability

That's a goal!

By the end of Section 3.11, you should be able to:

→ **define** the terms 'balance' and 'stability' and **identify** the factors that affect them

→ **describe** how balance and stability can affect force production

→ **explain** how you can alter your body's balance and stability to improve skill execution.

balance
a term used to describe the ability of a person or thing to control their state of equilibrium (i.e. distribute their weight evenly in order to remain upright and not fall over)

stability
the ability of an individual to control the influence of internal and external factors on their performance of a motor skill

static balance
a term used to describe the ability of a person or thing to maintain balance when stationary (e.g. a gymnast holding position on a balance beam)

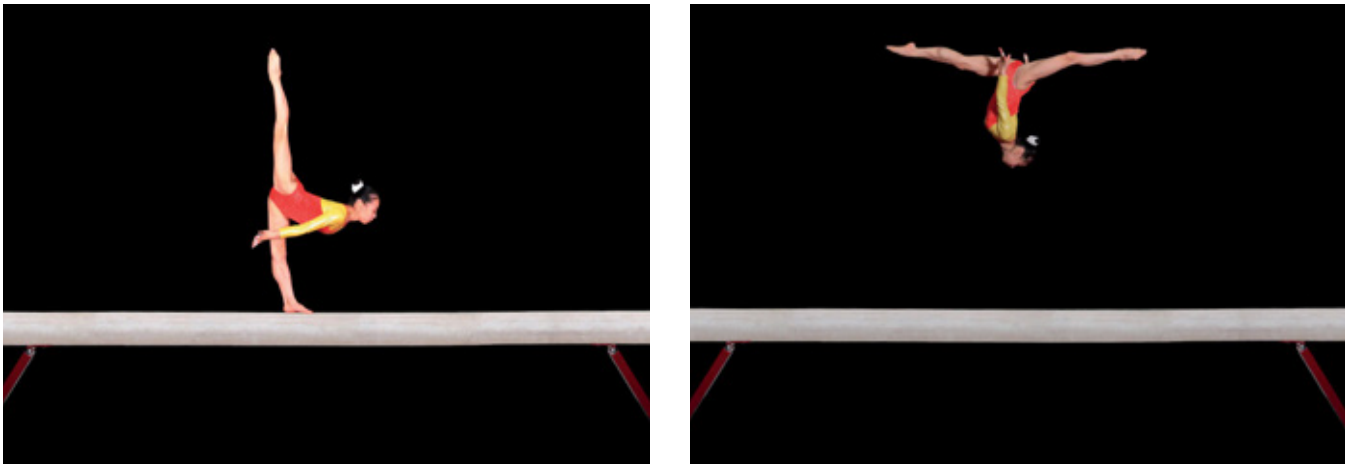
dynamic balance
a term used to describe the ability of a person or thing to maintain balance while moving (i.e. a gymnast performing on a jump a balance beam)

Defining balance and stability

Balance and **stability** are two important concepts in biomechanics that are separate, yet highly interrelated. In short:

- balance is a term used to describe the even distribution of weight that enables a person or thing to remain upright and not fall over. This state is often referred to as equilibrium. As a result, balance can also be defined as the ability of a person or thing to control their state of equilibrium. There are two types of balance (see Source 1):
  - **static balance** – balance when the body is stationary (e.g. a gymnast holding needle scale position on a balance beam)
  - **dynamic balance** – balance when the body is moving (i.e. a gymnast performing a back aerial on a balance beam).
- stability is a term used to describe the degree to which a person or thing can resist challenges to their state of equilibrium.

Balance and stability are essential in many sports and physical activities. A thorough understanding of these concepts can also help to improve technique and performance outcomes.



SOURCE 1 Balance is the ability of a person or thing to control their state of equilibrium. There are two types of balance: static balance (shown left) and dynamic balance (shown right). Stability is the degree to which a person or thing can resist challenges to their state of equilibrium.

Balance and stability concepts

The ability of a person or thing to maintain balance and stability is dependent on a number of factors. These include:

- **base of support**
- centre of gravity
- **line of gravity**
- mass.

We will now learn about each of these factors in detail.

base of support
the area beneath a person or thing that is in contact with a supporting surface

line of gravity
the direction in which gravity is acting on a person or thing

Base of support

Base of support is the area beneath a person or thing that is in contact with a supporting surface. In general, the larger the base of support, the greater the stability of a person or thing. For example:

- a boxer standing with his feet shoulder-width apart and knees bent (see Source 2) will have a large base of support and therefore greater stability
- a yoga teacher standing on one foot demonstrating a complex position (see Source 2) will have a small base of support and therefore less stability.

SOURCE 2 Base of support refers to the area beneath a person or thing that is in contact with a supporting surface; the larger the base of support, the greater the stability of a person or thing.

Modifying base of support

Athletes can modify their base of support depending on demands of a particular situation, or the requirements of a particular skill. This is because a body may be stable in one direction but not in another. For this reason, it is essential to consider the orientation of the base of support relative to the force an athlete may encounter.

For example, a wrestler wanting to prevent being pushed backwards will adjust their base of support by placing their feet in a long stance, one foot behind the other. This increases their front to back stability.

If the same wrestler wants to prevent being pushed sideways, they will adjust their base of support by placing their feet in a wide stance in line with each other. This increases their side to side stability.

An athlete may also need to place more pressure on one aspect of their base of support to increase stability. A classic example is passing a ball in rugby. In a static position, the base of support is evenly distributed between the two feet and balance can be maintained when passing the ball. However, it becomes more difficult when passing a ball on the run as the base of support will often be just one foot. It is much easier to pass the ball if the weight is on the outside foot to maintain balance – for example, when passing to the left, the weight should be on the right leg.

STUDY TIP

Every piece of assessment in Physical Education requires you to apply and evaluate two body movement concepts when developing specialised movement sequences and movement strategies.

From a biomechanical perspective, body awareness is a significant body and movement concept that considers the importance of stability, balance and transfer of weight – these are worth considering when developing your assessment response.

Transferring momentum is essential for generating maximum power. Transferring weight from one part of the body to another is one way to transfer momentum. Athletes can often promote this through changing the weight displacement on their base of support. When striking in sports such as softball, golf, tennis and cricket, it is common to see the athlete move their weight to their back leg prior to commencing the stroke. This allows their weight to transfer to the front foot at the point of impact.

SOURCE 3 Athletes can often transfer momentum by changing the weight displacement on their base of support. Batters can improve the efficiency of transferring momentum by starting the swing on their back leg.

Centre of gravity

Centre of gravity is the central point around which the mass of a person or thing is distributed and balanced. Every person and thing has a centre of gravity, which can shift depending on the position (or movement) of that person or object.

Understanding where an athlete's centre of gravity is located during different sporting skills and on objects (such as bats and balls) can often be the key to improving technique and optimising performance.

Locating the centre of gravity

SOURCE 4 Locating the centre of gravity of most objects is generally quite simple. If an object is perfectly round (such as a tennis ball) the centre of gravity is found in the centre of that object.

Locating the centre of gravity of things (i.e. inanimate objects) is generally quite simple. For example, to locate the centre of gravity of a ruler, place it across one finger until you find the point at which it stays horizontal and does not fall to the ground. The point at which it is balancing on your finger is its centre of gravity.

If an object is perfectly round (such as a tennis ball, cricket ball or soccer ball) or uniform in shape (such as a cube or block) then the centre of gravity is always found in the exact centre of that object. If an object is an irregular shape (such as a boomerang or a shuttlecock), the centre of gravity can be quite far away from the centre of the object – and sometimes even outside it – but will be the position at which the weight is balanced.

Unfortunately, locating the exact position of the gravity of people is not quite so simple – particularly when it comes to sport and physical activity. Unlike many objects, the human body is not uniform in shape when it is stationary, nor is it stationary very often. Instead, the human body is flexible and can assume many different positions and move constantly. As a result, an athlete's centre of gravity can shift very rapidly. In addition to this, individual body parts (such as arms and legs) have their own centres of gravity.

SOURCE 5 Locating the exact position of the centre of gravity of a person is not always simple.

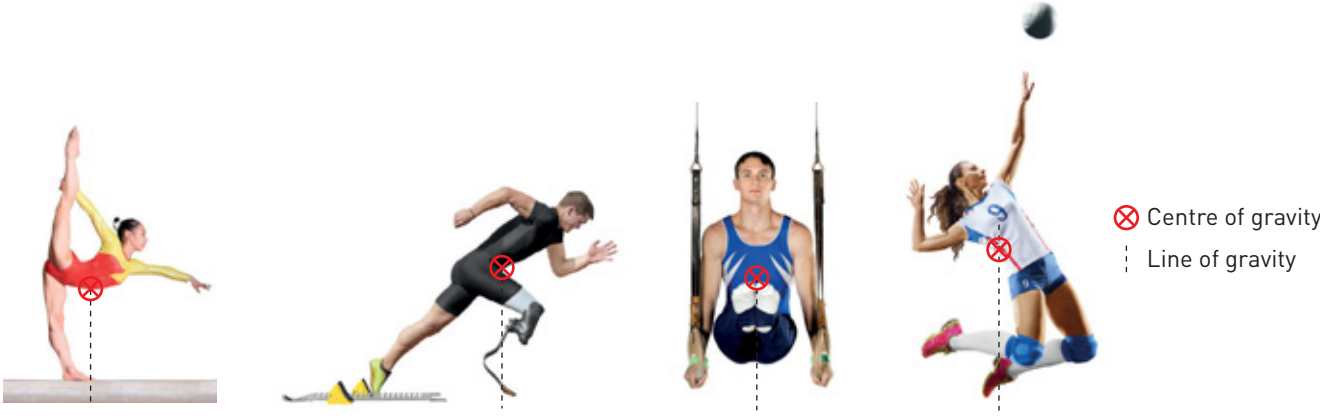
Because the body is so flexible, in some cases the centre of gravity may even be located outside the body of the athlete. An example of this is a high jumper clearing a bar. Because of the way in which high jumpers performing the Fosbury Flop technique bend their bodies, the centre of gravity is actually lower than the bar they are clearing. Manipulating the shape of their bodies to achieve this makes it a much more efficient movement.

SOURCE 6 An athlete performing the Fosbury Flop.

Line of gravity

Line of gravity refers to the direction in which gravity is acting on a person or thing. The line of gravity for any person or thing can be represented by drawing a straight line from the centre of gravity to the ground (see Source 7).

An object is most stable when the line of gravity lands in the centre of the base of support. This is because it increases the distance that the centre of gravity must be moved before balance is compromised.



SOURCE 7 An athlete's centre of gravity can shift as they take on different positions.

STUDY TIP

One way to increase body awareness is to practise a skill with your eyes closed.

Removing one sense can heighten the awareness of how your body moves through the various skill segments.

Practising the swing of a tennis racquet or golf club, or a basketball set shot are examples of activities that can be safely performed with your eyes closed.

Moving the line of gravity towards the edge of the base of support reduces a body's stability. The further off-centre from the base of support the centre of gravity is, the less stable the body. This is most noticeable when a person is not balanced while performing a skill. Being aware of the body's position throughout a skill execution can allow an athlete to make minor adjustments to their position to regain an optimum level of stability.

Mass

Mass is a measure of how much matter (i.e. particles and atoms) there are in an object. When it comes to balance and stability, the mass of an object or thing is one final factor to consider.

The greater the mass of an object, the greater its stability. It takes more force to accelerate a heavy body at a given rate. Sumo wrestlers are the ultimate example of using weight to increase stability.

Many sports have specific positions that utilise an athlete's mass for particular movement sequences and movement strategies – for example, defensive positions require more stability. Defenders in sports such as rugby league, rugby union, football and basketball require stability at certain points in the game (such as at the point of impact to either maintain possession or defend a field or court position) and as such they are often the biggest players in the team. Lighter athletes are advantaged in sports where agility and speed are required.

SOURCE 8 Centre of gravity, line of gravity and base of support

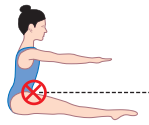
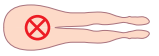
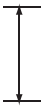
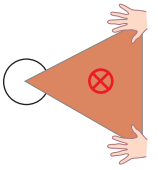
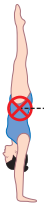
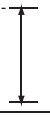
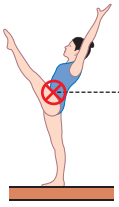
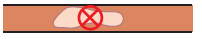
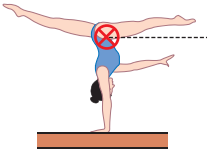
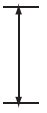
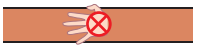
Maximising balance and stability

Maximising balance and stability during training and performance can improve technique, optimise performance and lead to improved outcomes. As shown in Source 8, balance and stability can be maximised by:

- increasing the base of support as required (i.e. extending the base of support in the direction of an oncoming force)
- ensuring the line of gravity falls within the base of support
- shifting the line of gravity towards the oncoming force
- lowering the centre of gravity
- increasing mass.

PERFORMANCE | SKILL DRILL 3.11 | Evaluate the impact of base of support on quality of movement

>> Turn to pages 338–339 to complete this integrated physical performance activity.

Balance showing centre of gravity (CG)	Height of CG above base	Base of support	Stability
		Low CG/large base 	Greatest
		Relatively low CG/large base 	
		High CG/small base	
		High CG/small base 	
		High CG/very small base 	Least

SOURCE 9 Stability is related to the size of the base of stability and the relative height of the centre of gravity.

3.11 Check your learning

Engage and understand

1 **Identify** four factors that have a direct impact on a person's stability.

2 **Describe** how you can improve weight transference for striking skills.

Analyse and apply

3 **Differentiate** between static and dynamic balance.

4 **Analyse** the specialised movement sequences within your selected physical activity in terms of their need for balance and stability. **Determine** how you can increase stability in one of the movement sequences.

Evaluate and justify

5 'A stable base of support is essential for generating maximum power'. Do you agree or disagree with this statement? **Justify** your response in a 150- word written response. Be sure to include relevant examples from your selected physical activity.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  3.11 Check your learning
- **» Video**
  Balance and stability concepts
- **» Skill Drill worksheet**
  3.11 Evaluate the impact of base of support on quality of movement
- **» Weblink**
  Balance and stability concepts

3.12 Levers

That's a goal!

By the end of Section 3.12, you should be able to:

→ **describe** the characteristics of a lever

→ **identify** three types (i.e. classes) of levers and explain how they can be used to multiply force and speed

→ **explain** how you can increase the effectiveness of third-class levers to improve your performance in your selected physical activity.

Defining levers

lever
a simple machine consisting of a solid bar supported by a pivot point (i.e. fulcrum) designed to help move a load (i.e. resistance) on one end by applying effort (i.e. force) on the other end

A **lever** is a simple machine consisting of a solid bar (or rod) supported by a pivot point. A lever is designed to help move a heavy load on one end of the bar when pressure is applied on the other end of the bar. In sport, a lever can increase the efficiency of movement, increase the speed of an object and help athletes produce force.

How do levers work?

Levers have three main parts:

- the load – this is the object that is to be moved. The load is also referred to as the **resistance** or **output force**
- the effort – this is the energy that is used to move the lever. The effort is also referred to as **force** or **input force**
- the pivot point – this is the point at which the lever pivots. The pivot point is also referred to as the **fulcrum**.

Levers can make it easier to move heavy loads with less effort. Levers can also be used to increase the speed of an object. Levers are frequently used in sport and physical activity for this purpose.

The human body contains many levers made up of bones and muscles. In fact, our arms, legs and fingers are all types of levers. These levers allow the body to move and generate force. Many types of sporting equipment are also levers that allow us to hit objects faster and further (e.g. bats and racquets).

A solid understanding of how levers work can help athletes to modify their technique in order to move more efficiently and with greater effect.

first-class lever
a type of lever in which the pivot point (i.e. fulcrum) is positioned between the effort (i.e. force) and the load (i.e. resistance)

second-class lever
a type of lever in which the load (i.e. resistance) is positioned between the effort (i.e. force) and the pivot point (i.e. fulcrum)

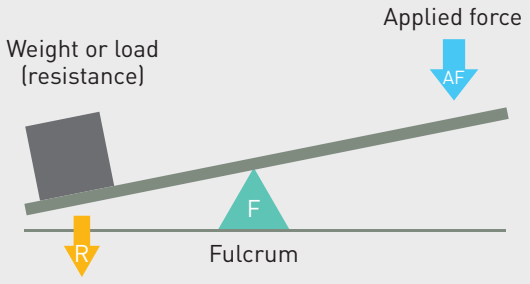
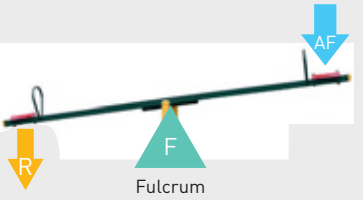
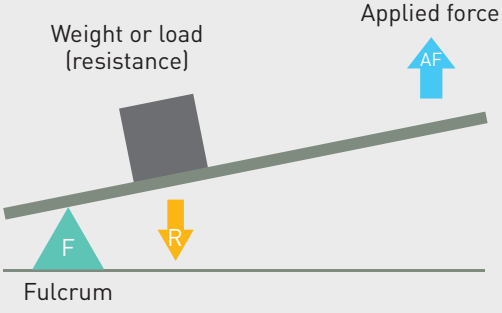
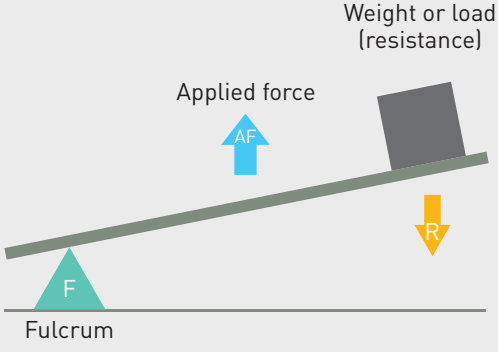
third-class lever
a type of lever in which the effort (i.e. force) is positioned between the load (i.e. resistance) and the pivot point (i.e. fulcrum)

Types of levers

There are three different types of levers, all of which play a role in the performance of different sports and physical activates. They include:

- **first-class levers** (where the fulcrum is positioned between force and resistance)
- **second-class levers** (where the resistance is positioned between the effort and the fulcrum)
- **third-class levers** (where the effort is positioned between the resistance and the fulcrum).

Each lever works slightly differently, as shown in Source 1. We will now look more closely at how each one functions.

Type of lever	Diagram	Example
First-class levers → In a first-class lever, the fulcrum is placed between the resistance and the force. That is, the pivot point is in the middle, with the load and effort at each end. → Resistance and force are applied in the same direction. → The most basic example of a first-class lever is a see-saw.		
Second-class levers In a second-class lever, the resistance is placed between the fulcrum and the force. That is, the load is in the middle, with pivot point and effort at each end. → Resistance and force are applied in opposite directions. → The most basic example of a second-class lever is a wheelbarrow.		
Third-class levers In a third-class lever, the force is placed between the fulcrum and the resistance. That is, the effort is in the middle, with pivot point and load at each end. The most basic example of a third-class lever is a hammer being used to extract a nail.		

SOURCE 1 There are three types of levers. Every lever has a pivot point (i.e. fulcrum), a point at which a load is present (i.e. resistance) and a point at which force is applied (i.e. applied force).

STUDY TIP

A good way to remember the **middle position** of each type of lever is to use the mnemonic (i.e. memory trick) – '**FLEE**':

Fulcrum – First-class lever
Load – Second-class lever
Effort – Third-class lever
Easy to remember!

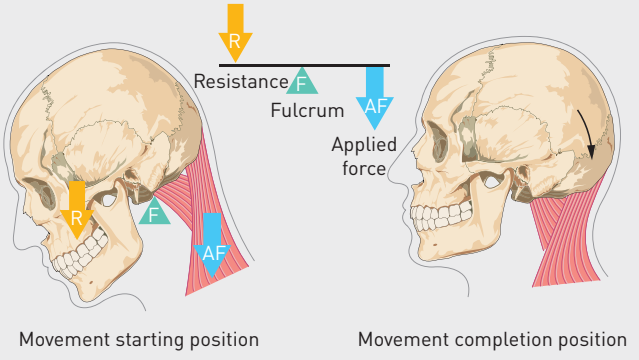
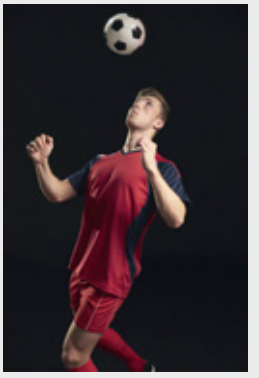
Levers in sport

The bones, joints and muscles in our bodies function as levers. The long bones of our arms and legs used as levers to help reduce effort in moving a load and our knees and elbows are used as fulcums.

We will now look at some examples of the three different types levers of at work in the body and learn how these can be applied in sporting situations.

First-class levers

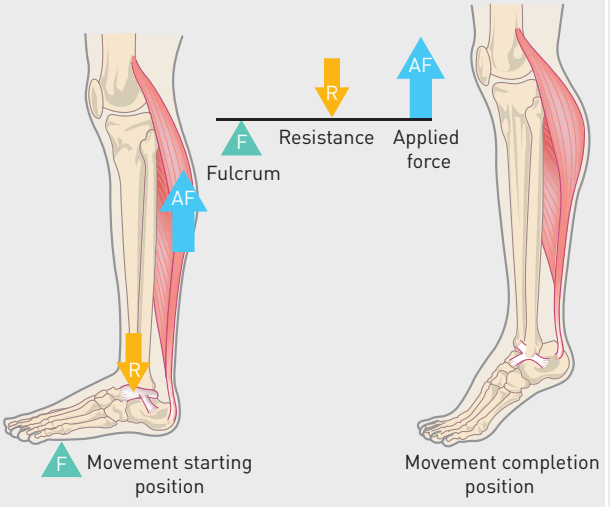
While it is easy to find examples of first-class levers in the world around you, there are not that many examples of first-class levers in the human body. One of the few examples of a first-class lever is nodding your head up and down (see Source 2).

First-class levers	First-class levers in the human body	Example
In this example: • the muscles and tendons of the neck provide the **force** • the spine acts as the **fulcrum** • the weight of the head provides the **resistance**. This lever is commonly used in sport for heading a ball in soccer and packing into a scrum in rugby.		

SOURCE 2 Nodding your head up and down is an example of a first-class lever.

Second-class levers

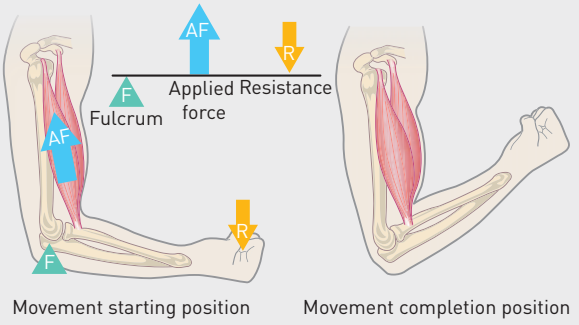
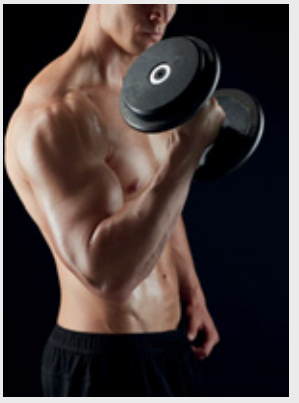
There are also not that many examples of second-class levers in the human body. One example of a second-class lever is standing on the ball of your foot (see Source 3).

Second-class levers	Second-class levers in the human body	Example
In this example: • the calf muscles and Achilles tendon provide the **force** • the ball of the foot acts as the **fulcrum** • the weight of the body provides the **resistance**. This lever is commonly used in sport when jumping for height to complete a block in volleyball or to complete a jump shot in basketball.		

SOURCE 3 Standing on the ball of your foot is an example of a second-class lever.

Third-class levers

Third-class levers are the most common type of lever found in the body. They are also the most widely used in sports and physical activities. This is because our bones are the resistance, joints become the fulcrum and muscles, which provide the force, are inserted close to the joint for increased efficiency. One example of a third-class lever in the human body is performing a bicep curl (see Source 4).

Third-class levers	Third-class levers in the human body	Example
In this example: • the tendon and bicep muscles provide the **force** • the elbow joint acts as the **fulcrum** • the weight of the forearm and hand provides the **resistance**. This lever is commonly used in sport when performing a bicep curl or hitting a ball in cricket, tennis or softball.		

SOURCE 4 A bicep curl is an example of a third-class lever.

Levers in sport and physical activity

Levers are used in all types of sports and physical activities to improve performance in different ways. Depending on the type of sport and the specific skill being performed, different types of levers can be more useful than others. For example, in certain sports we use bats and racquets to extend the levers in our arms and deliver a greater force and speed. The action or advantage gained from of using a lever is known as **leverage**.

leverage
the advantage gained from using a lever

Understanding the different effects levers can have in these situations is key to using them to your advantage.

Anatomical levers in sport

When it comes to performance in sport and physical activity, it's important to consider the effects of individual anatomy. 'Natural' levers in the body (i.e. those created by our bones, joints and muscles) are commonly referred to as **anatomical levers**.

Taller people naturally have longer anatomical levers than shorter people. This creates the potential for more speed at the end of their levers. A longer muscle also has greater potential to exert more force, and this can also contribute to generating greater speed. Athletes in striking and throwing events can have an advantage based on the length of their anatomical levers. Shorter athletes in these sports need to rely on excellent technique (e.g. using the summation of forces and the ability to transfer momentum) to optimise the result of their 'natural' levers when performing in the same events. However, shorter athletes have natural advantages over taller athletes in other sports, such as weight lifting, gymnastics and diving.

As discussed earlier in this section, force is required to cause a lever to rotate around the fulcrum. Getting a lever moving from a stationary position can sometimes require additional force to overcome inertia (i.e. a reluctance to begin rotation). Longer levers require more strength to overcome this initial resistance. To make it easier to move and

SOURCE 5 Athletes can create short and long anatomical levers by moving their body parts to different positions, as shown here by this sprinter.

swing through with speed, athletes will often shorten the length of their body levers by bending their arms or legs. An example of this can be seen when running. As shown in Source 5, the leg remains bent in the back recovery phase to shorten the lever. This helps overcome inertia and increases the speed of the leg as it moves into the forward recovery phase. During the propulsion phase the leg is extended to lengthen the lever and deliver the maximum force and speed.

The process of kicking a ball in soccer is very similar. The kicking leg starts in the bent position before opening out to a straight position just before contact.

A similar approach is adopted with the arms in other sports, such as tennis, cricket, volleyball and javelin. In all these examples, the arm lever is shortened to overcome the arm's inertia, which generates more speed as the weight of the lever moves closer to the fulcrum (i.e. the shoulder). This action increases the rotational momentum generated from the torso and is a technical aspect that can significantly increase the speed of a lever. For accuracy, it is important that the lever is straightened at the point of contact to ensure the maximum speed and force is transferred to the ball or object. If a performance lacks speed or force, it's possible that an athlete is not taking full advantage of levers.

SOURCE 6 Similar to changes in a sprinter's legs shown in Source 5, in a tennis serve, the arm starts in the bent position before opening out to a straight position just before contact.

Force multipliers and speed multipliers in sport

In many types of sport and physical activities, athletes combine the use of anatomical levers (i.e. internal levers) with the use of sporting equipment such as bats and racquets (i.e. external levers). Some of this equipment helps athletes to multiply (increase) force, while others help them multiply (increase) speed. To understand which types of external levers are best suited to different sports and physical activities, it helps to divide them into two categories: force multipliers and speed multipliers.

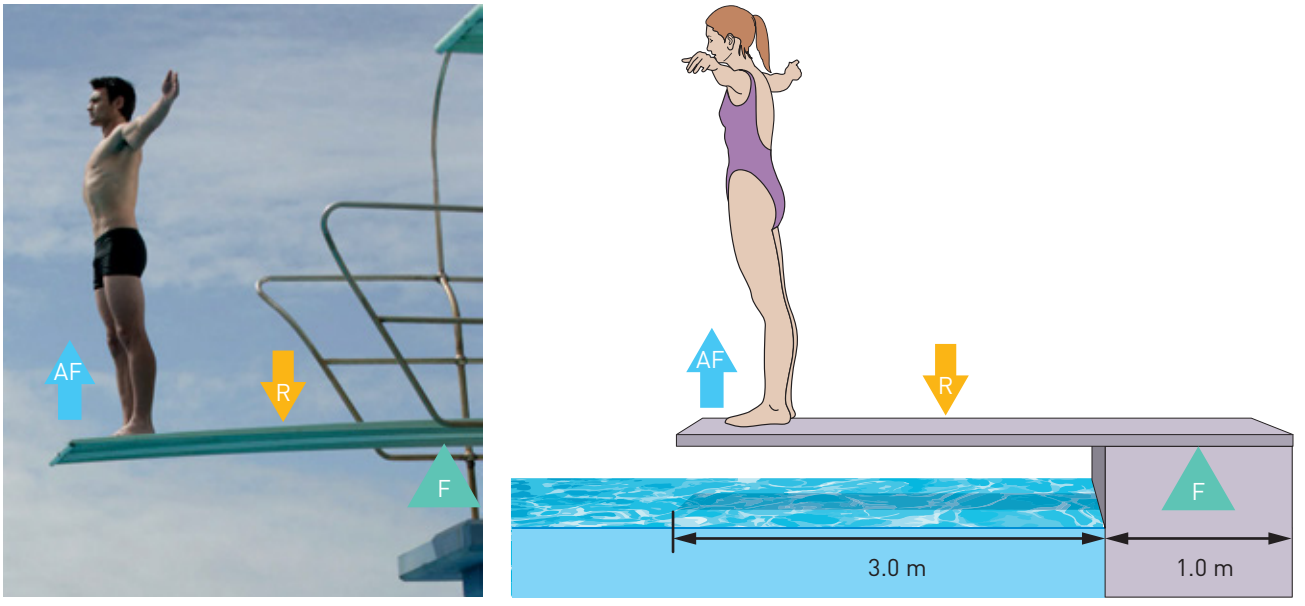
Force multipliers

Force multipliers **have a long force arm** that requires **less effort** (i.e. force) to move a heavier load (i.e. resistance). These kinds of levers are used to move heavy loads (i.e. objects). An example of a force multiplier being used in sport is a diver jumping off a springboard (see Source 7).

force multipliers
levers that make it easier to move a heavy object with less force by increasing the distance over which the force is acting

During the dive, the force generated by second-class anatomical levers (i.e. in the feet and legs across the ankle joints) is combined with an external piece of equipment (i.e. a diving board). The board is an external second-class lever and a force multiplier because it increases mechanical advantage. By using the board, the diver is able to generate more force to produce a higher jump.

As shown in Source 7, the force is applied by the athlete to the end of the board. The resistance is supplied by the weight of the board. The fulcrum is located where the board is secured to the side of the pool (or ground). The end result of these two force multipliers is greater height to perform the required skills.



SOURCE 7 A diving board is an example of a force multiplier. It helps a diver to multiply the force of a jump because it increases mechanical advantage. By using the board, the diver is able to generate more force to produce a higher jump.

Speed multipliers

speed multipliers
levers that can increase the speed of, or distance travelled by, an object by changing a strong force that operates over a shorter distance into a weak force that operates over a longer distance

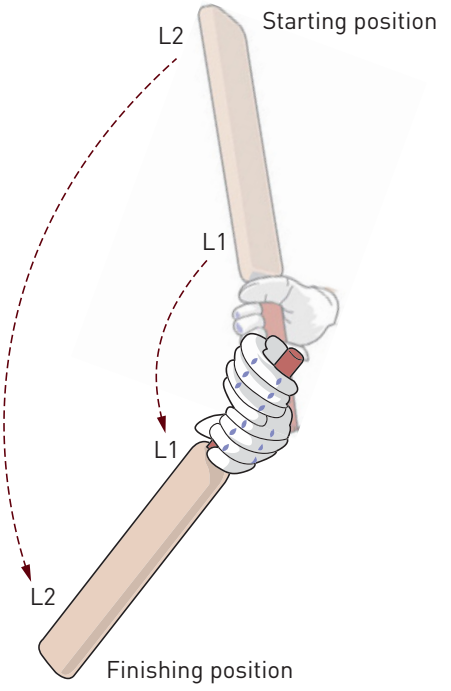
Speed multipliers have a long resistance arm that requires **greater effort** (i.e. force) to move a load (i.e. resistance). These kinds of levers are used to increase the speed of or distance travelled by an object. Any object or implement (i.e. piece of sporting equipment) that can increase the length of a resistance arm is classed as a speed multiplier. The increased movement offered by a longer lever means that the velocity at the end of a long lever is faster than the velocity at the end of a short lever. This means the end of a lever will move more quickly than any other point on the lever.

An example of a speed multiplier being used in sport is a ball being hit by a cricket bat (see Source 8). Here, the end of the bat (i.e. the longer lever labelled L2) travels a longer distance than the middle of the bat (i.e. the shorter lever labelled L1) in the same amount of time. This means it is moving at a greater speed.

Athletes don't always need to use speed multipliers such as bats and racquets to increase speed. For example, in cricket, bowlers will generate more speed on the ball if they use a straight arm, because a straight arm lengthens the lever of their arm.

FOR THE RECORD!

The woomera is a wooden spear thrower that has been used by Indigenous Australians for around 5000 years. Woomeras vary between 60 and 90 centimetres in length and are used as an extension of the human arm. This additional leverage allows the spear to travel around three times further than it would with the arm alone.



SOURCE 8 A cricket bat is an example of a speed multiplier. It extends the lever of the arm to produce greater force and increase the speed of the object being hit (i.e. the ball).

When it comes to speed multipliers, it is necessary to balance speed with accuracy. In other words, there is a limit to the optimum lever length. Increasing the length of a lever too much will create handling errors and reduce the accuracy with which an object can be hit. For example, the cricket player in Source 8 would not want to use a bat that is 4 metres long – even if it would technically allow her to hit the ball faster and over a longer distance – because the size of the bat would reduce control and accuracy.

For this reason, most bats and racquets available today come in a range of different lengths to suits athletes of different heights. Softball bats, tennis racquets, golf clubs and cricket bats are examples of implements that come in different lengths so that all athletes

can maximise the advantages of using a third-class levers, based on their particular size and height. In addition to this, players may choose to 'give up' a little bit of power and speed in exchange for accuracy by shortening their grip on their bat, racquet or club.

PERFORMANCE | SKILL DRILL 3.12

Compare the effectiveness of levers in the production of speed in sport

>> Turn to pages 340–341 to complete this integrated physical performance activity.

3.12 Check your learning

Engage and understand

1 **Define** the term 'lever' and **explain** the basic characteristics of each of the three types of levers.
2 **Identify** the types of levers that are considered:
   a force multipliers
   b speed multipliers.
3 **Explain** the advantage a tall sprinter has over a short sprinter in terms of levers.
4 **Explain** how you can maximise your body's levers to generate more speed.

Analyse and apply

5 **Consider** the average length of a tennis racquet. Draw a picture to explain why a racquet that is too short and a racquet that is too long can restrict performance.
6 **Identify** two discrete skills from your selected physical activity this term. **Classify** each one using the table below (i.e. by providing a lever type, description and illustration).

Physical activity		
Type of lever	Name and description of skill	Diagram (including labels: force, fulcrum, resistance)
First-class		
Second-class		
Third-class		

7 A see-saw is a classic first-class lever. **Identify** problems that could arise if the people on the see-saw were not of similar weight. **Consider** ways this problem could be solved. Apply the terminology of force arm and resistance arm to justify your response.
8 A tennis player uses a racquet as a lever during serves to maximise force and velocity.
   a At the point of impact with the ball, **determine** where the axis, resistance and force are.
   b Use this information to identify the class of lever.
   c What term can be used to **describe** the tennis racquet in this example?

Evaluate and justify

9 'Third-class levers generate too much speed for skill execution.' **Evaluate** this statement and **justify** your point of view in a written response of 200 words. Your response should make reference to a relevant quality of movement criteria (see Section 2.7) and include examples from your selected physical activity.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  3.12 Check your learning
- **» Skill Drill worksheet**
  3.12 Compare the effectiveness of levers in the production of speed in sport
- **» Video weblink**
  Levers in the human body
- **» Weblink**
  Introduction to levers

3.13 Bernoulli's principle

That's a goal!

By the end of Section 3.13, you should be able to:

- → **define** Bernoulli's principle
- → **explain** how the Magnus force works
- → **describe** how swimmers use lift to make their swimming stroke more efficient
- → **describe** how pressure can be applied to create various spins and trajectories
- → **explain** how you can use various spins to increase the effectiveness of selected strategies and skills in your selected physical activity.

Defining Bernoulli's principle

Bernoulli's principle
a scientific theory that explains that any increase in the velocity of a fluid (e.g. air or water) is accompanied by simultaneous decrease in pressure; these differences in fluid velocity and pressure explain the movement of many objects (including how planes fly) as well as how lift force is generated

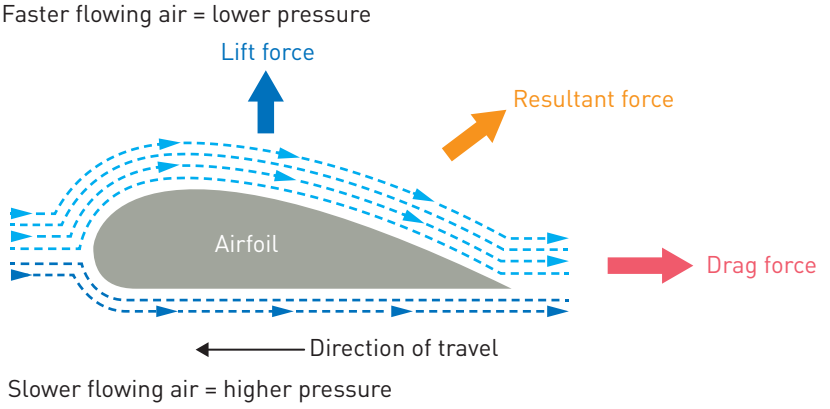
lift force
any force that acts to push an object or body upwards

Bernoulli's principle is a scientific theory proposed by a Swiss mathematician and physicist by the name of Daniel Bernoulli in 1738. In short, Bernoulli's principle states that any increase in the velocity of a fluid (e.g. air or water) is accompanied by a simultaneous decrease in pressure.

Bernoulli's principle can be challenging to grasp. One of the best ways to explain it is to look at it in action. Today, Bernoulli's principle is most commonly used to explain how aeroplanes fly, so we will use this as an example to explain its basic principles.

Source 1 shows a cross-section of an aeroplane wing. This shape is known as an airfoil. It is the basic form of the wings in most aircraft today. As shown, when a fluid (in this case air) travels around the airfoil, the air travelling over the top of has a higher velocity than the air moving underneath. This is due to the fact that the curved shape of the air foil forces air travelling over the top of the wing to cover a greater distance than air travelling underneath – in the same amount of time.

As a result of these differences in velocity, the pressure above the wing is lower and the pressure under the wing is higher. Because particles generally move from high to low pressure zones, the wing is drawn upwards in a process called **lift force**.



SOURCE 1 Bernoulli's principle states that any increase in the velocity of a fluid (e.g. air or water) is accompanied by simultaneous decrease in pressure. It is commonly used to explain how aeroplane wings work. As shown, air moving over the top of the wing at a higher velocity generates low pressure, and air moving under the wing at a lower velocity generates high pressure. Because particles generally move from high to low pressure zones, the wing is drawn upwards.

SOURCE 2 Bernoulli's principle helps to explain lift in water in the same way that it does air.

As discussed in Section 3.6, when any object travels through fluid (e.g. air or water), it encounters resistance. This resistance is commonly referred to as **drag force**. Drag force acts to slow the wing of the plane down as it moves through the air.

As a result, the overall force acting on the plane wing in Source 1 is a combination of the lift force and drag force that are being applied to it. Gravitational force in not considered in this example as it is a constant. Each of these forces have different strengths and directions. The sum of these two forces gives the **resultant force** (i.e. the single force that has the same overall effect on the wing as all the individual forces acting together as one). The resultant force indicates the direction in which the wing will ultimately move.

drag force
a type of contact force that is generated by a fluid (e.g. air and water) opposing the movement of an object

resultant force
the sum of lift force and drag force added together

Bernoulli's principle in sport

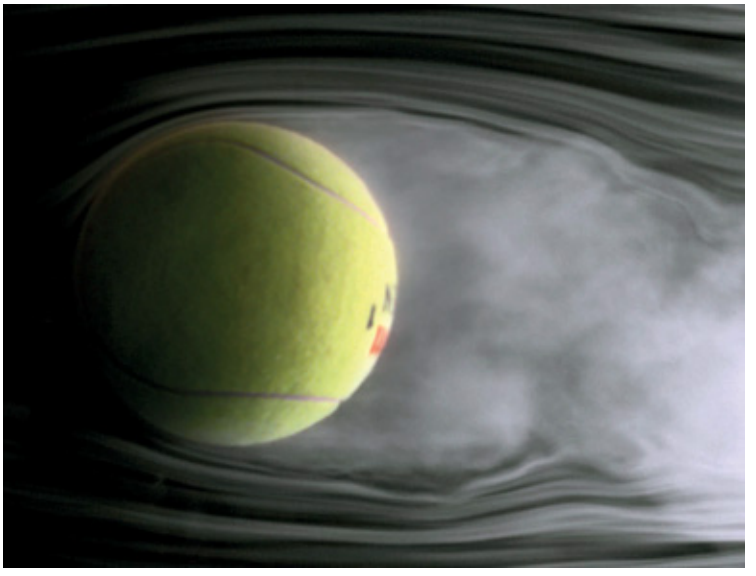
In addition to explaining how aeroplanes fly, Bernoulli's principle also has many useful applications to the world of sport and physical activity. In fact, it can be used to explain how differences in air and water pressure can affect the speed and movement of:

- objects through air (e.g. balls, javelins and discuses)
- bodies through air and water (e.g. long jumpers and swimmers).

It can also be used to explain how a number of forces act on these bodies and objects as they move. When an object or a body moves through a fluid (e.g. air or water), it exerts a force on that fluid and simultaneously encounters a resisting force from it. In sporting contexts, whenever a body or object exerts a force on a fluid, drag and lift forces are generated:

- lift force – is any force that acts to push an object or body upwards
- drag force – is any force that acts to oppose the movement of an object or body and slow it down.

A thorough understanding of these concept at work can help athletes improve technique and optimise their performance.

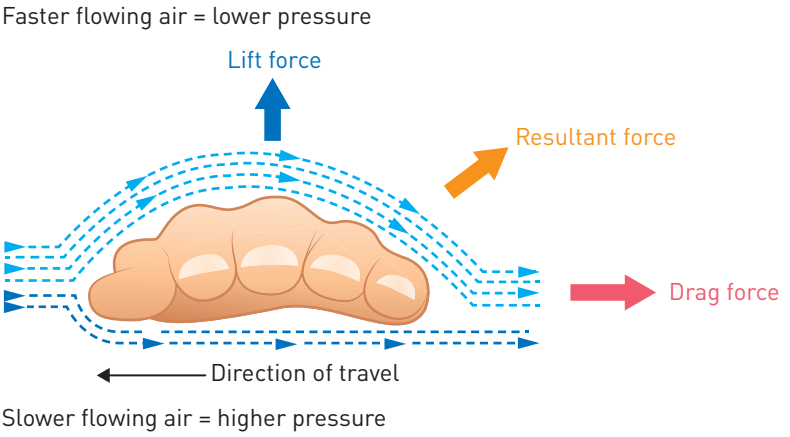


SOURCE 3 A tennis ball creating turbulence in a wind tunnel with no spin.

Applying Bernoulli's principle in the water

In sport, the object is usually a projectile and lift is used to overcome the drag resistance caused by air (e.g. a discus moving through air); however, lift can also help overcome the drag in water (e.g. a swimmer moving through water). Bernoulli's principle helps to explain lift in water in the same way that it does air.

As shown in Source 4, when a swimmer's hand moves in a sideways sweeping motion through the water (e.g. when sculling water), the flow of water over the curved



SOURCE 4 Bernoulli's principle explains how aeroplane wings work, but the same principle applies to a hand sculling water. As shown, water moving over the top of the hand at a higher velocity generates low pressure, and water moving under the hand at a lower velocity generates high pressure. The difference in water pressure forces the hand upwards and gives it lift force.

edge and back of the hand (i.e. known as the dorsal side) is much faster than the flow of water over the flatter palm side of the hand (i.e. known as the palmar side). This is because of the increased distance the water must travel over the dorsal side of the hand compared to the palmar side (in the same amount of time). The difference in the velocity of the water on the two sides of the hand creates areas of high pressure and low pressure – and generates lift. A swimmer can manipulate the angle at which they face the curved side of their hand to change the direction of the lift force.

SOURCE 5 The eggbeater kick is often used in water polo to create lift and propel players out of the water. It is an example of the application of Bernoulli's principle in water.

Another example of Bernoulli's principle at work in the water is when an eggbeater kick is performed during a game of water polo. Lift force is created as the legs circle under the water, creating pressure differences between the top and bottom of the leg and foot. This lift force acts to push the athlete up above the surface of the water (as shown in Source 5). Similarly, synchronised swimmers are able to support themselves in the water by using continuous sculling actions of their hands and feet. The flow of water over these parts of the body creates a lift force that holds them steady in the water or propels them above the surface of the water.

Applying Bernoulli's principle in the air

In many sports, athletes look for ways to achieve one or more of the following goals:

- to make objects travel through the air more efficiently – by increasing lift and reducing drag – in order to maximise the distance travelled (e.g. javelin, discus and shot put)
- to manipulate the speed, spin and direction of objects – by controlling lift and drag – in order to maximise their chances of success (e.g. cricket, soccer and tennis).

The ability of athletes to achieve these goals can often mean the difference between success and failure during performance. In order to succeed, many athletes rely on factors described in Bernoulli's principle.

Magnus force
a type of force that explains why objects that are spinning as they travel through the air curve away from the trajectory (i.e. pathway) they would ordinarily follow if they were not spinning

SOURCE 6 In many sports, athletes look for ways to maximise the distance travelled by objects (e.g. a discus throw), or manipulate the speed, spin and direction of objects (e.g. a ball bowled in cricket). In both cases, athletes rely on elements of Bernoulli's principle.

The Magnus force

The **Magnus force** (also known as the Magnus effect) was proposed by German physicist Heinrich Magnus in 1852. Magnus force is the reason why objects that are spinning as they travel through the air curve away from the trajectory (i.e. pathway) they would ordinarily follow if they were not spinning.

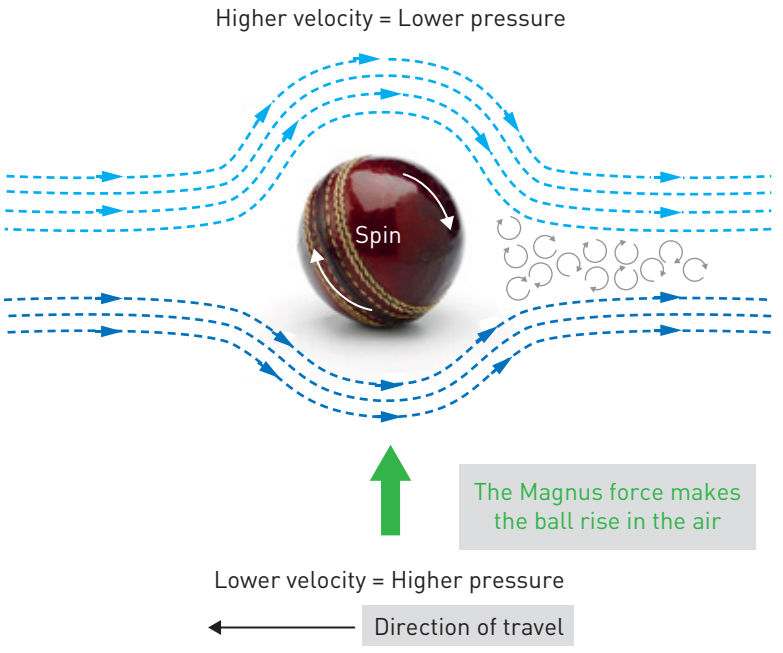
Magnus force and Bernoulli's principle are closely related because Magnus force takes the central idea of Bernoulli's principle – i.e. that an object will always move from an area of high pressure to an area of low pressure – and extends on it by adding information relating to various types of objects and the ways in which they can spin. These include:

- **topspin** – when an object rotates forwards, causing it to drop sharply during flight
- **backspin** – when an object rotates backwards, causing it to fall slowly towards the end of its flight
- **sidespin** – when an object rotates sideways, causing it or curve left of right during flight.

topspin
when an object (i.e. projectile) rotates forwards, causing it to drop sharply during flight

backspin
when an object (i.e. projectile) rotates backwards, causing it to fall slowly towards the end of its flight

sidespin
when an object (i.e. projectile) rotates sideways, causing it to curve left or right during flight



SOURCE 7 Magnus force

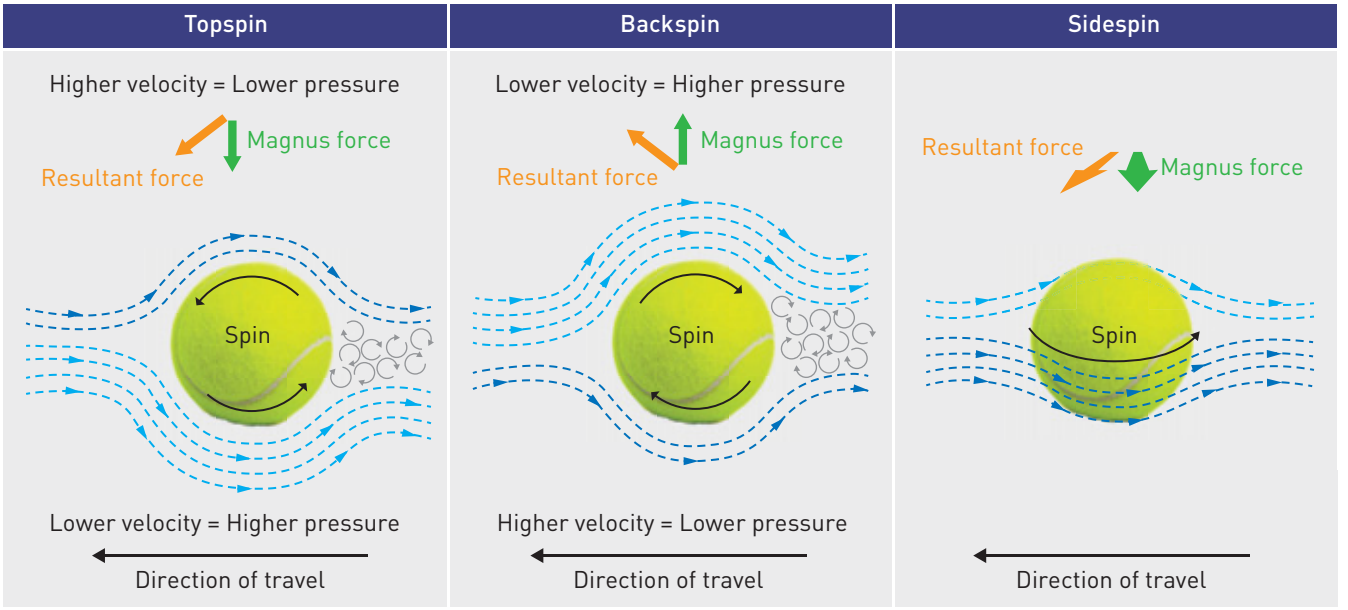
FOR THE RECORD!

Rafael Nadal hits the heaviest topspin forehand in the game of tennis! His average spin rate is 3200 rpm, but he has been measured at 5000 rpm (at peak). By comparison, Roger Federer has an average spin rate of 2500 rpm.

You can see the Magnus force at work when watching the flight paths of balls that are given a spin at the same time as they are thrown, hit or kicked. In sports such as tennis, soccer, cricket, softball and many more, players rely on spin to curve the ball and increase their chances of scoring points or defeating their opponents. These athletes will often use various techniques to increase the efficiency of a projectile. For example, bowlers in cricket often deliberately apply spin to the ball to make it follow a curved flight path. This makes it difficult for the opposing batter to read the directions of the ball and hit it accurately.

To illustrate the effect of Magnus force, we will now look at the example of a spinning cricket ball (see Source 8):

- As the ball moves through the air, its spinning motion causes the air pressure on one side to be less than on the other side.
- Velocity increases (and air pressure decreases) on the side of the ball that is travelling in the same direction as the air around it.



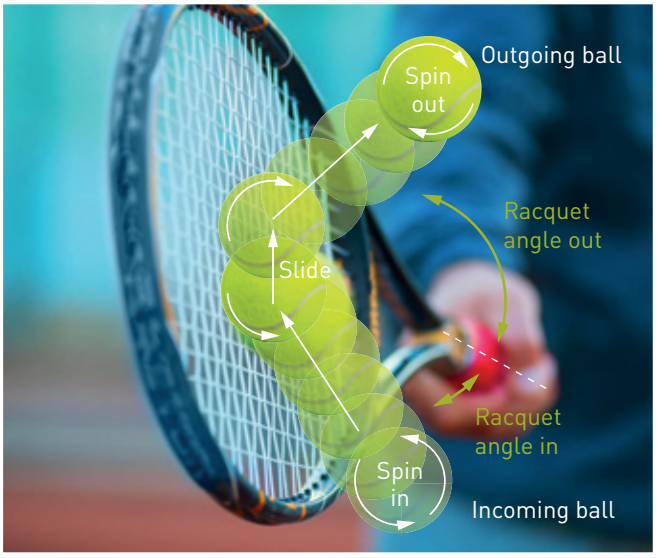
Topspin	Backspin	Sidespin
If a ball moves through the air with **topspin**: → air flows over the top of the ball at a lower velocity (because it is travelling against the direction and speed of spin on the ball). This creates an area of high pressure above the ball → air flows over the bottom of the ball at a higher velocity (because it is travelling with the direction and speed of spin on the ball). This creates an area of low pressure under the ball. → The difference in pressure creates a downward Magnus force on the ball.	If a ball moves through the air with **backspin**: → air flows over the top of the ball at a higher velocity (because it is travelling with the direction and speed of spin on the ball). This creates an area of low pressure above the ball → air flows over the bottom of the ball at a lower velocity (because it is travelling against the direction and speed of spin on the ball). This creates an area of high pressure under the ball. → The difference in pressure creates an upward Magnus force on the ball.	If a ball moves through the air with **sidespin**: → air flows over one side of the ball at a higher velocity (because it is travelling with the direction and speed of spin on the ball). This creates an area of low pressure on one side of the ball → air flows over the other side of the ball at a lower velocity (because it is travelling against the direction and speed of spin on the ball). This creates an area of high pressure on the opposite side the ball. → The difference in pressure creates a sideways Magnus force on the ball.

SOURCE 8 The Magnus force can be explained by Bernoulli's principle and determines what happens to an object when it undergoes topspin, backspin or sidespin.

- Velocity decreases (and air pressure increases) on the other side of the ball where the spin is moving against the direction of the air flow around it.
- The effects of the different velocity and air pressure on each side of the spinning ball cause it to curve towards the side with the higher velocity and lower air pressure as a result of the Magnus force.

Tennis players for example, use a variety of spins to control the height of their shots. This makes sense strategically. For example, a ball hit with topspin will have greater clearance over the height of the net due to the ball being hit into the air using a swing path from low to high through impact. This technique is demonstrated by Roger Federer in Source 9. Federer creates topspin by producing a racquet swing path (red line) from low to high. This swing path produces a Magnus force to bring the ball back into the court rather than flying out of the stadium.

Tennis players also manipulate the racquet face through impact to hit around the outside of the ball. This produces shots that can curve left or right through the air. Furthermore, when tennis players hit under the ball by using a relatively flat swing path (i.e. a slice or drop shot), this places backspin on the ball and forces it to 'float' through the air. Various spins are created depending on where force is applied to the tennis ball (see Source 9). These spins can create tennis shots that move through the air at different heights and different arcs. They can also produce unpredictable results when balls bounce off the surface of the court.



SOURCE 9 The white line shows how Roger Federer imparts topspin by having a swing path that moves from low to high just prior to impact.

Theory in action | Golf balls in flight

Have you ever wondered why golf balls are covered in small dimples? The answer is that dimples on golf balls actually improve their ability to travel greater distances. As a result, golf ball manufacturers spend a great deal of time determining the optimum depth and pattern of golf ball dimples.

The dimples work in several ways:

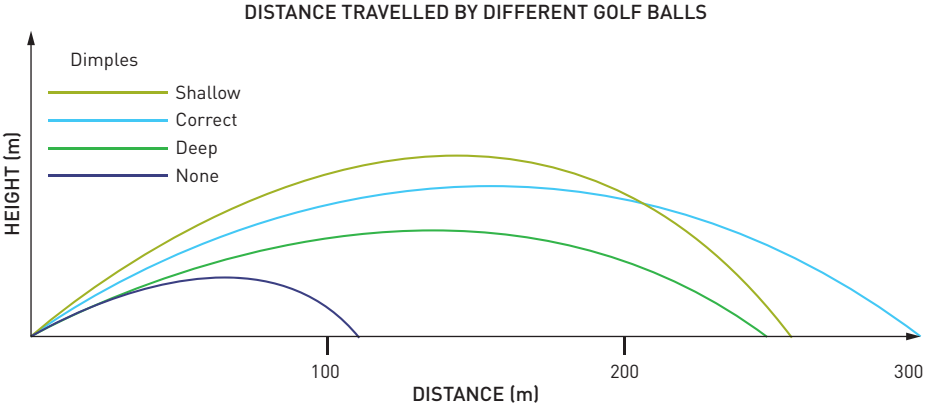
→ They act to reduce the air resistance – as the ball flies through the air, a boundary layer of air forms around the ball.

→ They act like small scoops to push air around and enhance the effects of Bernoulli's principle and the Magnus force – this helps to increase lift and reduce drag.

→ They help to force the air around the ball as it spins – less air pressure builds up behind the ball, reducing drag.

Finally, the size of the dimples on a golf ball count. If the dimples are too deep, they increase the ball's resistance through the air and shorten its trajectory. If the dimples are too shallow, they do not provide the benefits of reducing air pressure and increasing lift.

SOURCE 10 When hit with the same force, an old, worn out golf ball with hardly any dimples will still travel higher and further than a golf ball with no dimples, or one with dimples that are too deep.



In summary, the effect that Bernoulli's principle and the Magnus force can have on a ball is determined by:

- how much force is applied at impact
- the angle of the implement (e.g. racquet) at impact
- the size and shape of the ball (e.g. a larger ball = greater surface area = more air resistance = more movement)
- the density of the air (e.g. greater density = more air resistance = more movement).

3.13 Check your learning

Engage and understand

1 In your own words, **define** Bernoulli's principle.

2 **Explain** the relationship between Bernoulli's principle and the Magnus force using an example from your selected physical activity.

3 **Identify** the factors that impact the spin of a projectile.

Analyse and apply

4 In 2018, members of the Australia cricket team were involved in a ball tampering scandal when they were caught scratching the ball with sandpaper. **Reflect on** what you have learnt about Magnus force and explain what the cricketers were hoping to achieve by making one side of the ball rough while keeping the opposite side smooth.

5 Look closely at Source 10. Using Bernoulli's principle **analyse** the information provided in the graph and account for the differences in the distances travelled by a golf ball with no dimples and a golf ball with deep dimples.

6 **Apply** what you have learnt about Bernoulli's principle and the Magnus force in order to suggest how a volleyball player who cannot reach above the height of the net might use the principles of spin to perform an effective spike. Your response should include a diagram to illustrate your suggested solution.

Evaluate and justify

7 A first and second serve in tennis should be hit with the same velocity, but a tennis player will often apply a different spin to the ball on a second serve. **Evaluate** which type of spin would be most effective for a second serve and **justify** your choice in a 150-word written response.

8 When treading water, water polo players can move their hands in a sculling motion; move their feet using the eggbeater technique – or both simultaneously. With reference to Bernoulli's principle, **justify** whether using just your hands or just your feet is more efficient.

9 **Assess** the impact applying spin to a ball will have on the ease at which a softballer can pitch at a high velocity.

SOURCE 11 A tennis player will often apply more topspin to the ball on a second serve.

Check your obook assess for the following additional resources and more:

- **» Student book questions** 3.13 Check your learning
- **» Video weblink** The Bernoulli effect
- **» Video weblink** Understanding Magnus force
- **» Weblink** Topspin and backspin

3.14 Analysing specialised movement sequences

That's a goal!

By the end of Section 3.14, you should be able to:

→ **analyse** specialised movement sequences (from your selected physical activity) using functional anatomy and biomechanical concepts

→ **identify** and **evaluate** different phases and sub-routines from specialised movement sequences (in your selected physical activity)

→ **devise** biomechanical strategies to improve the performance of specialised movement sequences

→ **apply** relevant body and movement concepts in order to improve your specialised movement sequence.

Putting theory into action

Throughout this chapter you have learnt many new concepts and skills from two specialised fields of science – functional anatomy and biomechanics. These concepts and skills work together to inform our understanding of:

- how the muscles and bones in the body work together to produce movement
- how the laws of mechanics relate to motion (i.e. the movement of people and things) and the forces that produce motion.

Understanding how these concepts apply to various sports and physical activities can help you to:

- **improve technique** by identifying errors early and correcting them
- **optimise performance** by implementing the most effective techniques at the right times (while identifying and exploiting weaknesses in the technique of opponents)
- **improve safety and reduce the risk of injury** by identifying potential risks and detecting issues early.

In this section, we will model an approach for putting all of the theory you have learned in this chapter into action. We will do this by providing the general framework and tools you will need in order to analyse a specialised movement sequence of your choice (from your selected physical activity). The framework is presented in a number of steps that will provide general recommendations and tips that are applicable to a whole range of skills from different sports.

Choosing the best approach

The goal of any analysis is to identify strength and weakness in the performance of specialised movement sequences (i.e. motor skills) by collecting, recording and analysing movement and skill data. Before you begin your performance analysis, you will need to decide on the types of data you will collect and the type of approach you will take for data collection.

Types of data

There are two types of data that can be useful and relevant when carrying out a performance analysis. These include:

- **primary data** – any data that you collect yourself that relates directly to your performance (e.g. video footage or photographs of your performance, sketches, personal performance statistics, etc.)
- **secondary data** – any data that you do not collect yourself, but may still relate directly to your performance (e.g. video footage or photographs of elite athletes taken by other people, sketches or visual analysis performed by other people, performance data for other athletes, etc.).

When conducting your own performance analysis over the two-year course, you will be expected to use a combination of primary and secondary data.

Types of analysis approaches

There are two approaches to choose from when carrying out a performance analysis. These include:

- **quantitative analysis** – this approach focuses on collecting and analysing data that can be recorded in numbers (e.g. measuring and analysing aspects of performance such as heart rate, stride length, distance covered, time spent in the air)
- **qualitative analysis** – this approach focuses on collecting and analysing data that can be recorded in words (e.g. describing and analysing aspects of performance such as personal journals or diaries describing 'quality' of movement, personal observations, feelings and thoughts).

When conducting your own performance analysis this year, you may opt to carry out a quantitative analysis or qualitative analysis; however, in order to get the most out of the process, it may be wise to incorporate elements from both approaches.

SOURCE 1 The goal of any analysis is to identify strength and weakness in the performance of specialised movement sequences (i.e. a combination of fundamental movement skills) – and devise strategies for improvement – by collecting, recording and analysing movement and skill data.

primary data
any data that you collect yourself that relates directly to your performance (e.g. video footage or photographs of your performance, sketches, personal performance statistics, etc.)

secondary data
any data that you do not collect yourself, but may still relate directly to your performance (e.g. video footage or photographs of elite athletes taken by other people, sketches or visual analysis performed by other people, performance data for other athletes, etc.).

quantitative analysis
a type of analysis that focuses on data that can be recorded in numbers (e.g. measuring and analysing aspects of performance such as heart rate, stride length, distance covered, time spent in the air)

qualitative analysis
a type of analysis that focuses on data that can be recorded in words (e.g. describing and analysing aspects of performance such as personal journals or diaries describing 'quality' of movement, personal observations, feelings and thoughts)

Performance analysis framework

There are five stages to conducting an effective performance analysis of a specialised movement sequence:

- Stage 1 – Select your specialised movement sequence and identify its objective
- Stage 2 – Identify a model of effective technique
- Stage 3 – Observe your performance and gather data
- Stage 4 – Evaluate your performance
- Stage 5 – Devise and implement strategies for improvement

Stage 1 – Select your specialised movement sequence and identify its objective

Before you can begin any kind of performance analysis, you will need to:

- **Select a specialised movement sequence (from your selected physical activity)**
  1. Choosing the right specialised movement sequence is the key to a conducting a successful and beneficial analysis. Specialised movement sequences are complex movement skills. This means they combine a number fundamental movement skills (like walking, running, jumping) in demanding performance environments such as organised games and sports. Examples of specialised movement sequences include fielding a ground ball in softball; climbing a rock wall; performing a grapevine step in aerobic gymnastics.
  2. You may choose to analyse a specialised movement sequence that you consider to be an area of weakness for you – in order to understand how you can improve it.
  3. Alternatively, you may choose to analyse a specialised movement sequence that you consider to be an area of strength for you – in order to improve it further or understand how to transfer particular skills to other movement sequences.
- **Identify the objective of the specialised movement sequence**
  1. Correctly identifying the objective of the specialised movement sequence is also important for a successful analysis. For example, the objective of a discus throw is to apply effective techniques to make the discus travel over the greatest distance possible, while staying within the rules of the sport.
  2. If the objective of the specialised movement sequence is poorly articulated or wrong, the analysis will not be useful. For example, if the objective of a volleyball serve is identified as 'getting the ball over the net', an unhelpful analysis may be conducted. Instead, the objective should be articulated as 'use specialised technique in hitting the ball over the net, ideally in a way that prevents the return of the ball'.
- **Identify the individual phases and sub-routines of the specialised movement sequence**
  1. Once you have determined the objective of your selected skill, you can begin to break it down into its component. First, identify the various skill phases that combine to form the specialised movement sequence. This makes it easier to analyse and compare how concepts have been applied throughout execution.

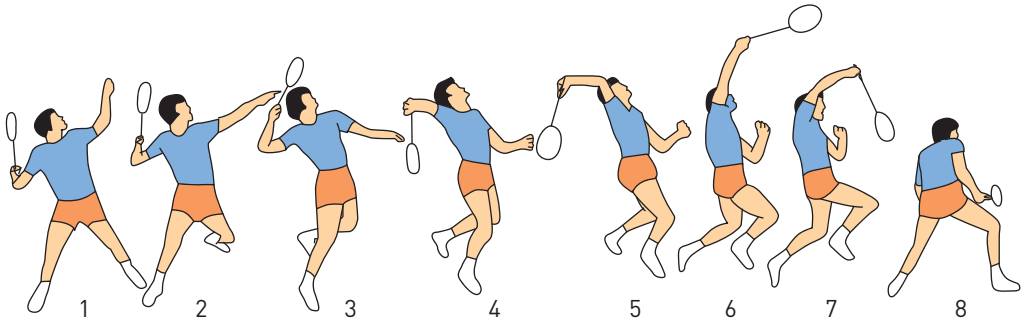
2 Once each phase has been identified, break these down further by looking at the specific sub-routines that make up the phase. This allows a more detailed analysis that can identify which phase, or more specifically, which sub-routine, has the greatest impact on your performance.

3 Similar specialised movement sequences across different sports have similar phases. As an example, Source 2 shows six striking activities across different sports that all share common phases. Common phases also exist for kicking activities in different sports.

	Badminton smash	Volleyball spike	Volleyball serve	Tennis forehand	Softball hit	Golf swing
PHASES	Approach	Approach	Preparation	Approach	Preparation	Stance
	Take off (optional)	Take off	Ball toss	Preparation		Backswing
	Swing	Preparation	Swing	Swing	Swing	Downswing
	Impact	Impact	Impact	Impact	Impact	Impact
	Follow through	Follow through	Follow through	Follow through	Follow through	Follow through

SOURCE 2 Phases for striking activities

We will illustrate the process of breaking a specialised movement sequence into phases and sub-routines using a badminton smash as an example.



SOURCE 3 The phases of a forehand smash in badminton

Specialised movement sequence	Sub-routines	
Forehand smash	→ Take off position → Adjust grip → Racquet arm back (strings down) → Raise non-racquet arm	→ Jump (optional) → Forward swing → Impact → Follow through

SOURCE 4 Sub-routines of a forehand smash in badminton

Stage 2 – Identify a model of effective technique

In the second stage of the performance analysis, you will need to identify a model of effective technique. This involves finding an example of a specialised movement sequence being performed in the 'ideal' way. You can do this by finding video footage, images or information online, or by observing demonstrations by your teacher or other students in your class).

The performances of elite (i.e. professional) athletes are often ideal for modelling effective technique. They make good subjects for activity analysis because they often exhibit the movements and skills that are most likely to lead to optimal performance. It is important to remember, however, that some professional athletes are successful in spite of poor technique.

SOURCE 5 Almost all elite badminton athletes demonstrate near identical body positions at impact. This position is an ideal model of effective technique.

STUDY TIP

The body and movement concepts include:

- body awareness
- space awareness
- quality of movement
- relationships.

These concepts will need to form part of your movement analysis and are discussed in detail in Section 2.7 (pages 69–75).

It's easy to find images of elite athletes performing a variety of skills on the internet. Research will also reveal specific aspects to consider when analysing elite performance, such as the angle of the leg when jumping, the optimum release angle for a projectile, where the centre of gravity should be in relation to the base of support, and the efficient movement patterns and lines of approach for a particular skill. This information will help to identify the essential biomechanical and anatomical concepts that apply to your chosen skill.

Identify relevant body and movement concepts

At this stage of the analysis, it is helpful to establish which body and movement concepts are relevant to the execution of your specialised movement sequence. For example, one possible specialised movement sequence in badminton is the transition from offence (attacking from the front court) to defence (back court position). Two body and movement concepts that directly relate to this movement sequence are:

- speed – quality of movement
- body action and position (i.e. balance) – body awareness.

Identifying how speed and balance can be improved through the application of anatomical and biomechanical concepts will not only help you improve your critical thinking skills, it will also help optimise your performance.

Some aspects of a badminton performance to consider relating to speed and balance are listed in Source 6 below.

Aspect of performance	Example	Relevant sub-routine to focus on
Base of support	A wide stance will increase stability; a narrow stance will not allow sufficient force to be applied for upward movements when jumping.	Sub-routine to consider would be width of feet and being in a side-on position for take-off.
Moving into position	Feet should stay close to the ground when moving, to increase speed.	Sub-routine to consider would be pivot step to get side-on and quick 'shuffle' movements.
Balance	Consider the position of your centre of gravity and where the line of gravity falls. Another aspect to consider is raising the non-hitting arm as you shuffle back to position.	Body positioning and posture are relevant sub-routines to consider. To stop yourself overbalancing, your body weight needs to be on the inside of the back foot when bracing to jump (centre of gravity fall within base of support).
Inertia	If flat-footed, there will be greater body resistance to overcome when moving.	Where weight is positioned would be the sub-routine that improves balance and speed; that is, weight should be on the balls of your feet.

SOURCE 6 Aspects of badminton performance

Stage 3 – Observe your performance and gather data

In the third stage of the performance analysis, it is time to observe yourself performing the specialised movement sequence you have chosen (and collect a range of data relating to your performance).

Data collection is the process of gathering and recording information. The most common way to gather data is through observation. Observation is a practical method of data collection, but there are a number of factors to consider before you complete this stage of the analysis.

These are summarised in Source 7.

STUDY TIP

When you are searching for a model of effective technique, make sure that any video footage you locate has been captured from a similar perspective to the skill sequence you have recorded (or vice versa).

This will allow you to annotate your footage and identify the phases and sub-routines more easily. This will also help you compare techniques more consistently.

Method	Description
Choose the most suitable environment	→ It is important to identify the best environment in which to perform your chosen movement sequence: – Performing in a closed environment (e.g. alone in a quiet area) allows for greater control of the environment and execution of the skill. – Performing in an open environment (i.e. during a game) allows for more authentic performance conditions. → You may like to observe the performance of the skill in both situations to provide the best of both worlds.
Choose the most suitable day and time of day	→ It is important to perform your chosen movement sequence at a time when you are: – well rested – free from injury and illness – used to performing the skill (e.g. early in the morning or later in the afternoon).
Choose the most appropriate method of data collection	→ There are a number of methods that can be used to help you observe and record the performance of your chosen movement sequence. These include: → **Visual methods** – digital video recordings (e.g. smart phones, digital cameras, GoPro, etc.) – continuous high-speed photography (e.g. smart phone 'burst' mode or digital cameras) – video analysis apps (e.g. Coach's Eye, Spark Motion, Coach My Video, Dartfish) – motion capture (e.g. specialised infrared cameras and body markers) – camera drone (e.g. a mobile drone fitted with video camera to capture game play from above) → **Non-visual methods** – performance diaries (e.g. personal recounts of performances) – training logs – statistical data (e.g. heart rate, distance travelled) – game performance assessment instruments (GPAIs).
Choose the most suitable angles and viewing position	→ It is important to consider the following factors when observing your chosen movement sequence: → **Angles** – In most cases, the observation should be recorded from a position at right angles to the performance (i.e. side on); however, in some cases it is also very helpful to observe performance from multiple angles (e.g. side, front, back, above) → **Viewing position** – The viewing position needs to have a clear, uninterrupted line of sight to the performer. It cannot be too far from the action (as the recording will be unclear) or too close to the action (as aspects of the performance will be out of frame and the equipment may interfere with the performance) → Always conduct a number of test performances to check that your recording equipment is functioning correctly and that the images captured are suitable in terms of clarity and action being captured.
Choose a suitable number of performances	→ It is important to identify the right number of performances required for a representative indicator of your overall abilities. → It may be sufficient to record the movement sequence being performed 4–5 times in a single environment. Alternatively, you may wish to record the movement sequence being performed 5–10 times across a number of different environments (i.e. closed and open).

SOURCE 7 There are a number of methods (and types of equipment) that can be used to help you observe and record the performance of your chosen movement sequence – some of the most useful and widely available include digital video recordings and smartphone apps.

Stage 4 – Evaluate your performance and devise strategies for improvement

In the fourth stage of the performance analysis, it is time to analyse and evaluate all of the data you have gathered and devise some strategies to improve (or correct) certain elements of your performance. In order to do this, you will need to:

- view all of the video footage
- look over any non-visual material you have collected
- compare and contrast your performance of the movement sequence with the model of effective technique, paying particular attention to:
  - differences in technique
  - any errors or issues in your performance
  - any strengths in your performance.

Once you have observed your performance, you will be able to determine the most important element (or elements) to correct.

In many cases, it is the initial phase of the movement sequence that requires most attention. This is due to technique errors involving larger muscle groups used (e.g. in the legs) and the base of support. The base of support qualities will dictate what type of force is required for your movement sequence. Skills that require agility require a smaller base of support for changing direction as the smaller base of support makes you less stable and hence, it is easier to overcome your body's inertia (resistance to change). Jumping for height (e.g. a badminton smash take-off) requires explosive power to be transferred to smaller body parts. This requires a more stable base, as explained in summation of forces (Section 3.7). Another factor to consider is the angle at which your legs bend prior to jumping to exert maximal force.

The easiest way to collate data and evaluate your performance is through a compare and contrast table (see Source 8).

FOR THE RECORD!

Badminton is the fastest racquet sport in the world with shuttlecock speeds reaching more than 300km/hr. Maximising technical efficiency through biomechanical analysis is crucial in being able to keep up with such speed. The original concept for badminton was invented in China but instead of the shuttlecock being hit with a racquet, players used their feet. Now, this would have required some significant technical prowess!!

SOURCE 8 Evaluate your performance of the specialised movement sequence and devise strategies for improvement

Qualitative observations			
Specific movement sequence: Badminton smash: Forehand			
Body movement concept: Accuracy (quality of movement)			
When I move to hit the shuttlecock, I am facing front on. When jumping (not very high), I am often overbalancing and falling backwards at impact. I make impact with the shuttlecock above or behind my head. The end result is the shuttlecock often goes upwards...not desirable for a smash!			
Phase	**Elite athlete (sub-routines)**	**You (probable sub-routine errors)**	**Relevant biomechanical concept/s**
Approach	Weight on balls of feet Move to anticipate impact point Pivots to turn side-on Starts momentum for shuffle steps to get into position Wide stance Body facing sideways Feet parallel to back line Weight on the back leg Back leg is bent to absorb force Racquet back Strings facing down Shoulder alignment (hitting shoulder lower)	Run towards impact point Facing front on. Body facing forwards Racquet in front of body and down	Newton's 1st law Momentum Base of support Balance
Take-off	Push off back leg for height Non striking arm raised Legs bent when jumping	Not stable when jumping Not using non-hitting arm to help generate height	Newton's 3rd law Balance Summation of forces
Swing	Elbow of hitting arm leads action Racquet strings face the ground as racquet approaches impact	Minimal arm bend resulting in racquet travelling a shorter distance through swing Minimal torso rotation	Shortening lever (third-class) Rotational momentum (elbow) Transferring momentum (jump into swing) Summation of forces (transferring momentum to hitting arm)
Impact	Shuttlecock hit in front of the body Impact where arm is fully outstretched Shuttlecock trajectory is down	Impact above or behind head No power Direction of shuttlecock is up	Impulse: direction of applied force Class 3 lever Newton's 2nd law
Follow through	Back foot comes forward Land with wide stance Knees remain bent to absorb landing Racquet follows intended path of shuttlecock	Minimal follow through due to a lack of force	Absorption of momentum

SOURCE 9 Qualitative analysis of badminton smash

The body movement sequence that has been identified for improvement is accuracy. First reflections could determine that the 'impact phase' is the source of the problem – a shuttlecock hit too late due to the body moving backwards when jumping will produce erratic forehand smashes. The root cause of hitting the shuttlecock at the wrong time is being in the wrong position to execute the forehand smash. Therefore, one way to improve accuracy would be to modify the sub-routine of how you move into position.

SOURCE 10 Biomechanical analysis will allow you to maximise your technical ability. This section uses examples from the sport of Badminton.

Error	Impact behind the head
Biomechanical solution	Move to a side-on position with a wide base of support to increase stability and allow the line of gravity to fall within base of support
Body movement concept	Movement pathways – Space awareness:
Outcome	Improved body position to hit the shuttlecock in front of the body: a more accurate and downwards shuttlecock trajectory.

SOURCE 11 Forehand smash error analysis

Other diagnoses appear in the table below.

Phase	Identified error/problem	Sub-routine correction strategy	Body and movement concept
Approach	Hitting shuttlecock behind head	Get side-on, shoulder alignment with non-hitting arm raised	Space awareness
Take-off	Lack of power	Increase stability by bracing back leg prior to jumping for height	Body awareness
Swing	Lack of power	Shorten lever of hitting arm Lengthen path of racquet	Quality of movement
Impact	Shuttlecock travels upwards	Correct the grip: Shake hand grip with the handle completely in the hand	Relationships
Downswing	Poor timing	Prepare racquet early Strings face the ground	Relationships

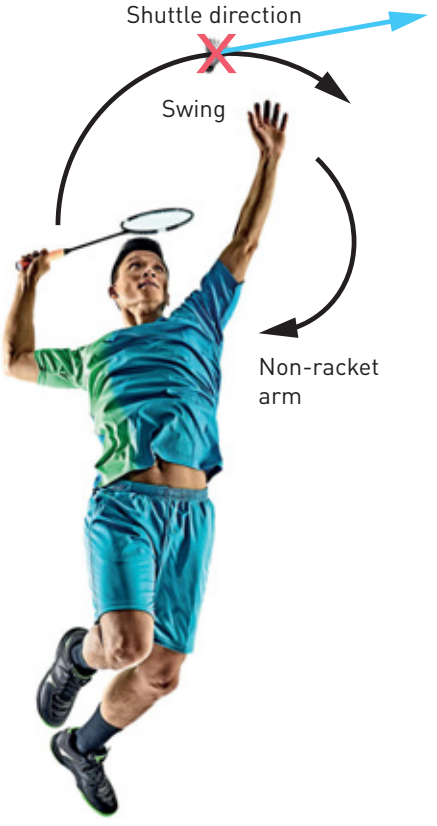
SOURCE 12 Sub-routine diagnosis

Stage 5 – Implement strategies for improvement

To determine if your analysis has been relevant and useful, and evaluations are correct, you will need to implement your selected strategies and practice them over a period of time with your teacher or coach. Refinement of a change in technique should incorporate practice methods from Chapter 2, Motor learning. Some considerations could be:

- Skill complexity: If the skill was complex, part practice is recommended, where you work on the specific sub-routines before practising the whole specialised movement sequence.
- Type of environment: A closed environment allows you to control the variables within the sub-routines and ensure that the specific modifications are developed and stored as a new motor program.
- Type of practice: Associative and autonomous learners can benefit from massed practice to increase the automaticity and fluency of the specialised movement sequence. Cognitive learners require more frequent breaks and should use distributed practice to increase their efficiency and ability to identify errors.
- Feedback: Extrinsic feedback from a teacher or video can help refine minor technical modifications.

In order to make an objective assessment about whether or not the modifications to your technique have improved your performance of the movement sequence, you will need to observe yourself performing the skill again (under the same environment as you did in Stage 3 – Observe your performance and gather data). Your stage of learning should dictate whether your skill comparison is in an open or closed environment. Cognitive learners would show successful modifications more consistently in closed environments. Associative and autonomous learners should have sufficient fluency and skill level to demonstrate modifications in problem-solving drills or authentic situations. Problem-solving drills are easier to set up as they are more predictable in ensuring the performance of your selected movement sequence.



SOURCE 14 In badminton, the impact point for the smash is in front of the body, which will result in a more attacking shuttlecock trajectory.

Once you have collected this data, you can make direct comparisons between your original data, your new data, and the model of effective technique.

Source 6 identifies other methods of collecting data to help substantiate justifications. GPAIs and journal reflections can also provide specific data to support justifications and insightful modifications to your specialised movement sequence.

FOR THE RECORD!

Technology has revolutionised the way we analyse and optimise skill performance. Simple 2D imagery has been replaced by such things as: cameras that can capture movement using 500 frames per second (fps) at high resolution to 10 000 fps at a reduced resolution; digital floors that can measure force production; and electromyography devices that use wireless probes attached to an athlete to provide a dynamic analysis of muscle activity.

3.14 Check your learning

Engage and understand

1 **Identify** the five stages required for effective performance analysis.
2 **List** two different methods of data collection and provide two examples of each.
3 **Explain** why stability levels need to differ for:
   a different sports
   b various specialised movement sequences within a particular sport.
4 When collecting video footage of your specialised movement sequence, **explain** what considerations are involved.

Analyse and apply

5 **Differentiate** between a quantitative analysis and qualitative analysis.
6 **Determine** the objective of your selected specialised movement sequence.
7 **Determine** the phases and sub-routines relevant to the specialised movement sequence you have selected.
8 **Compare** and **contrast** the differences between jumping into a striking action (volleyball serve, badminton smash) or hitting from a stationary position (feet on the ground). **Reflect on** how these impact on the generation of force.

Evaluate and justify

9 **Evaluate** your performance of one specialised movement sequence from your selected physical activity. Use the four body and movement concepts in your analysis and discussion.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  3.14 Check your learning
- **» Additional resource**
  Performance analysis template
- **» Weblink**
  Quantitative and qualitative analysis
- **» Weblink**
  Tips for gathering video footage

CHAPTER 3 REVIEW

Sum it up!

3.1 **Functional anatomy** is the study of how muscles and bones in the body work together to produce movement.

3.2 The **skeletal system** provides a framework for movement and consists of the bones of the skeleton, tendons, ligaments and cartilage. All bones contain two forms of bone tissue: **compact bone** and **spongy bone**. All bones are classified into one of four main categories according to their shape: **long bones**, **short bones**, **flat bones** and **irregular bones.** Bones can also be classified according to their location: **sesamoid bones** and **sutural bones**.

3.3 Joints enable the range of movements required to perform specialist movement sequences. They are classified according to their structure and function: **fibrous joints**, **cartilaginous joints** and **synovial joints**. There are six types of synovial joints: ball and socket joints, gliding joints, hinge joints, pivot joints, ellipsoid joints and saddle joints. Joint movements can be **paired** (e.g. flexion and extension) or **unpaired** (e.g. hyperflexion, hyperextension, rotation).

PAGE 182

3.4 The **muscular system** is made up of all muscles responsible for movement (i.e. **skeletal muscles**). Muscles produce movement through one of two actions: **contraction** and **relaxation**. Skeletal muscles can be classified into three groups depending on the relationship they have with each other: **agonists**, **antagonists**, and **stabilisers** (i.e. synergists and fixators).

3.5 Biomechanics is the study of the laws of mechanics related to movement. Principles of biomechanics include the study of force, motion, balance and stability, levers and Bernoulli's principle.

3.6 **Force** is anything that causes, or has the potential to cause, a change in motion of the object on which it acts. There are two main categories of forces: **internal** and **external**. External forces include **contact forces** and **non-contact forces**.

3.7 **Force production** is the ability of the body to generate internal force (i.e. movement) against external force (i.e. resistance). Force production is often the combined result of **momentum**, **summation of force** and **impulse**.

3.8 **Motion** is the change in position of an object over time. There are many types of motion: **linear**, **curvilinear**, **angular** and **general**. Concepts used to describe motion include speed, velocity, acceleration, displacement and distance.

3.9 **Newton's three laws of motion** help to explain the properties of moving objects in order to optimise movement in a sporting context. They include Newton's first law of motion – **inertia**; Newton's second law of motion – **acceleration** and Newton's third law of motion – **action and reaction**.

3.10 **Projectile motion** is the movement of any object that has been launched, hurled or thrown in the air. Key factors that influence the trajectory (i.e. pathway) of a projectile include the **angle of release**, **height of release** and **speed of release**.

3.11 **Balance** is the even distribution of weight that enables a person or thing to remain in equilibrium. Balance can be static or dynamic. **Stability** is the degree to which a person or thing can resist challenges to their state of equilibrium. The ability of a person or thing to maintain their balance and stability depends on their **base of support**, **centre of gravity**, **line of gravity** and **mass**.

3.12 A **lever** is a simple machine consisting of a solid bar (or rod) supported by a pivot point. There are three classes of levers: **first-class**, **second-class** and **third-class**. Levers increase force (i.e. **force multipliers**) or speed (i.e. **speed multipliers**).

3.13 **Bernoulli's principle** explains that any increase in the velocity of a fluid is accompanied by a simultaneous decrease in pressure. **Magnus force** explains why objects that are spinning as they travel through the air curve away from the trajectory they would ordinarily follow if they were not spinning

3.14 Specialised movement sequences are made up of phases and sub-routines that can be investigated as part of a biomechanical analysis.

Dig deeper!

Exam-style revision questions and tasks

SECTION A

→ Ten multiple-choice questions

QUESTION 1

Functional anatomy is a field of science that studies

(A) how the skeletal system and muscular system interact to produce movement.

(B) how the skeletal system and nervous system interact to produce movement.

(C) how the skeletal system and muscular system interact to produce new blood cells.

(D) how tendons, ligaments and cartilage interact to produce movement.

QUESTION 2

There are three main types of muscles in the human body. These include:

(A) skeletal muscle, cardiac muscle and smooth muscle.

(B) skeletal muscle, cardiac muscle and internal muscle.

(C) skeletal muscle, striated muscle and non-striated muscle.

(D) skeletal muscle, voluntary muscle and involuntary muscle.

QUESTION 3

The appendicular skeleton is

(A) made up of 206 bones.

(B) attached to the axial skeleton and provides support for the long axis of the body.

(C) attached to the axial skeleton and provides support for the arms and legs.

(D) attached to the axial skeleton and provides support for the vertebral column.

QUESTION 4

The structure of a joint determines

(A) how it functions.

(B) how big it is.

(C) which ligaments are required to hold it together.

(D) how effective the articular cartilage is at cushioning the bones.

QUESTION 5

Isometric contraction is

(A) a process in which the muscle fibres produce tension as they shorten or lengthen.

(B) a process in which the muscle fibres produce tension but neither shorten nor lengthen.

(C) a process in which the muscle lengthens to release the bones and move them further apart.

(D) a process in which the muscle shortens to pull on bones and bring them closer together.

QUESTION 6

Force is defined as

(A) an interaction that causes (or has the potential to cause) a change in the motion of an object.

(B) an interaction that causes (or has the potential to cause) a change in the mass of an object.

(C) an interaction between the body and the external environment.

(D) an interaction that is generated inside the body.

QUESTION 7

General motion is a combination of

(A) linear and curvilinear motion.

(B) linear and angular motion.

(C) angular and curvilinear motion.

(D) linear, angular and curvilinear motion.

QUESTION 8

Bernoulli's principle explains that as the velocity of a fluid or gas increases

(A) its pressure increases.

(B) its pressure decreases.

(C) its pressure stays the same.

(D) it moves from an area of high pressure to low pressure.

QUESTION 9

Newton's first law of motion states: 'A body continues in a state of rest or uniform velocity unless acted upon by an external force.' This is known as

(A) inertia. **(B)** acceleration.

(C) action and reaction. **(D)** gravity.

QUESTION 10

Levers with a longer resistance arm are known as

(A) force multipliers **(B)** speed multipliers

(C) first-class levers **(D)** second-class levers.

SECTION B

→ Two short-response questions

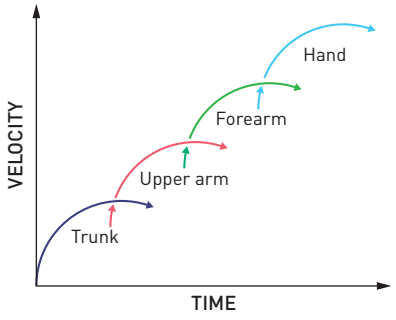
→ One extended written response question

QUESTION 11 (150 words)

The graph below shows how force is produced and transferred during a stationary throw.

a Annotate the graph to show how force production is maximised during the throw.

b Explain the concept of summation of forces, using examples from your selected physical activity to support your explanation.



QUESTION 12 (150 words)

Annotate this image to show where each of the six forces listed in the table below occur. Provide a brief description in the table for how each force is acting on its surroundings.

Force	Description
→ Ground reaction force	
→ Joint reaction force	
→ Friction force	
→ Drag force	
→ Inertial force	
→ Elastic force	

QUESTION 13 (400 words)

Read the following quote from US Olympic bobsled world champion Elana Meyers Taylor:

> 'We're all playing with Newton's laws. And whoever can navigate those laws the best, wins the race.'

Drawing on specific examples from your selected physical activity, discuss how you have 'played with' and 'navigated' Newton's laws to optimise your performance.

Check your obook assess for the following additional resources and more:

» **assess quiz**
Test your skills with this auto-correcting multiple-choice quiz for Chapter 3

» **Revision notes**
Make your own revision notes for assessment tasks with this handy template

» **Data analysis worksheet**
Chapter 3 review – Practice your data analysis skills with this worksheet

» **Practice assessment task ISMG**
Instrument-specific marking guide for the practice assessment task in Chapter 3

Practice assessment task

Subject	Physical Education	**Instrument number**	
Technique	Project – folio		
Unit	1 Motor learning, functional anatomy, biomechanics and physical activity		
Topic	2 Functional anatomy and biomechanics		

Conditions			
Duration	5 hours of class time		
Mode	Multimodal (visual and written or spoken)	**Length**	9–11 minutes
Individual / Group	Individual	**Other**	Examples of multimodal folios include: → a pre-recorded presentation submitted digitally → a presentation conducted in front of an audience (class or teacher) → a digital portfolio of video, images and diagrams with annotations or commentary → a multimedia movie or slideshow that may combine images, video, sound, text and a narrative voice.

Context

In this unit, you have engaged in integrated learning experiences applying functional anatomy and biomechanical strategies to improve your performance of a specialised movement sequence from your selected physical activity. To optimise your performance, you have modified your technique based on a qualitative biomechanical analysis.

Task

Justify the biomechanical modifications you have made to a specialised movement sequence to demonstrate an improvement in two body and movement concepts for one movement strategy.

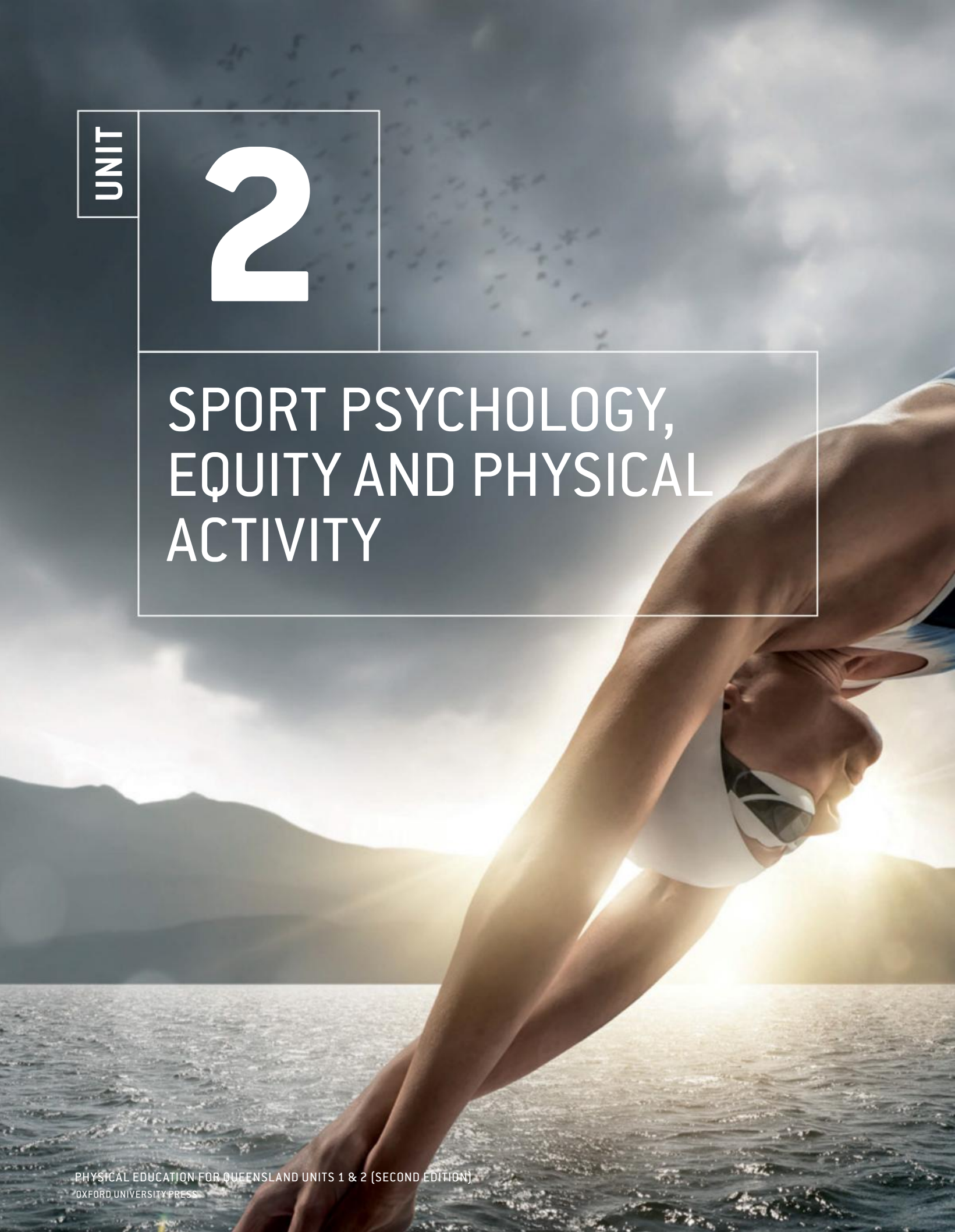
To complete this task, you must:

→ Recognise and explain:
  - that performance can be analysed using biomechanics, functional anatomy and by identifying applicable phases and sub-routines of movement in the selected physical activity
  - body and movement concepts about the specialised movement sequences.

→ Analyse primary data and secondary data to show how biomechanics and functional anatomy can influence performance.

→ Evaluate the effectiveness of:
  - biomechanical modifications to personal performance of the specialised movement sequence to enhance two body and movement concepts (quality of movement and one other)
  - selected biomechanical strategies to optimise personal performance.

You can find a detailed instrument-specific marking guide (ISMG) for this task on your obook assess.



UNIT

2

SPORT PSYCHOLOGY, EQUITY AND PHYSICAL ACTIVITY

UNIT 2 OBJECTIVES

In this unit you will:

- → recognise and explain sport psychology and equity concepts and principles about selected physical activities
- → demonstrate specialised movement sequences and movement strategies in the selected physical activity
- → apply concepts to specialised movement sequences and movement strategies in the selected physical activity
- → analyse and synthesise data to devise strategies about sport psychology and equity
- → evaluate sport psychology, equity and movement strategies
- → justify sport psychology, equity and movement strategies
- → make decisions about and use language, conventions and mode-appropriate features for particular purposes and contexts.

UNIT 2 TOPICS

The learning for this unit has been divided into two topics. The table below show how each topic aligns with the chapters in this book and lists the notional hours of teaching time for each topic.

Topic	Chapter	Notional hours
Topic 1 Sport psychology integrated with a selected physical activity from one of the six categories	Chapter 4 Sport psychology	33
Topic 2 Equity – barriers and enablers	Chapter 5 Equity – barriers and enablers	22

‘It is not the mountain we conquer, but ourselves.’

Sir Edmund Hillary (1919–2008)

New Zealand mountain climber and explorer who, together with the Tibetan mountaineer Tenzing Norgay, was the first person to reach the summit of Mount Everest (8848 metres above sea level)

CHAPTER

4 SPORT PSYCHOLOGY

KEY TERMS

By the end of this chapter, you should understand the meanings of the following key terms. They are defined throughout the chapter, as well as in the glossary. Use this handy checklist to test your understanding.

- ☐ affirmations
- ☐ amotivation
- ☐ anxiety
- ☐ arousal
- ☐ attention
- ☐ autonomy
- ☐ breathing techniques
- ☐ choke
- ☐ cognitive anxiety
- ☐ competence
- ☐ concentration
- ☐ confidence
- ☐ goal setting
- ☐ group norms
- ☐ group roles
- ☐ irrelevant cues
- ☐ meditation
- ☐ mental rehearsal
- ☐ motivation
- ☐ negative self-talk
- ☐ non-self-determined motivation
- ☐ outcome goals
- ☐ over-arousal
- ☐ performance goals
- ☐ performance segmenting
- ☐ positive cue words
- ☐ positive emotions
- ☐ positive self-talk
- ☐ pre-competition routines
- ☐ pre-task routines
- ☐ process goals
- ☐ progressive muscle relaxation (PMR)
- ☐ relaxation and energiser techniques
- ☐ relevant cues
- ☐ self-belief
- ☐ self-confidence
- ☐ self-determination theory
- ☐ self-determined motivation
- ☐ self-efficacy
- ☐ self-talk
- ☐ SMARTER principle
- ☐ social cohesion
- ☐ somatic anxiety
- ☐ sport psychology
- ☐ task cohesion
- ☐ team cohesion
- ☐ team dynamics
- ☐ under-arousal
- ☐ visualisation

SUBJECT MATTER OUTCOMES COVERED IN CHAPTER 4

The following tables list all of the subject matter dot points you are required to cover in **Unit 2 – Topic 1** of the Physical Education General Senior Syllabus. They also show you exactly where that subject matter is covered in this Student book.

Unit 2 – Topic 1: Sport psychology integrated with a selected physical activity

In Unit 2 – Topic 1, students engage in learning that involves the integration of sport psychology subject matter and the subject matter from a selected physical activity.

Stage 1: Engage and understand

Subject matter	Section/s	Page/s
In this area of study, students will:		
→ recognise and explain that sport psychology aims to optimise performance through the application of psychological knowledge and strategies	4.1	192–195
→ recognise and explain the concept of – motivation as a continuum, from extrinsic to intrinsic	4.2	196–199
– confidence, including self-confidence, self-belief and self-efficacy	4.3	200–203
– arousal as a continuum, from relaxed drowsiness, wakefulness, curiosity and attentiveness to joy, exhilaration, anxiety, panic and rage	4.4	204–209
– attention and concentration, including broad, narrow, internal and external foci	4.5	210–213
– team dynamics and cohesion, including group roles, group norms and social support	4.6 4.11	214–217 230–232
→ identify and explore the impact of motivation, confidence, arousal, attention, concentration and team dynamics on personal performance in the selected physical activity	Skill Drill 4.4 Skill Drill 4.6 Skill Drill 4.9 Skill Drill 4.15	342–343 344–345 346–347 348–349
→ investigate information about psychological techniques that can be used to optimise performance – goal-setting techniques – process goals, outcome goals and performance goals	4.8	220–223
– mental rehearsal techniques – mental rehearsal of the entire performance, visualisation of one aspect of skill execution prior to performance, and internal and external perspectives of imagery	4.9	224–227
– positive self-talk techniques – using positive cue words and positive emotions to create self-belief	4.14	240
– self-confidence techniques – identifying how thoughts can affect self-confidence e.g. situation, thoughts, emotions and reactions, using affirmations to change personal reactions to situations	4.10	228–229
– pre-performance techniques – construction of a pre-performance routine and checklist; investigating mental rehearsal and pre-event tasks and cues to prepare for training and competition e.g. technical points, triggers or competition segments	4.12	233–235
– relaxation and energiser techniques – progressive muscle relaxation (PMR), deep breathing techniques, music and visualisation techniques	4.13 4.16	236–239 246
– attention and concentration techniques – selective attention, using trigger words, performance segmenting, pre-performance routines and within-competition routines	4.14 4.15 4.17	240–243 244–245 247
– team dynamics and cohesion techniques – leadership, communication, norms, rules and discipline	4.11	230–232
→ investigate the use of psychological techniques on personal performance in authentic performance environments	Skill Drill 4.4 Skill Drill 4.6 Skill Drill 4.9 Skill Drill 4.15	342–343 344–345 346–347 348–349
→ 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 the selected physical activity.	Chapter 4	188–251

Stage 2: Apply and analyse

Subject matter	Section/s	Page/s
In this area of study, students will: → analyse and synthesise primary data and secondary data about the influence of sport psychology concepts and principles on specialised movement sequences and movement strategies in the selected physical activity	Skill Drill 4.4 Skill Drill 4.6 Skill Drill 4.9 Skill Drill 4.15	342–343 344–345 346–347 348–349
→ optimise performance in the selected physical activity by devising personal and team sport psychology strategies that consider the influence of sports psychology concepts and principles on specialised movement sequences and movement strategies – effect of the psychological techniques on personal and team motivation, confidence, arousal, attention, concentration and/or team dynamics – factors affecting the implementation of the techniques		
→ implement the sport psychology strategies and movement strategies to gather primary data about the outcomes, implications and limitations of decisions		
→ analyse primary data and secondary data to ascertain relationships between the sport psychology and movement strategies, concepts and principles, and personal performance.		

Stage 3: Evaluate and justify

Subject matter	Section/s	Page/s
In this area of study, students will: → reflect on primary data and secondary data to evaluate the effectiveness of sport psychology and movement strategies to achieve a determined outcome including – meeting the requirements of personal and team performance in the selected physical activity – using suitable sport psychology techniques to optimise personal and team motivation, confidence, arousal, attention, concentration and/or team dynamics – optimising the performance of specialised movement sequences and movement strategies	Skill Drill 4.4 Skill Drill 4.6 Skill Drill 4.9 Skill Drill 4.15 Chapter 4 review – Practice assessment task	342–343 344–345 346–347 348–349 248–251
→ make decisions to maintain or modify the sport psychology strategies and movement strategies		
→ justify the development of sport psychology and movement strategies using evidence from primary data and secondary data		
→ justify maintenance or modification of the sport psychology and movement strategies using evidence from primary data and secondary data		
→ make decisions about and use language, conventions and mode-appropriate features to convey meaning for particular purposes and contexts.		

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Check your obook assess for the following additional resources and more:

» **Chapter glossary**
Learn key terms from Chapter 4

» **Flashcard glossary**
A digital interactive to help you test your knowledge of key terms

» **Weblink**
QCAA Physical Education General Senior Syllabus

4.1 Introduction to sport psychology

That's a goal!

By the end of Section 4.1, you should be able to:

→ **define** the term 'sport psychology'

→ **explain** how sport psychology aims to optimise the performance of athletes

→ **identify** five concepts that are central to sport psychology.

Defining sport psychology

sport psychology
a field of science that investigates how an athlete's mental processes (e.g. their thoughts and emotions) influence their participation and performance in sport and physical activity; the discipline of sport psychology aims to assist athletes to achieve optimum mental health and to improve performance

choke
(in sport) a term used to describe the failure of an athlete or team to perform to their full potential (e.g. freezing under pressure or making unnecessary errors due to nerves)

Sport psychology is a field of science that investigates how an athlete's mental processes – such as their thoughts, feelings and emotions – influence their participation and performance in sport and physical activity. The discipline of sport psychology aims to assist athletes to achieve optimum mental health and improve performance.

Early attempts at applying psychological theories in the sporting world began in the late 1800s, but it wasn't until the late 1900s that the field of sport psychology became accepted in its own right. Today, most professional athletes consult with sport psychologists on a wide range of issues, such as how to deal with pressure or overcome anxiety.

When training for any sport or physical activity, the best programs ensure an athlete is both physically and mentally ready to perform at their best. In sporting history, countless athletes in peak physical condition have been known to **choke** under pressure or fail to perform at their best during competition (see Source 1), because they did not have the necessary psychological knowledge, skills and techniques to help them deal with a range of situations. In fact, when competing athletes are matched in terms of their physical fitness and ability, the difference between the winner and the loser often comes down to their mental strength.

SOURCE 1 The intense pressure of competition can cause athletes to choke, even when they are at peak physical fitness. Nick Kyrgios is well known for taking out his frustrations on his racquet.

Theory in action | Greg Norman's 1996 US Masters meltdown

Greg Norman is an Australian golfing legend. During his career, he enjoyed 91 professional victories internationally and spent a total of 331 weeks ranked at world number one. Norman won two major tournaments and was runner-up eight times.

Ask your parents about Greg Norman and they will probably be familiar with his nickname: 'the Great White Shark'. They might also remember that Norman was involved in one of the most famous chokes in sporting history. It took place at the 1996 US Masters Tournament – the most prestigious event on the golfing calendar. Norman started out in near perfect form and by the final day, he had set up an almost unbeatable lead of six shots.

However, on the final day of competition, rival golfer Nick Faldo was '**in the zone**', playing the best round of the day at five under par. After the 7th hole, Norman's performance took a sudden turn for the worse. With each hole, his nerves began to get the better of him and his lead was whittled away. Norman was definitely not 'in the zone' – by the 18th hole, not only had he lost the tournament; he had lost it by five shots!

SOURCE 2 Greg Norman's performance at the 1996 US Masters will go down as one of the greatest chokes in the history of sport.

In a press conference afterwards, Norman admitted that the only thing he could do at the end of the day was walk down to the beach to sit, cry and ponder how it all went wrong. A video of the incident is provided on your obook assess.

Key concepts in sport psychology

There are many different concepts used in sport psychology to help athletes build mental strength, reduce the risk of failing to perform, and optimise performance. Some of the most important psychological concepts include:

- **motivation** – a general desire, need or want that drives a person to behave in a particular way
- **confidence** – the belief that a person can have faith in (or rely on) themselves, someone or something
- **arousal** – a feeling of mental and physical alertness or excitement
- **attention and concentration** – the level of focus and attentiveness a person dedicates to a task or stimulus
- **team dynamics and cohesion** – the relationships between members of a group of people (who are working together to achieve a common goal) and the degree to which they can stick together as a united whole.

in the zone
(in sport) a term used to describe a state of focused concentration that allows an athlete or team to perform at the peak of their physical and mental ability

Each of these concepts will be explored in detail in this chapter. They are central to the study of sport psychology because – regardless of the stage of learning an individual athlete (i.e. from beginner through to expert) – a thorough understanding of these concepts will help every athlete maximise their potential and optimise their performance.

Most athletes already have a basic understanding of the importance of these psychological concepts, but it is important to be aware that levels of motivation, confidence,

FOR THE RECORD!

Many professional athletes and elite sporting teams now employ sport psychologists. Sport psychologists may travel with an individual or team to offer advice and support during training and competition, and even during downtime. According to payscale.com, top sport psychologists working with an elite athlete can expect to earn in excess of $100 000 per year.

SOURCE 3 Sally Pearson was 'in the zone' when she won gold in the women's 100 metres hurdles at the London 2012 Olympic Games.

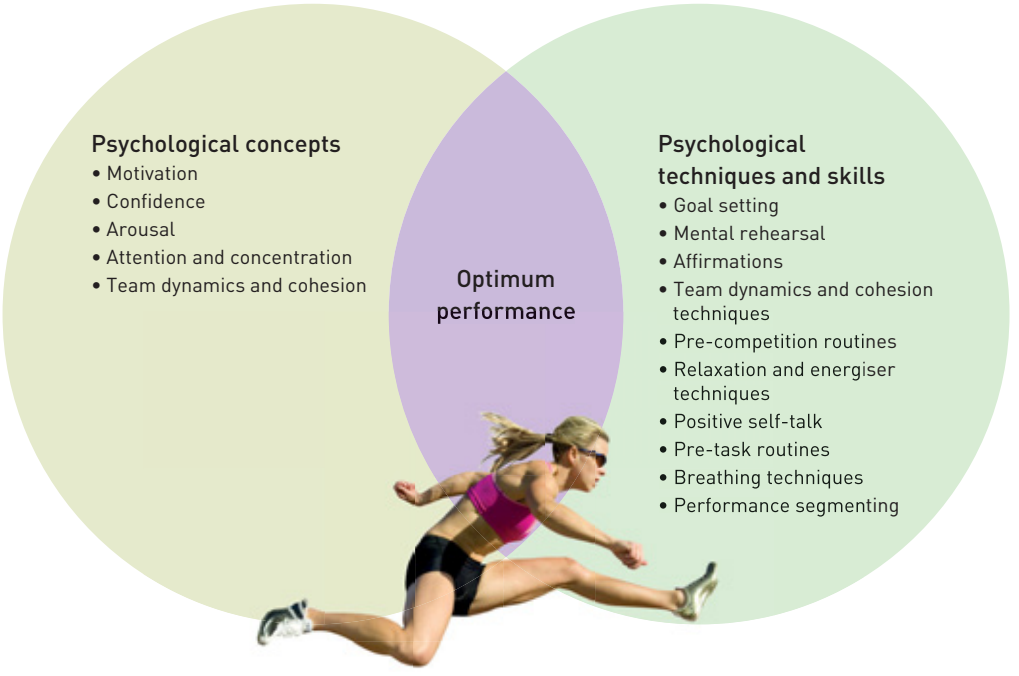
arousal, attention and concentration within athletes do not remain constant. Instead, the levels of each of these characteristics can vary widely on a monthly, weekly, daily or even hourly basis due to a range of factors.

For example, an athlete's confidence levels may be high at the start of the week, but may decrease as the week progresses. That same athlete's motivation and concentration might also reduce as a result. It is therefore important for athletes to constantly evaluate their mental state during training and competition so that they can take the necessary steps to get into the right 'zone'. When all of these characteristics are at their optimum levels, an athlete can enter a state of focused concentration that allows them to perform at the peak of their physical and mental ability. This state is often referred to as being 'in the zone'. This optimum zone is different for every athlete – for example, some athletes perform best when they are hyped up during competition, while others perform best in a more relaxed state.

Key techniques in sport psychology

In order to optimise the psychological concepts mentioned, there are a number of practical psychological techniques that athletes can apply at any stage during training and competition. These are listed in Source 4 and will be discussed in detail later in this chapter. Research has shown that these sport psychology techniques can assist athletes to:

- enhance their performance
- cope with the pressures of competition
- recover from injuries
- stay motivated and keep up with a training program
- get more enjoyment out of their chosen sport or physical activity.



SOURCE 4 Athletes can apply different psychological concepts, techniques and skills to optimise their performance. Psychological concepts are discussed in Sections 4.2–4.6 of this chapter, and psychological techniques and skills are discussed in Sections 4.7–4.17.

STUDY TIP

Diagrams and flowcharts are great tools to enhance your understanding of a concept. If you're struggling to grasp a particular idea, try creating your own diagram to explain it. Alternatively, you could redraw a diagram in your own style and add in extra details. It can also help to have a go at explaining a concept diagram to a friend.

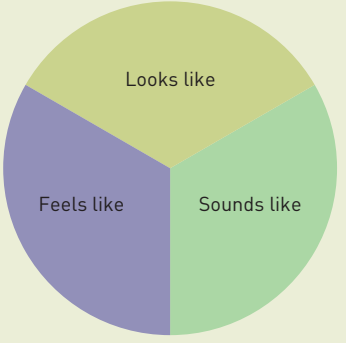
4.1 Check your learning

Engage and understand

1 In your own words, **summarise** the term 'sport psychology'.
2 **Describe** some of the benefits and advantages that sport psychology can offer athletes.
3 **Explain** what is meant by the term 'in the zone'.
4 **Identify** five key concepts that underpin sport psychology. **Define** each one briefly in your own words.

Analyse and apply

5 Copy the Y-chart provided into your notebook and use it to help you **describe** two situations (either during training or competition) when you:
   a were 'in the zone'
   b choked under pressure.
   Compare the sights, sounds and feelings of each situation and **determine** the impact they had on your performance in your sport.



Evaluate and justify

6 Read 'Greg Norman's 1996 US Masters meltdown'. It states that Nick Faldo was 'in the zone' on the final day of play and had the best round of the tournament. **Assess** the effect that Faldo's strong performance may have had on Greg Norman's poor performance that day.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  4.1 Check your learning
- **» Student worksheet**
  4.1 Introduction to sport psychology worksheet
- **» Video weblink**
  Greg Norman's 1996 US Masters meltdown
- **» Weblink**
  Introduction to sports psychology

4.2 Motivation

That's a goal!

By the end of Section 4.2, you should be able to:

→ **define** the concept of motivation

→ **identify** two main types of motivation (i.e. extrinsic and intrinsic)

→ **explain** the role that motivation plays in optimising the performance of athletes.

motivation
a desire, need or want that causes a person to behave in a particular way

Motivation is a key concept in sport psychology. It refers to the drive within us to behave in a particular way to achieve our goals. Most people would agree that any athlete who wants to succeed in their chosen sport will need high levels of motivation – but what does that actually mean?

SOURCE 1 Athletes are motivated by many different things including: medals or prize money, belonging to a team or cheering fans.

Different things motivate people at different times and to different extents. For example, one athlete might be motivated by awards (such as trophies and prize money), another might be motivated by the thrill of participating in sport, while another might be motivated by the roar of the crowd. Some athletes might be motivated by all of these things at the same time. In fact, there are many variables that can influence the motivation levels of an individual athlete on any given day.

Often, a coach's emphasis is solely on increasing the quantity of motivation – the assumption being that higher motivation will lead to better performance. However, research has shown that the quality of motivation, rather than the quantity, is a greater predictor of sporting success.

Self-determination theory

Unlike many theoretical frameworks of motivation, **self-determination theory (SDT)** makes the distinction between the quality and quantity of motivation. SDT was developed in 1985 by US psychologists Edward Deci and Richard Ryan. It is a theoretical framework used to analyse human behaviour and is very useful for understanding what motivates people to participate in sport and physical activity in the ways they do. The central argument of SDT is that all human beings are born with three basic psychological needs:

- **autonomy** – a person's need to control their own life and make their own decisions
- **competence** – a person's need to learn and master skills that challenge their abilities
- **relatedness** – a person's need to feel a sense of belonging by interacting with others and feeling part of a group or community.

When an athlete feels in control of their behaviour (autonomy), experiences success (competence), and feels accepted and valued by their coach and teammates (relatedness), they will demonstrate a more positive mindset during training and display a healthier psychological state. How well these psychological needs are met in an athlete has an impact on the quality of motivation they experience.

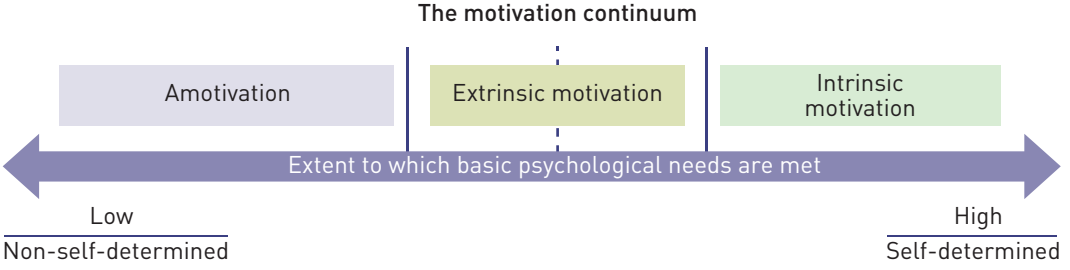
SDT suggests that there are three main types of motivation that exist along a continuum:

- **amotivation** – the absence of motivation
- **extrinsic motivation** – a type of motivation driven by external factors (i.e. factors that come from outside a person)
- **intrinsic motivation** – a type of motivation driven by internal factors (i.e. factors that come from inside a person).

The motivation continuum

As shown in Source 2, SDT defines motivation in terms of a continuum from amotivation (on the left), through extrinsic motivation to intrinsic motivation (on the right). The continuum moves from **non-self-determined motivation** to more **self-determined motivation**. If a person's basic needs for autonomy, competence and relatedness are not being met at all, there will be a complete absence of motivation (referred to as 'amotivation'). As these needs are increasingly met, levels of motivation become more self-determined.

A thorough understanding of SDT can be beneficial for coaches and training staff, as it is often their responsibility to help optimise the motivation levels of the athletes they are working with. The more self-determined an athlete's motivation, the more beneficial it is for their performance and their psychological wellbeing. We will now look at intrinsic and extrinsic motivation in more depth.



SOURCE 2 Self-determination theory explains motivation in relation to three basic needs and places it on a continuum from amotivation (i.e. non-existent), through to extrinsic motivation (i.e. medium) and intrinsic motivation (i.e. high), based on the degree of self-determination an individual feels.

Extrinsic motivation

Extrinsic motivation is a type of motivation that is driven by external factors. In other words, when a person is extrinsically motivated to perform a task, they value the likely outcome more than the task itself. In a sport setting, extrinsic motivations can include things like:

- awards, trophies and prize money
- praise and recognition from friends, family, teachers or the public (i.e. spectators or fans)
- pressure or threats from friends, family or teachers
- a desire to be popular or make friends
- a desire to lose weight or build muscle.

self-determination theory
a theoretical framework used to analyse human behaviour and explain what motivates people

autonomy
a person's need to control their own life and make their own decisions

competence
a person's need to learn and master skills that challenge their abilities

relatedness
a person's need to feel a sense of belonging by interacting with others and feeling part of a group or community

amotivation
the total absence of motivation

extrinsic motivation
a type of motivation driven by external factors (i.e. factors that come from outside a person) such as money and fame

intrinsic motivation
a type of motivation driven by internal factors (i.e. factors that come from inside a person) such as fun and personal satisfaction

non-self-determined motivation
a type of motivation that is not controlled by the individual

self-determined motivation
a type of motivation that is controlled by the individual

Types of extrinsic motivation

Not all forms of extrinsic motivation are the same. According to the SDT, they vary in type depending on the amount of control a person has over the activity they are performing (i.e. the degree of autonomy they have).

Extrinsic motivation can be categorised generally into two groups:

- externally controlled
- internalised and integrated.

SOURCE 3 Praise from spectators is an example of an externally controlled extrinsic motivator.

When an athlete is given very little choice about what to do (i.e. low autonomy), they are motivated purely by an external demand and its associated reward – their extrinsic motivation is externally controlled. An example of this is an athlete going for a run because their coach has threatened them with bench time if they don't improve their fitness. Externally controlled motivation is low in self-determination and therefore sits to the left of the motivation continuum (see Source 2).

By contrast, when an athlete enjoys more choice about what to do (i.e. high autonomy), there is an alignment between the task they are performing, its associated reward, and their personal values. In this case, the reward comes from outside the athlete, so the motivation is still extrinsic. It seems to come from within because the reward and the values associated with it have been internalised by the athlete and integrated into their sense of who they are and what is important to them. An example of this is a runner who goes for a run because they value fitness and appearance and running helps them to meet their own goals for weight loss and improved fitness. Although more self-determined than the earlier example of the athlete who runs in response to the threat of bench time, the motivating factor in this instance is still extrinsic because it comes from an external, societal-based source.

In this way, there are different types of extrinsic motivation that sit at different points along the motivation continuum based on how self-determined they are. However, the consistent feature in each case is that the motivating factor is external to the individual.

Extrinsic motivation can be a very strong motivator, especially for young athletes or people who are new to a sport. For some athletes, praise and recognition can serve as strong encouragement for them to keep trying and not to give up. Nevertheless, there are limits to the effectiveness of praise and recognition over the longer term. It is important that externally regulated motivation is complemented by more self-determined forms of motivation for the athlete to experience longevity in participation and to find strength and motivation during challenging times in the sporting journey.

SOURCE 4 A combination of intrinstic and extrinsic motivation results in optimum performance.

Intrinsic motivation

Intrinsic motivation is a type of motivation that is driven completely by internal factors. For example, an athlete who goes for a run purely because they love the feeling of running is said to be intrinsically motivated. In a sport setting, intrinsic motivations can include things like:

- feelings of fun, pleasure and excitement
- the enjoyment of taking on a challenge
- a personal desire to learn new skills and experience new things.

Athletes who are intrinsically motivated tend to achieve much better long-term results and stay active in their chosen sport for longer periods of time. Athletes who have a strong sense of autonomy, competence and relatedness are more likely to experience intrinsic motivation. They

become their own motivator in difficult times (e.g. when they are under pressure) and continue to perform well in the absence of extrinsic motivators. However, studies have shown that athletes who are predominantly intrinsically motivated tend to lack the strong competitive drive needed to be a champion. They enjoy mastering tasks in their chosen sport, but are less concerned about pushing themselves in order to compete against others and win.

FOR THE RECORD!

Many people assume that elite athletes possess high levels of intrinsic motivation but that's not always the case – for example, Australian tennis player Bernard Tomic shocked the tennis world with his admission that he was 'bored' and struggling to find motivation during the 2017 Wimbledon Championships.

Achieving and maintaining optimum motivation

Sport psychologists generally agree that a combination of both intrinsic and extrinsic motivation results in optimum performance. This combination of intrinsic and extrinsic factors leads to desirable characteristics such as:

- persistence and perseverance
- a positive attitude
- enduring focus and concentration.

These characteristics can help athletes achieve long-term success and enjoyment in their chosen sport.

4.2 Check your learning

Engage and understand

1 In your own words, **define** extrinsic motivation and intrinsic motivation. **Explain** the main difference between them.

2 **Summarise** the self-determination theory. Make reference to the three basic psychological needs that must be met for an individual to experience intrinsic motivation.

Analyse and apply

3 **Categorise** the following examples as either 'controlled extrinsic motivation' or 'internalised and integrated motivation'.

- **a** Pushing through the pain of the last kilometre of a 5 km run because this will help you win the cross country trophy.
- **b** Joining a local lawn bowls club because you love playing the sport.
- **c** Getting up at 5 am to swim 30 laps of the town pool to stay fit and healthy.
- **d** Trying your hardest to win at the local archery tournament because your dad was a champion archer and is so excited to see you compete.

Evaluate and justify

4 **Evaluate** the following statement about self-determination theory. 'Athletes need to have high levels of autonomy, competence and relatedness to become optimally motivated'.

5 Refer to the motivation continuum (Source 2 page 197) and **decide** where you currently sit. Use primary and secondary data to justify your decision.

- **a** **Develop** and record one or two practical strategies that could help you move along the continuum towards the right (i.e. towards intrinsic motivation)
- **b** Each week over the course of Unit 2, revisit your strategies and **assess** if they are helping you to develop intrinsic motivation. Provide evidence (e.g. primary data) to support your response.

6 **Evaluate** the types of motivation you have experienced in sport throughout your life. Provide an example of a time you:

- **a** were amotivated
- **b** had externally controlled motivation
- **c** had internalised and integrated motivation
- **d** had intrinsic motivation.

7 **Examine** whether children should be given extrinsic rewards for participating in sport. Use the table below to help generate discussion points in your response.

Reasons for extrinsic rewards	Reasons against extrinsic rewards
1 2	1 2

Check your obook assess for the following additional resources and more:

- **» Student book questions** 4.2 Check your learning
- **» Video** Self-determination theory
- **» Student worksheet** 4.2 Motivation worksheet
- **» Weblink** Extrinsic versus intrinsic motivation

4.3 Confidence

That's a goal!

By the end of Section 4.3, you should be able to:

→ **define** the concept of confidence

→ **identify** three key factors that contribute to overall confidence (i.e. self-confidence, self-belief and self-efficacy)

→ **explain** the role that confidence plays in optimising the performance of athletes.

confidence
the belief that an individual can have faith in (or rely on) themselves, someone or something

Confidence is another key concept in sport psychology. In simple terms, confidence is the belief that a person can have faith in (or rely on) themselves, someone or something.

Confidence plays an important role in every athlete's overall performance. In fact, confidence underpins most of the other psychological characteristics demonstrated by successful athletes because it is critical to building mental strength. Take, for example, the following two athletes:

- a tennis player who is making repeated unforced errors on court during an important match and starts visibly slumping between points
- a soccer player who has to kick for goal to win the match in a penalty shoot out.

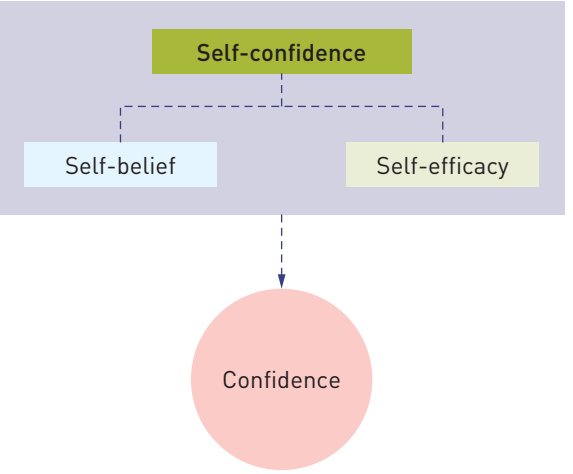
In both cases, each athlete's future performance will be strongly influenced by the degree of confidence they have in their ability to perform at the level required. For this reason, understanding confidence – and developing an appreciation of the role it plays in overall performance in different situations – is an important part of sport psychology.

SOURCE 1 Confidence contributed to the extraordinary success of the Matildas, who rose to be ranked fourth in the world in 2017 – their best result ever.

Sport psychologists often describe an athlete's overall confidence in terms of three factors. These include:

- **self-confidence**
- **self-belief**
- **self-efficacy**.

The relationship between these three factors – and the role that each one plays in an athlete's overall confidence – can be complex. Sometimes these terms are used interchangeably, while at other times they have a particular meaning. We will now explore each factor in more detail.



SOURCE 2 Self-belief and self-efficacy are components of self-confidence. All three factors combined determine an athlete's confidence.

Self-confidence

Self-confidence is a general term used to describe a feeling of trust in one's own abilities, qualities and judgments. In a sporting context, self-confidence is often defined as the acceptance and conviction that an athlete has the resources (i.e. the skills and abilities) to achieve success and win.

Self-confident athletes are composed, thrive on pressure, challenge themselves and rarely doubt their ability to perform at their best. By contrast, athletes who lack self-confidence hesitate more, persist less, doubt their ability to perform at their best, and make more errors.

Self-belief

Self-belief is another general term used to describe the overall trust an athlete has in their ability to succeed, regardless of their previous achievements and competencies. Self-belief can therefore be understood as one component or ingredient of self-confidence. Australian tennis star Lleyton Hewitt is a good example of an athlete with a very high level of self-belief. With his 'never give up' attitude, Hewitt was famous for coming back from the edge of defeat to grasp victory.

SOURCE 3 During his career, Australian professional tennis player and former world number 1 Lleyton Hewitt drew on reserves of self-belief when he needed it most.

self-confidence
an athlete's conviction that they have the skills and abilities to succeed

self-belief
an athlete's trust in their ability to succeed, regardless of their previous achievements and competencies

self-efficacy
an athlete's belief in their ability to perform a particular task

Theory in action | Appearing confident versus being confident

The lead up to any world-class boxing match provides a fascinating spectacle. Pre-bout hype can involve weigh-ins, intense press conferences and theatrical face offs. Boxers typically use these opportunities for showmanship, displaying extreme levels of confidence that are designed to intimidate their opponent. It also helps them to prepare psychologically to perform.

Muhammad Ali believed his words were his cannons. He defended his incessant pre-match trash talking by exclaiming: 'It ain't bragging if you can back it up.' It could be said that his self-efficacy and his capabilities matched. At just 22 years of age, Ali came up against Sonny 'Big Bear' Liston – an imposing figure with a criminal record. On the eve of the fight, Ali announced that he would use Liston's body as a bear rug in his home! He went on to win the fight and claim his place in the history books. Researchers at Florida State University have found that trash talking can improve performance by as much as 46%. It boosts self-confidence and the belief that your opponent is weaker because of it.

SOURCE 4 'Fake it till you make it' is a common saying regularly used by boxers. The idea being that if they proclaim their greatness enough, both they and their opponent will have no choice but to believe it.

Self-efficacy

Self-efficacy is a specific term used by sport psychologists to describe an athlete's confidence. It refers to the belief an athlete has in their ability to perform a particular task. In other words, the level of self-efficacy an athlete has when completing in a specific activity is a measure of the perception they have of their ability to successfully meet the demands of that particular task. This means that an athlete might have high self-efficacy in cricket and low self-efficacy in badminton. It may also mean that a cricketer has high self-efficacy in bowling, but low self-efficacy in batting.

The concept of self-efficacy was developed by US psychologist Albert Bandura. He saw self-efficacy as an indicator of self-confidence. While self-confidence is a general, slightly 'fuzzy' term, self-efficacy is a more specific and more useful term for sport psychologists to use when helping to improve the performance of athletes.

It is important to recognise that self-efficacy refers to an athlete's *perception* of their ability in a given task, rather than their *actual* ability. This distinction between self-efficacy and true capability is crucial in situations where an athlete's level of self-efficacy in a task leads them to be over- or under-confident about their prospects. Mismatches of self-efficacy and true capability in either direction can have a negative impact on an athlete's performance. Losing a match due to underestimating an opponent is one example of how self-efficacy can impact an athlete's performance in this way.

4.3 Check your learning

Engage and understand

1 In your own words, **define** the term 'confidence' in the context of sport.

2 **Identify** and list some of the key characteristics that distinguish a self-confident athlete from one who lacks self-confidence.

Analyse and apply

3 Read 'Appearing confident versus being confident'. **Analyse** how having a 'fake it till you make it' attitude can contribute to a successful performance.

4 **Reflect on** situations in sport when your self-efficacy did not match your true capability. Determine how this affected your self-confidence.

Evaluate and justify

5 **Create** your own diagram, flowchart or table to explain the interrelationship between self-confidence, self-belief and self-efficacy. You may like to expand or modify Source 2 to do this.

6 **Justify** a response that supports or refutes the following statement: 'Appearing confident is just as important as being confident.' Use Source 4 to help develop arguments for your response.

7 **Conduct** some online research to compile a list of three strategies that an athlete could use to overcome low self-efficacy. **Justify** your selection of strategies using primary and/or secondary data.

Check your obook assess for the following additional resources and more:

- **Student book questions** 4.3 Check your learning
- **Student worksheet** 4.3 Confidence worksheet
- **Video weblink** Building self-belief
- **Weblink** The importance of confidence in sport

4.4 Arousal

That's a goal!

By the end of Section 4.4, you should be able to:

→ **define** the concept of arousal

→ **identify** key stages on the arousal continuum (i.e. from relaxed drowsiness through to panic and rage)

→ **explain** the role that arousal plays in optimising the performance of athletes.

arousal
a feeling of mental and physical alertness or excitement

fight or flight response
an innate (i.e. instinctive) physiological response to a threat of danger or harm that prepares the body to defend or flee

Arousal is another key concept in sport psychology. In simple terms, arousal is a feeling of mental and physical alertness or excitement.

Arousal is linked to our body's **fight or flight response**, an instinctive reaction that all human beings have when they are faced with the threat of danger or harm. During the fight or flight response, the body prepares to fight or flee danger by undergoing a range of physiological changes (such as increased heart rate, more rapid breathing, increased perspiration and increased brain activity). Blood is diverted away from the abdominal organs and the skin, towards muscles in the arms and legs that are necessary to defend the body or propel it away from danger.

SOURCE 1 The arousal levels athletes experience when they are training or competing simulate the body's fight or flight response.

STUDY TIP

Throughout this unit, keep track of your arousal levels during training and competition by recording:

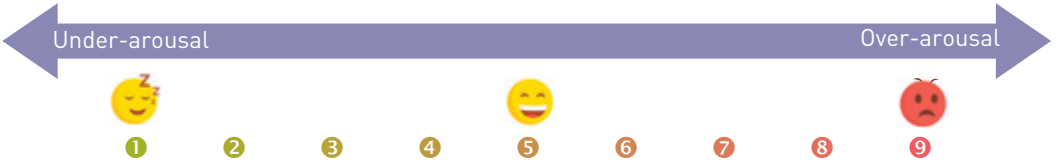
- dates and times of physical activity
- playing conditions (e.g. weather)
- position played
- your arousal levels before and during activity
- your rating on the arousal continuum (before and during activity).

Reflect on the interrelationship between these factors and how they affected your performance on the day.

When an athlete is preparing for, or competing in, an important event, their arousal levels simulate a fight or flight response. Throughout training, pre-performance and performance, athletes need to ensure that their mind and body are in an optimum state of arousal. Whether a boxer is in training for a title fight, a gymnast is about to take the floor for their final routine, or a swimmer is on the final lap of an 800 metre freestyle race, their arousal levels will need to be optimally controlled and matched to suit their performance needs.

The arousal continuum

Similar to motivation, arousal is often defined in terms of a continuum. As shown in Source 2, athletes performing at the lower end of the continuum are often described as being under-aroused, whereas athletes performing at the higher end of the continuum are said to be over-aroused.



1	**relaxed drowsiness**	a state of low arousal, low stress and low awareness
2	**wakefulness**	a state of consciousness and awareness
3	**curiosity**	a state of desire to know or learn
4	**attentiveness**	a state of paying close attention to detail
5	**joy**	a state of pleasure and happiness
6	**exhilaration**	a state of excitement, extreme happiness or elation
7	**anxiety**	a state of nervousness and worry
8	**panic**	a state of sudden uncontrollable fear or extreme anxiety
9	**rage**	a state of violent uncontrolled anger or aggression

SOURCE 2 The arousal continuum organises common states on a scale from under-arousal to over-arousal.

The arousal continuum is a useful tool to help understand the impact that different arousal levels can have on performance. Generally speaking, optimum arousal levels for most athletes and physical activities are located towards the middle of the continuum. However, this is not always the case.

In a state of optimum arousal, athletes will be both mentally and physically prepared for the type of activity and situation they are facing. It is therefore more helpful to think of optimum arousal levels in relation to individual athletes and the different tasks that they are required to perform. To illustrate this point, let's compare an archer with a discus thrower.

- The optimum level of arousal for an archer is probably not a state of joy or exhilaration. In fact, these are both likely to be considered states of over-arousal because archers try to slow their heart rate and release arrows between heart beats in order to improve aim and reduce extraneous (i.e. unnecessary) movement.
- The optimum level of arousal for a discus thrower is not likely to be a state of joy or exhilaration either. Instead, they will probably produce their best throw when they reach a level of arousal that exceeds these states. An experienced discus thrower who is 'pumped' (i.e. in a state approaching rage) is likely to channel this arousal into activating their muscles and increasing the distance of their throw.

All athletes need to be conscious of their arousal levels and manage them appropriately in order to maintain optimum levels for their situation. When athletes fail to do this, they risk entering states of **under-arousal** or **over-arousal**, both of which will prevent them from performing at their best.

under-arousal
a state of arousal generally considered too low for optimum performance

over-arousal
a state of arousal generally considered too high for optimum performance

anxiety
psychological and physical symptoms brought on by a sense of apprehension about something

cognitive anxiety
anxiety felt as an emotional response

somatic anxiety
anxiety felt as a physical response

SOURCE 3 Serena Williams' state of over-arousal during the 2018 US Open final cost her the match; this followed a similar incident at the 2009 US Open semi-final.

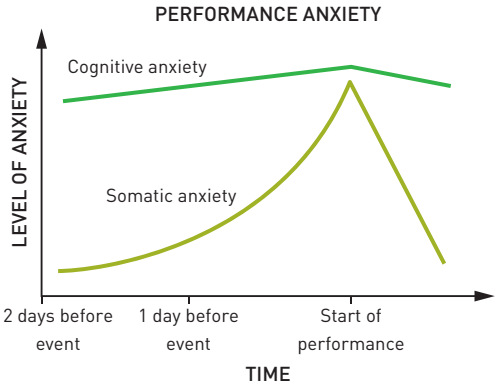
Understanding anxiety

Anxiety is one of the most common forms of over-arousal. Even the most experienced and talented athletes can struggle to manage anxiety. Anxiety is made up of two components:

- **cognitive anxiety** – the emotional and mental responses to over-arousal, such as feelings of worry and panic
- **somatic anxiety** – the physical responses to over-arousal, such as sweaty palms and shallow, rapid breathing (known as hyperventilation).

As Source 4 shows, in the lead-up to a performance, cognitive anxiety is initially much higher than somatic anxiety, as worrying thoughts occupy the mind of an athlete. However, somatic anxiety increases as the event gets closer, causing a physiological response.

Anxiety can cause athletes to feel threatened, seize up, be unable to think clearly and underperform. In such cases, it is important that athletes are able to adopt relaxation techniques in order to manage the anxiety they are experiencing. These are discussed in Section 4.13.



SOURCE 4 In the lead-up to a performance, cognitive anxiety is initially much higher than somatic anxiety, as worrying thoughts occupy the mind of an athlete. However, somatic anxiety increases as the event gets closer, causing a physiological response.

Trait and state anxiety

It is also common to distinguish between two types of anxiety:

trait anxiety
personality-based anxiety

state anxiety
situation-based anxiety

- **trait anxiety** – an athlete's natural tendency (i.e. a personality trait) to perceive something as threatening or non-threatening. Those with high levels of trait anxiety will naturally perceive a situation to be more threatening than a person with low levels of trait anxiety
- **state anxiety** – anxiety that is induced by a particular situation or environment. The emotional response they feel is a direct result of the event or experience they are having. The higher the pressure of the situation, the greater the state anxiety experienced. An athlete's level of state anxiety is often related to their self-confidence.

The interrelationship between trait and state anxiety will determine a person's anxiety levels from moment to moment. For example, it is common for athletes to feel nervous when playing an important match (state anxiety); however, the level of this anxiety is also influenced by their personality (trait anxiety).

The two most important factors that determine an athlete's level of anxiety are:

- the importance of the situation to the individual
- the uncertainty of the outcome of the situation.

STUDY TIP

The level of an individual's trait and state anxiety can be measured using questionnaires. You can find one of these questionnaires on your obook assess. Download and complete the questionnaire to get a better understanding of your personal anxiety levels.

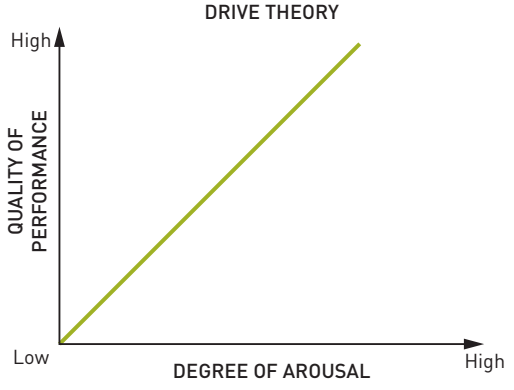
Achieving and maintaining optimum arousal

Sport psychologists generally agree that achieving and maintaining a level of arousal that is right for the individual athlete and their situation will result in optimum performance. However, there are so many differences in athletes' arousal levels that determining the optimum level for every individual is almost impossible. Over the last century, a number of theories have been developed that try to explain the relationship between arousal and performance. We will now examine four of the most common theories. These include:

- Drive Theory
- Inverted U Theory
- Zones of Optimal Functioning Theory
- the Catastrophe Model.

Drive Theory

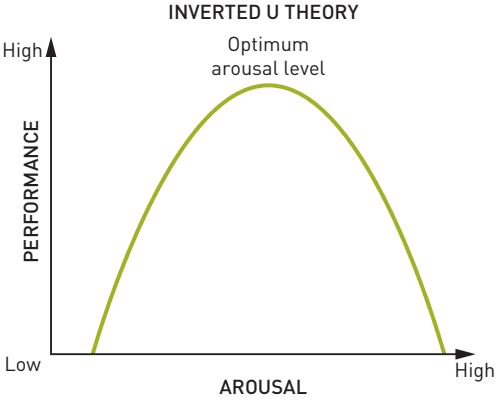
Drive Theory was first developed in 1943 by US psychologist Clark Hull. It proposed that there is a linear relationship between the quality of performance and the degree of arousal. As you can see in Source 5, according to Drive Theory, if an athlete's level of arousal is low, the quality of their performance will also be low. As the athlete's arousal level increases, so too does the quality of their performance.



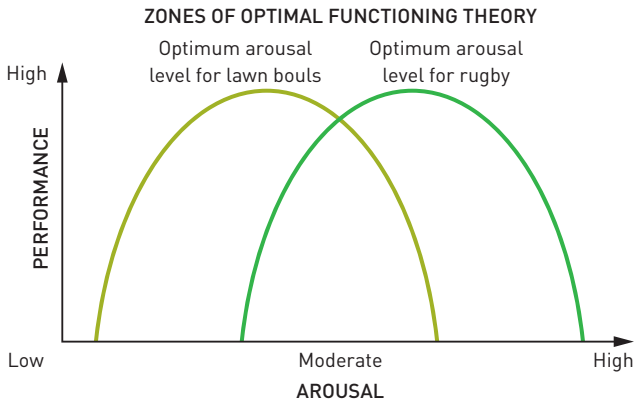
SOURCE 5 According to Drive Theory, the relationship between performance and arousal is a linear one.

Inverted U Theory

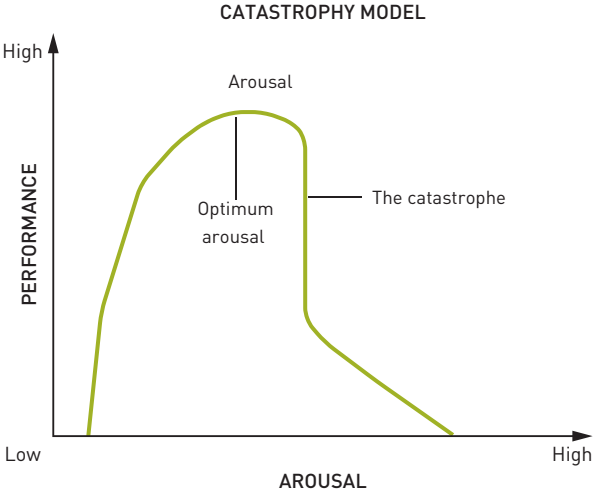
Inverted U Theory was originally proposed in 1908 by US psychologists Robert Yerkes and John Dodson. It suggests that performance increases as a result of mental and physical arousal, but only up to a certain point. Unlike Drive Theory, Inverted U Theory suggests that if levels of arousal become too high, performance actually decreases. As shown in Source 6, the relationship between performance and arousal is often presented as an inverted u-shaped curve, which increases and then decreases in response to rising levels of arousal.



SOURCE 6 According to Inverted U Theory, an increase in arousal causes improvement in performance up to an optimum point. After this point, increased arousal leads to a decline in performance.



SOURCE 7 According to Zones of Optimal Functioning Theory, the zone of optimum arousal differs for different activities.



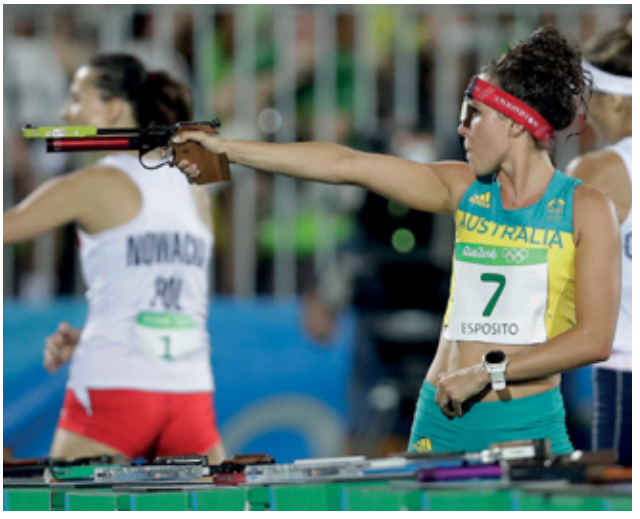
SOURCE 8 According to the Catastrophe Model, when an athlete experiences both cognitive and somatic anxiety, they can experience a sudden decline in performance.

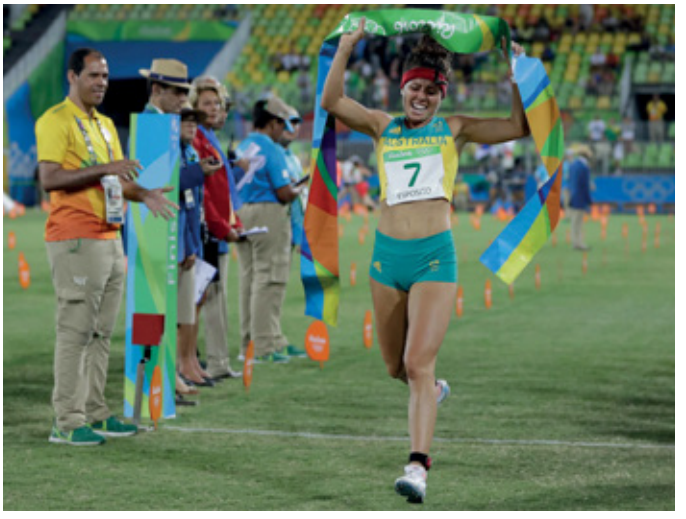
Zones of Optimal Functioning Theory

Zones of Optimal Functioning Theory was proposed by Russian sport psychologist Yuri Hanin in 1980. Like Inverted U Theory, it suggests that a narrow range (or zone) of arousal levels will produce the best performance; however, it goes further by suggesting that the zone of optimum arousal differs for different activities. As shown in Source 7, lawn bowlers will optimise performance by maintaining lower levels of arousal so they can perform controlled movements. Rugby players, on the other hand, will optimise performance by maintaining higher levels of arousal so they can generate maximum power during tackles and sprints.

Catastrophe Model

The Catastrophe Model, proposed by John Fazey and Lew Hardy in 1988, extends on Inverted U Theory by suggesting that the interplay between cognitive and somatic anxiety impacts the shape of the arousal curve. An athlete experiencing the physiological impact of anxiety or arousal (without accompanying cognitive effects) will follow the gentle curve of the U shape. A combination of both cognitive and somatic anxiety, however, will inevitably lead to a catastrophic decline in the athlete's performance, as show in Source 8.





SOURCE 9 For modern pentathletes, like Australia's Chloe Esposito, achieving and maintaining the optimum zone of arousal is tricky – for example, they require stillness and accuracy for shooting but also aggression and speed for running.

PERFORMANCE

SKILL DRILL **4.4**

Evaluate the impact of arousal on performance

>> Turn to pages 342–343 to complete this integrated physical performance activity.

4.4 Check your learning

Engage and understand

1 In your own words, **define** what is meant by the term 'arousal' in a sporting context.
2 **Describe** the relationship between arousal and performance.
3 **Look at** the four theories that are used to understand the relationship between performance and arousal in sport. **Identify** the theory that you think is the most useful and explain why.

Analyse and apply

4 **Compare** and **contrast** the arousal levels required for optimum performance in two or more of the physical activities you have studied so far this year.
5 **Differentiate** between trait and state anxiety. Use examples from your own experiences to enhance your response.

Evaluate and justify

6 Look carefully at the image of Serena Williams (Source 3, page 206). **Conduct** some additional online research to find out what events contributed to Serena's state of over-arousal. **Evaluate** the impact of the situation on her arousal levels and subsequent performance.
7 **Assess** the physical activity you are studying and **justify** why your zone of optimum functioning might be different to those of your friends and classmates.
8 Download the trait anxiety vs state anxiety questionnaire provided on your obook assess. Complete the questions. In one paragraph, **synthesise** and **evaluate** your results.
9 Look at the image of Chloe Esposito (Source 9). Conduct some online research to **assess** how she was able to reduce her arousal levels after a 3 kilometre run (in a packed stadium) to a level that allowed her to shoot so quickly and accurately that she was able to jump from 7th to 1st place in the women's modern pentathlon at the 2016 Olympic Games.

SOURCE 10 Achieving and maintaining optimum arousal levels will result in optimum performance.

Check your obook assess for the following additional resources and more:

- **Student book questions** 4.4 Check your learning
- **Skill Drill worksheet** 4.4 Evaluate the impact of arousal on performance
- **Video weblink** Serena Williams at the 2018 US Open
- **In the news** Serena Williams fined over outbursts at 2018 US Open

4.5 Attention and concentration

That's a goal!

By the end of Section 4.5, you should be able to:

→ **define** the concepts of attention and concentration

→ **identify** the two dimensions of attention (i.e. broad–narrow and internal–external)

→ **explain** the roles that attention and concentration play in optimising the performance of athletes.

attention
a technical term used by sports psychologists to refer to the specific ability of an athlete to attend and respond to appropriate internal (e.g. thoughts or feelings) and external (e.g. the starter's gun or an opponent) stimuli during training and competition

concentration
an everyday term used to describe how a person focuses their mental energy

selective attention
the ability to process and react to certain stimuli selectively (when several stimuli occur simultaneously)

relevant cues
essential (i.e. important) information that an athlete needs to focus on

irrelevant cues
extraneous (i.e. unnecessary) information that can distract an athlete

Attention and **concentration** are two more key concepts in sport psychology. In simple terms, attention and concentration are both concepts used to describe the level of focus and attentiveness a person dedicates to a particular task or stimulus.

People often use these terms interchangeably; however, when examining attention and concentration in the context of sport psychology, it is helpful to distinguish between them. In sport psychology:

- **attention** is the technical term used to refer to the specific ability of an athlete to attend and respond to appropriate internal stimuli (e.g. thoughts or feelings) and external stimuli (e.g. the starter's gun or an opponent) during training and competition.
- **concentration** is the everyday term used to describe how a person focuses their mental energy. Strong performances are often said to be the result of 'good concentration' and poor performances the product of 'lapses of concentration'.

In order to maintain the optimum levels of attention and concentration, players must use **selective attention**. This is where they narrow their focus to the specifics of the task required of them (known as **relevant cues**) and block out distractions (known as **irrelevant cues**). For example, during play a soccer goalkeeper will focus on relevant cues (such as the position of the ball, the speed of its approach and the location of other players on the field) and ignore irrelevant cues (such as a bird flying overhead, taunts from opponents, cheers from the crowd).

SOURCE 1 Successful athletes use selective attention to block out distractions and focus closely on the task at hand.

Achieving and maintaining optimum attention and concentration

Sport psychologists generally agree that achieving optimum performance is dependent on an athlete focusing on the right thing at the right time. Many theories have been developed to explain the relationship between attention and performance, but the most popular and widely accepted theory is known as Nideffer's Attentional Model.

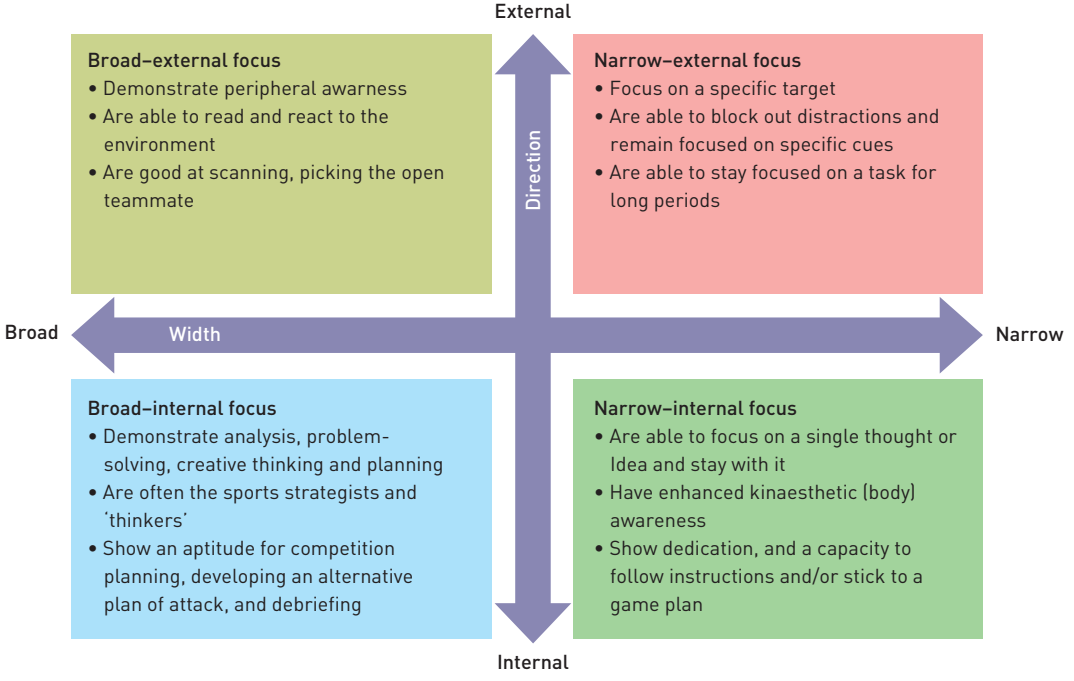
Nideffer's Attentional Model

Nideffer's Attentional Model was developed in 1981 by US sport psychologist Robert Nideffer (Source 2). It helps to define and explain attention and concentration behaviours in athletes by proposing that attention exists in two dimensions:

- width – this relates to the *amount* of information or cues an athlete perceives. These cues exist on a continuum from narrow focus (i.e. a single cue) through to broad focus (i.e. many cues)
- direction – this relates to the *source* of stimuli that an athlete perceives. These sources also exist on a continuum from internal (e.g. an athlete's own thoughts and feelings) through to external (e.g. an opponent or the wider environment).

Source 2 shows the model's four distinct types of attentional focus:

- broad–external – athletes with this focus are often referred to as 'aware'; for example, a volleyball setter who scans the defence before setting up the play.
- broad–internal – athletes with this focus are often referred to as 'strategic'; for example, a golfer carefully considering shot selection prior to addressing the ball.
- narrow–external – athletes with this focus are often referred to as 'focused'; for example, a tennis player focusing on her toss as she begins to serve.
- narrow–internal – athletes with this focus often referred to as 'systematic'; for example, a basketball player reviewing his self-talk prior to taking a free throw.



SOURCE 2 Nideffer's Attentional Model has four distinct types of attentional focus, with a number of characteristics common to each type.

STUDY TIP

Keeping a video log of your performance can be a great way of assessing your levels of attention and concentration. Store video clips of your performance in a folder on your computer and add either a voice over or a short written analysis of each one as you go. Look beyond physical performance. For example, note changes in your attention and concentration. Make a note of any links between strategies you have been implementing off court (e.g. mental rehearsal and meditation) and changes in performance on court.

The following Theory in action summarises strategies for improving concentration.

Theory in action | Improving concentration

Concentrating on the right things at the right time is one of the most important skills an athlete can possess. All athletes recognise that they have difficulties concentrating for the duration of a performance or at specific times. Difficulty concentrating is usually due to distractions. Rather than concentrating on appropriate cues, athletes become distracted by thoughts, emotions and other events. These distractions can be both internal and external. Sport Australia have outlined strategies for overcoming these distracters.

SOURCE 3 Sports Australia recommends the following strategies for improving concentration.

INTERNAL DISTRACTERS (THOUGHTS, WORRIES AND CONCERNS)

→ Living in the past – worrying about what just happened (especially mistakes).
→ Living in the future – thinking about results, outcomes and consequences.
→ Self-talk – especially when it is negative.
→ Arousal levels and anxiety – high arousal and anxiety can narrow your attentional field (that is, tunnel vision) and decrease environmental scanning. Alternatively, low arousal can cause a broadening in your attentional field and a focus on inappropriate cues.
→ Fatigue – focus requires effort, so if you are feeling fatigued it can sometimes be difficult to find the energy required to maintain your focus.

EXTERNAL DISTRACTERS

→ Visual distracters – crowd, competitors, scoreboards, cameras, etc.
→ Auditory distracters – talking, laughing, traffic, mobile phones, etc.
→ Gamesmanship – sledging, trash-talk.

STRATEGIES FOR IMPROVING CONCENTRATION

Attention control and concentration are skills that can be improved and worked on just like a physical skill. There are a number of sport and non-sport related strategies and exercises that can be used to assist you in enhancing your attention and concentration skills. These are:

→ Simulation training – identify the types of distractions that are present during competition and systematically incorporate and learn to manage these distractions in training.
→ Cue words – identify some key words/phrases that remind you of what you need to concentrate on.
→ Positive self-talk – repeat positive self-statements/affirmations (for example, 'I am feeling fit and strong', 'I am ready to go', 'I can do this').
→ Switching on and off – identify appropriate points during training or competition at which to 'switch on' (that is, direct attention and energy to the task at hand) and 'switch off' (that is, allow thoughts/attention to shift to a non-performance focus).
→ 'Parking' thoughts – try 'parking' your distracting thoughts. This involves putting them aside until a later time, typically by using a rational self-talk instruction or form of imagery that places the troublesome thought in a secure and non-distracting place until after the performance.
→ Staying in the 'here and now' – the only time frame that you have any control over is the present and therefore the importance of being present-focused cannot be overstated.

Sledging is a practice used by some cricket players to distract opponents and interfere with their concentration. This practice is further explored in the Theroy in action below.

Theory in action | Sledging: a true test of concentration

Cricket players are well known for their controversial use of sledging during matches. Sledging is a practice whereby athletes use trash talk to distract their opponents and break their concentration.

A batter in cricket is required to face a hard leather ball – sometimes travelling at speeds over 140 km/h – while also considering the placement of other players on the field, their grip on the bat, and the tally on the scoreboard. A good batter will also try to detect cues in the bowler's grip prior to them releasing the ball, so they can predict the type of delivery they are about to face.

To achieve this broad–external focus, the batter must be fully attentive. However, between balls, it is common for the bowler, wicketkeeper and slip fielders to make derogatory comments to (i.e. sledge) the batter, in the hope that his or her focus will shift to irrelevant cues and they will be put off their game.

When interviewed on the topic of sledging, one cricketer said: 'As a bowler, if you see a guy that is in form and in a routine, you almost want to say more to him to try and upset his rhythm ... It's all about trying to draw the batter outside of their own little bubble and give them something else to think about.'

SOURCE 4 Australian cricket player Mitchell Johnson exchanges words with England's Ben Stokes during the Second Ashes Test at Adelaide Oval in 2013.

Experienced cricket players must adopt strategies to overcome the distraction of sledging and maintain appropriate attention at all times. It only takes one moment of lapsed concentration for a costly error to be made.

4.5 Check your learning

Engage and understand

1 In your own words, **explain** the key difference between 'attention' and 'concentration' in sport psychology.
2 Read 'Sledging: a true test of concentration'. **Describe** the potential impact of sledging on an athlete's attention.
3 **Summarise** the two dimensions of attention and explain the difference between them.

Analyse and apply

4 Download the blank template of Nideffer's Attentional Model from your obook assess. Using Source 2 as a guide, **classify** each of the sports and coaching skills in the table provided into the most appropriate quadrant.

Sports skills	Coaching skills
→ Tackling in football	→ Developing a game plan
→ Putting in golf	→ Helping an athlete correct an error
→ Psyching up for the game	→ Listening to a player
→ Rebounding in basketball (when the ball has hit the rim)	→ Deciding how to respond to an official's bad call
→ Listening to instructions	→ Delivering a speech
	→ Analysing your competence as a coach

Evaluate and justify

5 **Evaluate** your ability to maintain appropriate levels of attention and concentration in your selected physical activity this term. Your evaluation should include examples and make specific reference to Nideffer's Attentional Model.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  4.5 Check your learning
- **» Video**
  Nideffer's Attentional Model
- **» Student worksheet**
  4.5 Attention and concentration worksheet
- **» Weblink**
  Improving concentration

4.6 Team dynamics and cohesion

That's a goal!

By the end of Section 4.6, you should be able to:

→ **define** the concept of team dynamics and cohesion

→ **identify** key stages of team development (i.e. forming, storming, norming, performing) and explain the importance of group roles, group norms and social support

→ **explain** the role that team dynamics and cohesion plays in optimising performance.

team dynamics
the relationships between all of the different members of a group (who are working together to achieve a common goal)

cohesion
(in sport) the extent to which individual members of a team can work together and function as a single unified (i.e. united) whole

Team dynamics and **cohesion** are key concepts in sport psychology. Both terms are used to describe the individual relationships between members of a group, as well as their ability to work together.

It is common to hear these terms used interchangeably in conversation; however, when examining team dynamics and cohesion in the context of sport psychology, they have different meanings. In sport psychology:

- team dymamics is a term used to describe the relationships between all of the different members of a group (who are working together to achieve a common goal)
- team cohesion is used to describe the extent to which individual members of a team can work together and function as a single, unified (i.e. united) whole.

Strong team dynamics and cohesion are the key elements that transform a group of individual athletes into a high-performing and successful team.

SOURCE 1 Strong team dynamics and cohesion can enable a group of skilled individual athletes to rise to the top of their field as a unified team.

Achieving and maintaining optimum team dynamics and cohesion

It's not difficult to think of a successful sporting team, but it can be challenging to work out exactly why certain teams are more successful than others. One way in which coaches and sport psychologists try to understand this is by examining team dynamics and cohesion. Over the years, many theories have attempted to explain the link between team dynamics, cohesion and performance. One of the most popular and widely accepted is known as the Tuckman's Stages of Group Development.

Tuckman's Stages of Group Development

Tuckman's Stages of Group Development was first developed in 1965 by US psychologist Dr Bruce Tuckman. Tuckman proposed that there were four distinct stages that teams go through in order to achieve cohesion (i.e. function together effectively) and deliver high quality results:

- Stage 1 – **Forming**
- Stage 2 – **Storming**
- Stage 3 – **Norming**
- Stage 4 – **Performing**

Stage 1 – Forming

In the forming stage, a group of individuals come together for the first time and begin to get to know each other. Coaches and athletes begin to think about establishing:

- **group roles** – the formal and informal positions that each individual on the team holds. Formal roles include positions of authority (such as captain and vice-captain) and playing positions (such as fullback, prop and hooker in rugby). Informal roles include positions that develop over time based on the individual personalities of the players (such as 'the joker', 'the morale booster', 'the problem solver', 'the good listener' and 'the Zen master')
- **group norms** – the rules and expectations set out for all members of the team to follow. Group norms include expectations and rules relating to things like training commitments, equipment requirements, dress codes and ethical conduct
- **group goals** – the vision or aims of a team for their time together (i.e. the season). Goals should be shared by the entire group and can be related to outcomes (e.g. team ranking at the end of the season) or performance (e.g. mastering a particular team strategy or completing a team challenge).

Stage 2 – Storming

In the storming stage, the team begins to work, train, play and compete together. Team members compete with each other for status and acceptance of their ideas. Conflict between team members is common, but roles can become clearer as a result and norms can be refined to suit the needs of the group. Good resolutions to conflict can strengthen team cohesion. Coaches and athletes work to develop:

- **social cohesion** – the degree to which team members like each other and interact together
- **task cohesion** – the ability to identify closely with the group's goals and to experience success in achieving those goals.

group roles
the formal and informal positions that each individual on the team is assigned or adopts

group norms
the rules and expectations set out for all members of the team to follow

group goals
the vision or aims of a team for their time together (i.e the season)

social cohesion
the degree to which team members like each other and interact together

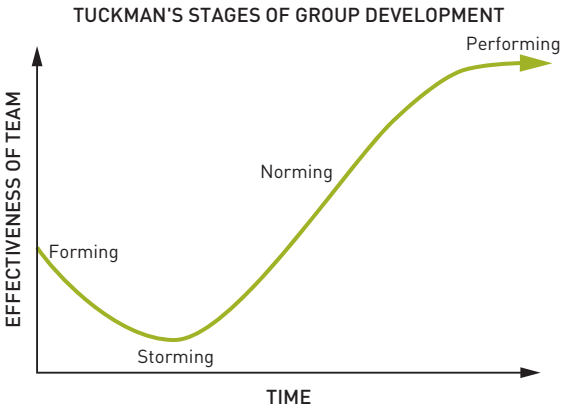
task cohesion
the ability to identify closely with the group's goals and to experience success in achieving those goals

Stage 3 – Norming

In the norming stage, the team is more settled and there is a greater acceptance of individual positions within the group. There is also wider acceptance of the rules and expectations being placed on the group. Rather than competing against each other for status and acceptance, members are able to work together towards a common goal. Coaches and athletes work to develop:

social support
the ability for team members to trust each other and actively seek each other out for assistance and support

- **social support** – the ability for team members to trust each other and actively seek each other out for assistance and support.



SOURCE 2 As a team works together over time, they pass through Tuckman's stages of team development. The effectiveness of the team will vary according to each stage of development.

Stage 4 – Performing

In the performing stage, the team is functioning at a very high level and can work effectively to achieve identified goals. Social and task cohesion and are at optimum levels and performance is strong as a result. In the face of conflict, group members can work together to find a solution (often without coaches or training staff). Team members are well aware of each other's strengths and weaknesses, and work well to optimise the team's performance.

It is important to note that not every team progresses to the performing stage. Many teams stop developing at the norming stage. It is also common for teams to fluctuate between the second, third and fourth stages of team development for a number of reasons, such as:

- individual team members may start working independently
- established members may leave the team and new members may join the team
- coaching and training staff may change, leading to changes in team goals and training expectations
- unexpected issues arise that challenge the team unity.

The New Zealand All Blacks are an example of a high-functioning sports team. Their success is further explored in the Theory in action below.

Theory in action | The world's most successful sporting team

According to many sporting agencies and media outlets, New Zealand's national rugby team the All Blacks is the most successful international sports team of all time.

In over a century of competition, the All Blacks have won more than three-quarters of their 538-plus matches. Since the beginning of the 2010 season, they have won an incredible 72 matches out of 80 played – a win ratio of 90 per cent. They have done the unprecedented, by winning back-to-back Rugby World Cups, retaining the Bledisloe Cup (2003–2017) and winning the Rugby Championship nine times over the past 12 years.

So, what is the secret to their incredible success? Team dynamics and cohesion have a lot to do with it.

The All Blacks team culture always puts the team before the individual, no matter how talented an individual player might be. It is this obsession with team unity that makes them an awesome winning unit.

The tantrums of overpaid stars that are a reality in many other teams are not tolerated by the All Blacks. The sense of honour and respect for previous achievements and holders of the jersey dictates the code of behaviour for new players joining the team. The team mantra is 'Better people make better All Blacks'– a saying that emphasises the importance of good character both on and off the field.

SOURCE 3 For over a century, the All Blacks have performed the haka (a traditional Māori dance) as a powerful pre-match team ritual.

PERFORMANCE | SKILL DRILL 4.6

Assess the impact of team cohesion on performance

>> Turn to pages 344–345 to complete this integrated physical performance activity.

4.6 Check your learning

Engage and understand

1 **Describe** the characteristics of an effective team.
2 In your own words, **summarise** the four stages of Tuckman's Stages of Group Development.
3 **Explain** the difference between group roles, group norms and group goals.
4 Read 'The world's most successful sporting team'. **Identify** the reasons given for the phenomenal success of the All Blacks.

Analyse and apply

5 **Create** as many endings for this sentence as you can: 'A cohesive team is one that ...'
6 **Analyse** the role that trust plays in developing team cohesion.

Evaluate and justify

7 **Evaluate** which of the following scenarios would be most likely to result in a successful team:
   → One strong leader with ultimate authority over all members of the team.
   → A collection of individuals who have authority in certain sub-areas (i.e. defensive leader, offensive leader etc.)

   Justify your response.
8 Research the concept of group conformity in sport. **Investigate** the problems associated with non-conformity with regard to team dynamics. Record your findings in point form.
9 A salary cap is a limit placed on the amount a team can pay individual players. **Conduct** some online research to identify two or three potential impacts that salary caps can have on team dynamics.

Check your obook assess for the following additional resources and more:

- **Student book questions**
  4.6 Check your learning
- **Skill Drill worksheet**
  4.6 Assess the impact of team cohesion on performance
- **Video weblink**
  The New Zealand All Blacks performing a haka
- **Weblink**
  Tuckman's Stages of Group Development

4.7 Psychological techniques to optimise performance

That's a goal!

By the end of Section 4.7, you should be able to:

→ **identify** a number of psychological skills and techniques that can be used to optimise performance (i.e. ongoing techniques, pre-performance techniques and in-performance techniques).

Even the most capable, experienced and physically able athletes can struggle to deal with a range of common psychological problems, such as low levels of confidence, lack of motivation, feelings of stress and anxiety, and lack of attention and concentration.

The main difference between a successful and unsuccessful athlete is their ability to successfully identify and resolve psychological problems as they arise. A mentally strong athlete is one who can recognise and diagnose a psychological problem, and then apply a relevant technique before too much damage is done to their performance.

Psychological techniques

Psychological techniques can be applied at different times to help athletes overcome a range of challenges and problems. These skills and techniques can be organised into three categories, according to when they are best performed or applied. Source 1 outlines these technique categories, and a list of the particular psychological techniques that belong to each one. It's important to note that even though the psychological techniques in Source 1 have been organised into categories based on when they are best applied (i.e. ongoing, pre-performance and in-performance techniques), some of these techniques can also be applied at other times. Remember to practise all of these techniques as often as you can and work out what's best for you!

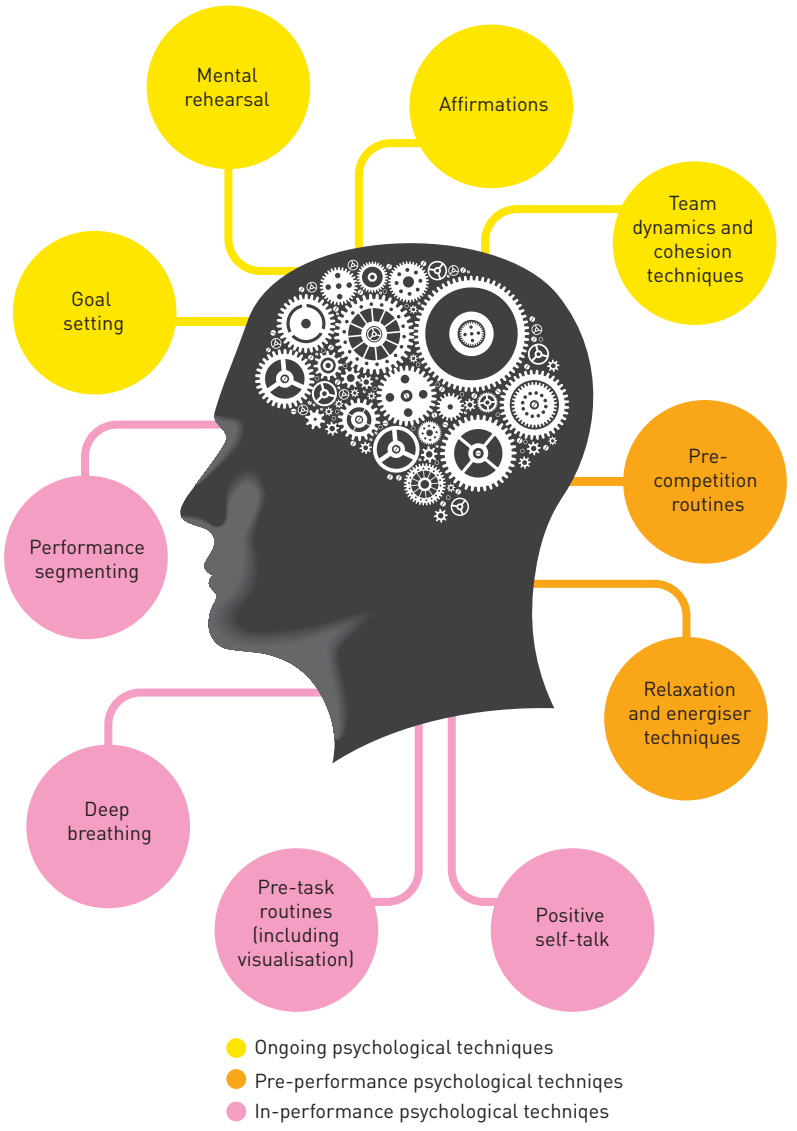
Category	Psychological techniques
→ **Ongoing psychological techniques** *Techniques that should be applied and then frequently revisited; they are best addressed outside of performances*	→ Goal setting → Mental rehearsal → Affirmations → Team dynamics and cohesion techniques
→ **Pre-performance psychological techniques** *Techniques that are best applied just before physical activity or competition*	→ Pre-competition routines → Relaxation and energiser techniques
→ **In-performance psychological techniques** *Techniques that are best applied during physical activity or competition*	→ Positive self-talk → Pre-task routines (including visualisation) → Deep breathing → Performance segmenting

SOURCE 1 Psychological techniques to deal with common problems among athletes

Developing a 'sport psychology resource kit'

As you learn about each of the skills and techniques in Source 1, you will be able to apply them to your own performances and the performances of other athletes. An awareness of the psychological concepts you learnt about earlier in this chapter, together with a strong understanding of the skills and techniques used to deal with them, will help you to develop a 'sport psychology resource kit'. This resource kit will contain a range of practical techniques and skills that you can apply in different situations and at different times to help you overcome problems and perform at your best.

While coaches should guide athletes towards the psychological techniques they think will be most beneficial, it is also important for the athlete to have some autonomy over the techniques they choose to apply. This often helps athletes maintain a level of mental strength that will keep them confident, motivated and focused throughout their performance, resulting in a better outcome.



SOURCE 2 A sport psychology resource kit contains a range of practical techniques to help you overcome problems and perform at your best.

4.7 Check your learning

Engage and understand

1 In your own words, **explain** what a sport psychology resource kit is.

2 **Compare and contrast** the three categories that psychological techniques can be organised into. In your opinion, which category is the most effective? Explain your answer.

Evaluate and justify

3 Look at the skills and techniques listed in Sources 1 and 2.

a Based on your current knowledge and understanding of each one, **evaluate** two or three skills or techniques and **justify** why you think these will be most valuable to you in your selected physical activity.

b As you learn more about each skill or technique over the course of this topic, revisit your answer and revise it, if necessary.

Check your obook assess for the following additional resources and more:

» **Student book questions**
4.7 Check your learning

» **Student worksheet**
4.7 Psychological techniques worksheet

» **Weblink**
Psychological techniques in sport

4.8 Goal setting

Ongoing psychological techniques

That's a goal!

By the end of Section 4.8, you should be able to:

→ **define** the strategy of goal setting

→ **identify** and **describe** three types of goals (i.e. process goals, outcome goals and performance goals)

→ **explain** the SMARTER principle and **create** SMARTER goals

→ **explain** how effective goal setting techniques can optimise performance.

FOR THE RECORD!

Throughout 2009, Kurt Fearnley (see Source 1) won wheelchair marathons in London, Paris, Seoul, Sydney, Chicago and New York. He also crawled the gruelling 96 kilometre Kokoda Track in Papua New Guinea. These incredible accomplishments would not have been possible without a strong ability to set and achieve goals.

Goal setting is a technique used to identify one or more things that you want to achieve and to establish measures to help you monitor and track your progress towards achieving them.

Goal setting is an ongoing psychological technique, meaning that it should be applied early on in an athlete's sporting pathway, and revisited regularly in training and performance as a source of motivation. Goals can also help an athlete achieve optimal arousal and concentration, and enhance team cohesion. Athletes need to develop, evaluate and revise their goals on a regular basis in order to optimise their performance.

Effective goal setting

Setting goals is vital for all athletes wanting to achieve success in their sport. Having goals serves a number of purposes and can be effective in strengthening a range of psychological traits, including confidence, motivation and concentration.

Athletes should analyse the types of goals they set to ensure they are maximising the benefits these goals can provide. In sport psychology, there are three main types of goals:

- **outcome goals**
- **performance goals**
- **process goals**.

Understanding the relationship between these types of goals can help athletes achieve their aim, one step at a time.

SOURCE 1 Australian Paralympian Kurt Fearnley is a three-time gold medallist who is expert at setting both personal and professional goals and working hard to achieve them.

Outcome goals

Outcome goals focus on winning and losing (i.e. the specific outcome of a performance or competition). For example, an outcome goal might be:

- to win an Olympic gold medal in basketball
- to place in the top 10 in the Brisbane Marathon.

While it is natural to make winning the goal, focusing only on outcome goals can contribute to anxiety in athletes, and must be combined with performance and process goals to help athletes remain 'in the zone' throughout their performances.

Performance goals

Performance goals focus on a particular performance standard that an athlete is trying to achieve. Performance goals are often designed to help athletes achieve their outcome goals by breaking them down into a series of smaller, more manageable targets. They focus on various aspects of an athlete's game, often using statistics to set the goal. For example, a performance goal might be:

- to improve shot accuracy from 60 to 70 per cent
- to complete a 20 kilometre training run in under 90 minutes.

Performance goals push athletes to monitor and record their improvement over time.

Process goals

Process goals focus on a specific technical aspect of an athlete's overall performance. They are often designed to help athletes achieve their performance goals by breaking them down into smaller targets that are completely under their own control. For example, a process goal might be:

- to hold the basketball shot follow through for one more second
- to train four days a week.

Process goals can help athletes manage the anxiety that develops when the focus is solely on the outcome. Process goals can also help athletes focus their attention on aspects of their technique.

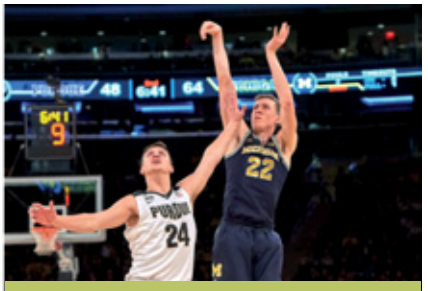
As shown in Source 2, athletes have more control over process and performance goals than outcome goals and can feel a greater sense of accomplishment and competence as they achieve them. Increased competence results in greater self-confidence and motivation.

goal setting
a technique used to identify a desired achievement and establish measures to track progress towards achieving it

outcome goal
a type of goal that focuses on winning and losing

performance goal
a type of goal that focuses on enhancing specific aspects of performance, often using statistics

process goal
a type of goal that focuses on improving technique



PROCESS GOAL
To improve follow through by one second

PERFORMANCE GOAL
To improve shot accuracy from 60% to 70%

OUTCOME GOAL
To win an Olympic gold medal in basketball

More control — Less control

SOURCE 2 Outcome goals, performance goals and process goals need to be combined to optimise an athlete's performance.

Setting SMARTER goals

SMARTER principle
an acronym that athletes can use to remember all the elements required for effective goal setting (i.e. SMARTER goals are Specific, Measurable, Achievable, Relevant, Time-bound, Evaluated, Recognised and rewarded)

Athletes need to monitor and assess the progress of their goals over time, and one of the most popular ways to do this is by applying the **SMARTER principle**.

SMARTER is an acronym (i.e. a word formed from the initial letters of other words) that athletes can use to remember all the elements required for a goal to be effective. For example, rather than writing general goals such as 'I want to get better at tennis' or 'I want to play well in the game this weekend', the SMARTER principle helps to identify the specific level required to attain and then measure the goal. Source 3 describes how this principle can be used for setting goals.

Specific	Effective goals are specific. Record as much detail about the goal as possible. For example: → I want to get better at tennis. ✗ → I want to achieve 50% of my first serves in court. ✓
Measurable	Effective goals are measurable. Be clear about what success will actually look like so that you can objectively assess whether you have achieved it. For example: → I will improve my service game by a lot. ✗ → Within 6 months I will achieve 50% of my first serves in court. ✓
Achievable	Effective goals are achievable. Think about whether your goal is appropriate for you. (i.e. Do you have the necessary time, money, talent, patience and/or dedication?) Goals should motivate you to challenge yourself, but they must also take your other commitments into account (e.g. school, work and family). For example: → I will be world number 1 tennis player in 6 months. ✗ → I will be club champion in 6 months. ✓
Relevant	Effective goals are relevant. Be clear about what you want so you can move in the right direction. Think about why you want to achieve this goal and whether it aligns with other goals you may have. For example: → I want to win my tennis club championship because I like to win trophies. ✗ → I want to improve my first service percentage from 20% to 50% because it will help boost my confidence, put me in a better position at the beginning of each rally and prove that I am a capable player. ✓
Time-bound	Effective goals are time-bound. Set a timeline for achieving your goals. For example: → I will improve my service game by a lot. ✗ → By January next year I will achieve 50% of my first serves in court. ✓
Evaluated	Effective goals are evaluated. Revisit your goals on a regular basis (every day, week or month) to ensure that you are on track. It's also important to remember that situations change – e.g. if you are injured or your priorities change, then your goals may need to change too.
Recognised and rewarded	Effective goals are recognised and rewarded. Celebrate when you achieve your goals. Rewarding yourself is a good way to create a positive feeling of success, and it will inspire you to set your next goal and achieve it.

SOURCE 3 Using the SMARTER principle gives athletes the best chance at achieving their goals.

4.8 Check your learning

Engage and understand

1 **Explain** why it is important to set goals.

2 **Describe** the key features of outcome goals, performance goals and process goals. **Summarise** the differences between each.

3 **Identify** two or three problems that might arise from focusing solely on outcome goals.

Analyse and apply

4 **Apply** the SMARTER goals acronym to develop your own set of specific goals to improve performance in your current physical activity.

5 **Categorise** each of the following as general goals or SMARTER goals.

→ Play smarter in my tennis matches.

→ Be more prepared for training sessions.

→ Increase my speed off the blocks by 0.2 seconds by the end of the season.

→ Become more accurate in passing the volleyball.

→ Run an interval training session of ten 50 metre sprints at 80 to 90% intensity with a rest/work ratio of 1:5 by week 3 of the touch football season.

6 **Identify** the problems with the general goals in Question 5 and rewrite them as SMARTER goals.

Evaluate and justify

7 Refer to Source 3 and use it to help you **create** four SMARTER goals related to your selected physical activity this term. Once you have created your goals, swap them with another student in your class to check that they meet the relevant criteria.

8 **Reflect on** a time when you set yourself a goal. It could be related to school, work, sport or any other aspect of your life.

a Write down the goal.

b Consider whether or not you achieved your goal (or partially achieved it).

c Using what you have learned about the SMARTER principle, **justify** if the goal was an effective one. **Determine** which elements of the goal could have improved.

d Rewrite the goal, taking all aspects of the SMARTER principle into account.

e **Evaluate** the effectiveness of your goal setting techniques. How could you improve your skills in future?

SOURCE 4 Goal setting creates a path for you to follow. It helps you to understand where you are right now and where you want to go in order to achieve optimal performance.

Check your obook assess for the following additional resources and more:

» **Student book questions**
4.8 Check your learning

» **Video weblink**
Effective goal setting: Interview with Kurt Fearnley

» **Weblink**
Tips for setting SMARTER goals

4.9 Mental rehearsal

Ongoing psychological techniques

That's a goal!

By the end of Section 4.9, you should be able to:

→ **define** the technique of mental rehearsal (including visualisation)

→ **explain** and **apply** the PETTLEP model for effective mental rehearsal

→ **explain** how effective goal setting techniques can optimise performance.

mental rehearsal
a technique used by athletes to develop skills, reduce anxiety, increase confidence and concentration, and ultimately improve performance

Mental rehearsal is a technique used by athletes to develop skills, reduce anxiety, increase confidence and concentration, and ultimately improve performance. The process involves imagining a performance from beginning to end and rehearsing every aspect of it in the mind. In other words, there is no visible physical movement involved in mental rehearsal.

Mental rehearsal is an ongoing psychological technique, meaning that it can be applied at any time. Athletes will often practise mental rehearsal in their downtime before a big performance; however, it can also be useful just prior to performance and, in some cases, during performance.

Effective mental rehearsal

Numerous studies have found that a combination of both mental and physical rehearsal results in better performances than just mental or physical rehearsal. Top athletes such as Michael Phelps, Sally Pearson, Andy Murray and Cristiano Ronaldo all include mental rehearsal as a key component of their preparation and performance.

Mental rehearsal can help athletes to convert distraction into focus, anxiety into confidence, and timidness into assertiveness. Rehearsing a performance in one's mind helps to create clarity around performance expectations. It can also help athletes cope with performance pressures (such as cheering crowds and television cameras) that can't always be replicated during training.

To get the most out of mental rehearsal, athletes need to think beyond just the visual aspects of a performance (i.e. what it will look like). Good mental rehearsal should involve as many of the senses as possible. The more sounds, smells, physical sensations and even tastes of the performance that can be incorporated into mental rehearsal, the more effective it will be.

It is believed that mental rehearsal works because imagining an action creates electrical activity in the muscles involved in the movement, even though they do not visibly move. Mental rehearsal also allows the brain to work out problems, propose solutions and make decisions. It also strengthens the neural connections between the brain and the muscles, which are needed to create the movement.

SOURCE 1 Effective mental rehearsal allows an athlete to not only see the performance in their mind, they can also feel it, hear it, smell it and taste it.

Visualisation

Visualisation is a technique related to mental rehearsal. It involves the use of imagery to create a mental picture of just one aspect of a physical performance or skill. Many athletes include visualisation as a part of their **pre-task routines**, by imagining themselves successfully performing the action needed to produce the desired result.

The term visualisation is sometimes used interchangeably with mental rehearsal, but in sport psychology, there are three key differences between these techniques:

- mental rehearsal involves rehearsing the entire performance (e.g. an entire game), whereas visualisation involves rehearsing a single aspect of the performance (e.g. a shot at goal)
- mental rehearsal often happens prior to training or competition, whereas visualisation often happens immediately before the performance (e.g. just prior to the shot at goal)
- mental rehearsal and visualisation both include visual aspects of the performance, but mental rehearsal also includes the other senses (smell, sound, feeling and taste).

visualisation
a technique that involves creating mental images to recreate real-life situations

pre-task routines
actions performed by athletes immediately prior to performing a task (e.g. a serve, free kick or pitch) within a performance

The PETTLEP model

The **PETTLEP model** was proposed by English sport scientists Paul Holmes and David Collins in 2001. It is a framework designed to help athletes get the most out of mental rehearsal and visualisation by making it functionally equivalent (i.e. as close as possible) to the real situation. PETTLEP is an acronym that athletes can use to remember all of the elements required for effective mental rehearsal and visualisation, as shown in Source 2.

PETTLEP model
a framework to help athletes get the most out of mental rehearsal and visualisation by making it as close as possible to the real situation

Physical	Imagine the physical characteristics of your body, including your sports uniform and equipment. You could also take the same physical stance (or position) that you would during performance.
Environment	Imagine the location where the performance will take place, including the surface of the playing area and the stadium and spectators around it.
Task	Imagine the exact requirements of the task. It is important to visualise the task being completed successfully, but it must also be at a level that is equivalent to your role and skill level.
Timing	Imagine the task or performance in real time. Generally, this is more effective than imagining tasks in slow motion; however, there are occasions where slow motion imagery can assist a player wanting to perfect a more difficult, technical element.
Learning	Imagine the task or performance that best suits your level of learning. Adapt imagery to reflect your development of skills of over time and any additional demands being placed on you.
Emotion	Imagine yourself feeling the same types of emotions as you would during a performance. If you generally feel anxious during a game, imagine that feeling during mental rehearsal too. However, avoid focusing too heavily on negative emotions such as panic and fear. Steer yourself towards more positive and constructive emotions instead.
Perspective	Imagine the task or performance from your own point of view. This is known as internal perspective (i.e. through your own eyes), which is generally more effective than external perspective (i.e. through the eyes of a spectator). Both perspectives are acceptable, though it is generally left to the athlete to choose. It is sometimes helpful to change perspectives to see if it results in any additional benefits.

SOURCE 2 The PETTLEP model helps guide athletes towards more effective mental rehearsal.

FOR THE RECORD!

Beach volleyball players Natalie Cook and Kerri Pottharst attributed a large part of their Sydney 2000 Olympic Games gold medal win to mental rehearsal. For example, they rehearsed what they would say to people on the day of the match and they visualised key moments of the match itself, particularly the moment they would finally serve for the win.

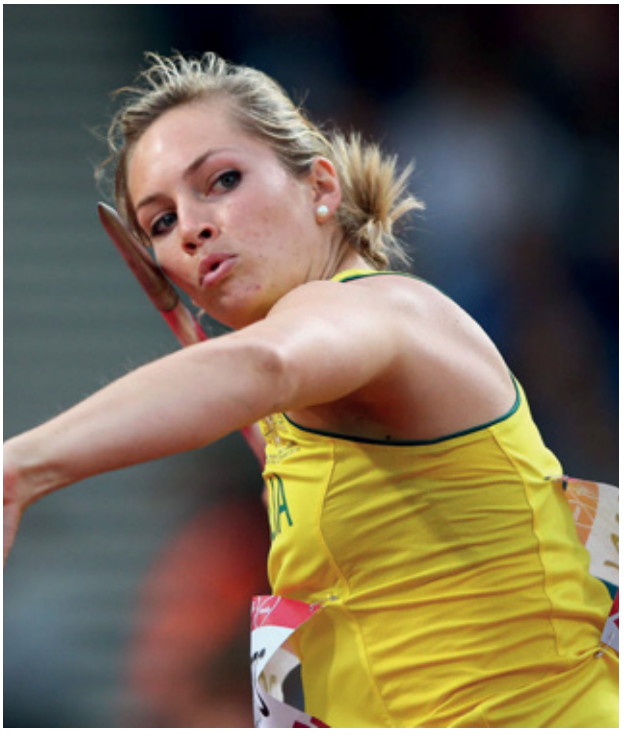
SOURCE 3 The use of mental rehearsal during preparation and performance may have helped retired US swimmer Michael Phelps (centre) to become the most successful Olympian of all time, with a total of 28 medals.

Theory in action | Olympic athletes harness the power of the mind's eye

Olympic athletes spend a large amount of their time training for events. However, a study conducted at the 1980 Winter Olympics, which compared the training schedules of four groups of Olympic athletes, revealed that the athletes who pictured themselves crossing the finish line first were more likely to do just that. Each group in the study was assigned a different combination of physical and mental training:

- → Group one: 100% physical training
- → Group two: 75% physical training, 25% mental training
- → Group three: 50% physical training, 50% mental training
- → Group four: 25% physical training, 75% mental training.

The scientists found that the fourth group were the top performers during the Olympics. As a result of these findings, over the last 20 years, the United States Olympic Committee has increased the number of its full-time sport psychologists from just one to six.



SOURCE 4 Australian javelin thrower Kelsey-Lee Roberts uses mental rehearsal techniques to help her prepare for competition.

What makes visualisation such a powerful technique for success?

According to Dr Srini Pillay, a US psychiatrist, brain researcher and author, 'We stimulate the same brain regions when we visualise an action as we do when we actually perform that same action'.

Visualisation becomes a sort of conditioning for the brain – establishing a goal, then visualising achieving that goal in detail and focusing on it over the long term. These simple techniques help the brain to know what to look out for. Without this conditioning, critical information that can help to achieve goals could end up as background noise.

PERFORMANCE

SKILL DRILL **4.9**

Assess the impact of mental rehearsal on performance

>> Turn to pages 346–347 to complete this integrated physical performance activity.

4.9 Check your learning

Engage and understand

1 In your own words, **define** 'mental rehearsal'.
2 **Differentiate** between mental rehearsal and visualisation.
3 **Describe** the process of mental rehearsal, using a sporting example to demonstrate how it works.
4 **Explain** how a quiet space can enhance mental rehearsal.

Analyse and apply

5 **Compare and contrast** internal and external perspectives in mental rehearsal. Which perspective do you prefer to use when visualising your performance? Explain the reasons behind your choice.
6 Download the blank PETTLEP template provided on your obook assess and use it to plan a mental rehearsal of your performance in a sport of your choice. This can form the basis for your own mental rehearsal.
7 **Reflect on** how mentally rehearsing tonight might improve your next physical performance in PE. **Consider** which elements from PETTLEP will be crucial to improving your performance.
8 Read 'Olympic athletes harness the power of the mind's eye'. **Consider** why the athletes who did 25% physical training and 75% mental training performed better at the Olympics than those who did 100% physical training.

Evaluate and justify

9 Susie and Mei are both preparing for a golf tournament. They understand the importance of mental rehearsal in their preparations.
→ Susie uses an external perspective and visualises herself hitting a hole-in-one on each hole. She sees the ball clearly rolling into the hole and feels excited to start the tournament.
→ Mei mentally rehearses her swing, watching the club move through the air to hit the ball in the 'sweet spot' off the tee. She hears the crowd cheering and feels the butterflies in her stomach dissipating after her first successful shot.
a Whose mental rehearsal do you think will be more effective? **Justify** your decision using the PETTLEP model.
b What aspects of the PETTLEP model could help improve Susie and Mei's mental rehearsal? **Propose** strategies that you believe will help to improve their technique.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  4.9 Check your learning
- **» Skill Drill worksheet**
  Assess the impact of mental rehearsal on performance
- **» Video weblink**
  Mental rehearsal: Interview with Michael Jordan
- **» Weblink**
  The PETTLEP model

4.10 Affirmations

Ongoing psychological techniques

That's a goal!

By the end of Section 4.10, you should be able to:

→ **define** what is meant by the term affirmations

→ **explain** how affirmation techniques can optimise performance.

affirmations
positive statements that are directly related to an athlete's qualities, abilities or goals

Affirmations are used by many athletes to increase confidence and motivation in order to improve performance. Affirmations are positive statements that are directly related to an athlete's qualities, abilities or goals. They are designed to help train an athlete's brain into believing that they possess the skills, abilities, attitudes and beliefs necessary to achieve whatever goal (or goals) they have set for themselves.

Affirmations are an ongoing psychological technique, meaning that they can be applied at any time during or between training and performance. Athletes need to continually practise creating and using affirmations in order to optimise their performance.

SOURCE 1 Positive self-talk and affirmations can improve an athlete's performance.

Using affirmations effectively

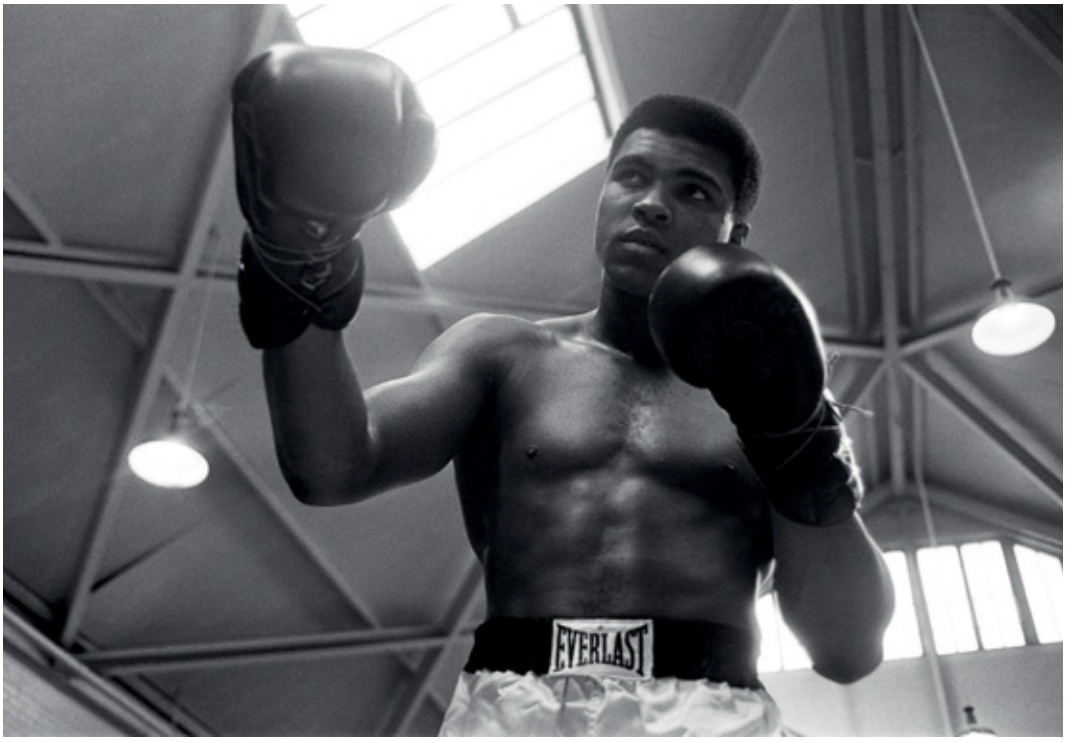
In the lead up to any training session or sporting event, it is common for feelings of doubt and anxiety to enter an athlete's mind. An athlete who regularly practices affirmations will become better at countering these negative thoughts and emotions in order to boost their confidence.

Many sport psychologists agree that the most effective affirmations are:

- written as a statement of fact rather than a wish or a hope (e.g. 'I am a natural born runner.')
- written in the first person (e.g. 'I can stay focused and strong.')
- written in the present tense (e.g. 'I love taking shots under pressure.')
- positive (e.g. 'I am a skilled player.')
- specific (e.g. 'My serve is powerful and lands first time.')

Some sport psychologists suggest that athletes take note of any negative thoughts that arise during training or competition and write six to ten inspirational affirmations to counter each one. These affirmations can be about specific skills or about the individual generally. Athletes should say these affirmations out loud and with conviction to themselves in a mirror or to a trusted friend or trainer. Displaying notes or posters with written affirmations is also beneficial.

The most famous advocate for the use of affirmations was US professional boxer and activist Muhammad Ali. Widely acknowledged as one of the greatest athletes in history, Ali told himself 'I am the greatest' so many times that even his opponents became convinced of it. Ali was also famously quoted as saying: 'It's the repetition of affirmations that leads to belief. And once that belief becomes a deep conviction, things begin to happen.'



SOURCE 2 Muhammad Ali was famously quoted as saying: 'I am the greatest. I said that even before I knew I was.' This is an example of an affirmation.

4.10 Check your learning

Engage and understand

1 In your own words, **explain** what an affirmation is.

2 **Describe** five characteristics of an effective affirmation.

Analyse and apply

3 **Reflect on** a time you had a negative thought about your sporting performance.

- **a** **Describe** the negative thought.
- **b** **Apply** the five characteristics of effective affirmations to create five new affirmations to counter the negative thought. Practise saying the affirmations aloud so you can redirect this negative thought into a positive one.

Evaluate and justify

4 **Conduct** some online research about the life and sporting career of Muhammad Ali.

- **a** **Assess** the role that affirmations played in the sporting and personal success of Ali.
- **b** **Discuss** five affirmations Ali used. **Justify** which affirmation resonates with you.

Check your obook assess for the following additional resources and more:

» **Student book questions**
4.10 Check your learning

» **Video weblink**
Affirmations: Interview with Muhammad Ali

» **Weblink**
Using affirmations effectively

4.11 Team dynamics and cohesion techniques

Ongoing psychological techniques

That's a goal!

By the end of Section 4.11, you should be able to:

→ **identify** and **define** a range of team dynamics and cohesion techniques (i.e. leadership, communication, norms, rules and discipline)

→ **explain** how team dynamics and cohesion techniques can optimise performance.

SOURCE 1 Team dynamics and cohesion techniques help individual members of a team work together as a unified whole.

Team dynamics and cohesion techniques include a range of different strategies and skills designed to help the individual members of a team:

- develop strong relationships
- establish clear roles and expressions
- maintain high levels of communication

so that they can work together and function as a unified whole.

Team dynamics and cohesion techniques should be applied continuously during training and performance.

Athletes need to develop, evaluate and revise their goals on a regular basis in order to optimise their performance.

In Section 4.6, we discussed the Tuckman's Stages of Group Development – a theory designed to explain the stages that teams go through in order to achieve cohision. At each stage of team development, there are important strategies athletes need to work through to optimise the cohesion of their team. A good coach will play an important role in implementing and facilitating these strategies. It is crucial, especially in the forming and storming stages, that the coach is open and available to hear and meet the needs of the individuals within the team. To ensure all members are motivated and driven, a coach must ensure that each individual is having their need for autonomy, competence and relatedness met (as discussed in Section 4.4). This will enable each athlete to contribute more and better accept their teammates' contributions.

Techniques for improving team dynamics and cohesion

There are many different aspects to team dynamics and cohesion, and therefore many different strategies and techniques for improving the cohesion of teams. It is therefore helpful to organise individual techniques into four broad categories based on their purpose. These are:

- techniques for establishing group goals and vision
- techniques for establishing group roles (including leadership)
- techniques for establishing group norms (including rules and discipline)
- techniques for building team identity
- techniques for improving communication.

Techniques for establishing group goals and vision

When everyone shares the same goals and vision, it not only fosters support and harmony within the group but it also motivates individuals within the team to work hard for the good of the team.

Goals should be:

- made in consultation with the whole team
- pertain to things other than just outcomes
- guided by the SMARTER principles (see page 222)
- written down and reviewed regularly.

Vision statements are short sentences or collections of words that capture the essence of the team's group goals. Vision statements should be:

- short
- memorable
- unique to the team.
- motivating
- related to the team goals

SOURCE 2 Rowing is an example of a team sport that requires a lot of team cohesion and cooperation.

Techniques for establishing group roles (including leadership)

When every player is aware of their role and the roles of others, they feel a greater sense of competence and relatedness to their teammates. In establishing group roles, it is important that:

- they are clearly communicated during the forming stage of team development. This clearly includes identifying leaders and people with the authority to make decisions on behalf of the group.
- they are made in consultation with the team
- each role has a description
- they are revised, as required.

Techniques for establishing group norms (including rules and discipline)

Group norms are rules, expectations and disciplinary guidelines set out for all members of the team to follow. Group norms should be:

- established by the coach (sometimes in consultation with some or all members of the team)
- communicated in full
- tailored to the goals and needs of the team
- revised when issues inevitably arise.

It is important that rules are established to ensure individuals within teams are clear on what is expected of them. Making the expectations of team members explicit lessens the potential for emotional stress. Players are often required to sign an agreement to uphold the team rules.

Rules may address the following issues:

- punctuality for games and training
- the dress code for games and training
- social media use
- anti-social behaviours in and out of the sporting arena.

Discipline for breaches of the rules should also be clearly communicated to the team.

Techniques for building team identity

Building a shared team identity is a useful strategy for improving team cohesion. There are many ways in which to build team identity, including:

- creating a team name and logo
- creating a team song and mascot
- creating unique team rituals (e.g. special hand slaps during breaks in play, team chants, and pre- and post-match routines such as a warm up and cool down).

All of these individual elements combine to help create bonds and feelings of belonging and shared identity within the group.

Techniques for improving communication

Communication is a key factor in creating harmony. A team needs an environment in which all members are encouraged to contribute their ideas and have their opinions and suggestions listened to. If communication is not effective, team officials might create a system for communication.

FOR THE RECORD!

The Australian Rugby Union team mascot is called Wally. Team tradition requires the youngest member of the squad to protect and care for Wally while on tour. They must place Wally on the sideline during Tests (facing the way the team is running), take Wally to all functions and ensure Wally is protected from pranks!

4.11 Check your learning

Engage and understand

1 **Identify** four strategies or techniques designed to improve team cohesion.

2 **Explain** why a shared team identity is important. Describe some common strategies used to build team identity.

Analyse and apply

3 Think of your physical education class as a team. **Reflect on** the development of your team since the start of the year.

- **a** **Identify** Tuckman's Stages of Group Development and discuss the reasons for your answer.
- **b** **Identify** any problems you have encountered as a group.
- **c** **Consider** which of the team building strategies suggested here that you have and have not adopted.

Evaluate and justify

4 Communication is a key factor in ensuring a positive team dynamic. **Justify** whether or not you agree with this statement.

5 **Reflect on** a time when you were part of an unsuccessful or dysfunctional team.

- **a** In your view, what made the team unsuccessful or dysfunctional?
- **b** What strategies or techniques could have been applied to improve team cohesion?

6 **Discuss** who should have the greatest say when establishing group norms – the coach or the players. Give reasons for your response.

7 'Leadership roles in junior sport should be rotated and shared equally between all team members.' **Critique** this statement and **justify** your response. Conduct additional research online to build your argument.

Check your obook assess for the following additional resources and more:

- » Student book questions
  4.11 Check your learning
- » Video weblink
  Techniques for improving team dynamics
- » Weblink
  Team dynamics and cohesion

4.12 Pre-competition routines

Pre-performance psychological techniques

That's a goal!

By the end of Section 4.12, you should be able to:

→ **identify** and **define** a range of pre-competition routines (i.e. pre-performance techniques and checklists, and pre-event cues such as technical points, triggers and competition segments)

→ **explain** how pre-competition routines can optimise performance.

pre-competition routines
a sequence of actions and/or thoughts that an athlete follows just prior to performance or competition

Pre-competition routines (also known as pre-performance techniques) are used by athletes to optimise their mental strength and help get them 'in the zone'. A pre-competition routine is a sequence of actions and/or thoughts (performed in order) that an athlete follows just prior to a performance or competition. Pre-competition routines are specific to individual athletes and sports. They are designed to generate feelings of certainty, familiarity and control, and they help athletes to focus on appropriate cues, combat anxiety and boost confidence.

Pre-competition routines are most commonly used immediately prior to a performance or competition; however, a number of these techniques can also be applied at other times (e.g. during performance). It is ideal for athletes to practise these techniques regularly so that they can apply them effectively whenever necessary.

Designing a pre-competition routine

In the lead up to competition, it is normal for athletes to complete an extensive, sport-specific warm up routine. Great athletes don't just focus on preparing their bodies for competition though; they place equal importance on preparing their minds. And they do this by running through pre-competition routines.

Pre-competition routines differ based on the strengths and weaknesses of a particular athlete, and the demands of their chosen sport. However, there are some common elements of pre-competition routines:

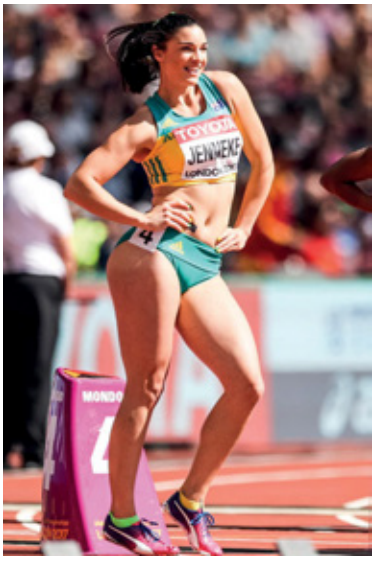
- **Complete a pre-competition checklist** – Checklists might include practicalities such as checking that the requisite equipment and uniform are ready, completing a warm up and taking part in a pre-game briefing. Once the items on the checklist are complete, the athlete can focus on other aspects of their pre-competition routine.
- **Define objectives or goals for the performance** – Having a clearly defined goal for every performance – and reviewing this goal prior to competition – is key to measuring and achieving success.
- **Mentally rehearse the performance or visualise specific aspects of the performance** – Some psychologists suggest rehearsing just the first segment of a competition immediately prior to competition to prevent athletes from becoming overwhelmed with the task ahead. However, it is generally left to individuals to decide the best option for them.

- **Use positive self-talk and affirmations** – In the lead up to performance, athletes need to remind themselves to trust in their skills and know that they have done all they can to optimise their performance. It is important to combat any negative self-doubt by using self-talk and affirmations.
- **Embrace the feelings associated with increased adrenaline release** – The jittery feelings that athletes experience prior to competition are actually helpful. They indicate that the body is getting physically ready for the demands about to be placed on it.
- **Perform rituals** – In sport, a ritual can be defined as a certain behaviour or action that an athlete repeatedly carries out in the belief that it can influence their performance. A ritual may include anything that is meaningful to an athlete. Wearing the same special socks to every game or taking the same route to a big match are some examples of rituals. These can help athletes get themselves mentally ready for their performance, with the familiarity offering them a confidence boost prior to their performance.

Implementing a pre-competition routine

Generally speaking, a pre-competition routine should be carried out 30 to 60 minutes prior to a match. It should take around 10 to 20 minutes to complete.

Some athletes find it best to complete their routine in a quiet space, while others prefer to be around people and noise. Athletes often listen to music while completing their pre-competition routine – some always listen to the same piece of music or artist to provide consistency and familiarity; while others simply wear headphones (without music) to give them the quiet time they need to work through their routines efficiently.



SOURCE 1 Many athletes have a pre-competition routine. Sun Yang listens to music before competing, while Michelle Jenneke gets into the right frame of mind by doing a dance on the starting line.

Australian hurdler Michelle Jenneke (see Source 1) includes dancing in her pre-competition routine. A video of her warm up dance at the starting line of her event went viral after the 2012 World Junior Championships. As she performed well at that meet, she has included the dance before both training and competition ever since. Michelle explains: 'I honestly don't get too nervous about the race. I am more excited than anything else – and the pre-race routine is an outlet for that, [it] gets me into a right frame of mind.'

Theory in action | A case of lucky underwear

Many athletes consider rituals such as wearing their favourite underwear or carrying a lucky charm an important part of their pre-competition routine.

Retired basketball legend Michael Jordan wore his University of North Carolina basketball shorts under his Chicago Bulls uniform in every match he played. He strongly believed that they brought him luck and contributed to his success. To hide his 'lucky' shorts, he wore longer shorts over the top, which started a trend that continues today.

Similarly, tennis legend Serena Williams has several routines to which she attributes her success. She always brings her shower sandals onto court with her, ties her shoelaces in a certain way and wears the same pair of socks for the duration of a tournament. When her performance is off, she will often cite not following one of her routines as the reason.

Some research has shown that rituals provide athletes with a sense of control in an otherwise unknown environment. This can have a positive impact on an athlete's confidence. However, some psychologists dismiss this idea and warn against getting too attached to rituals and superstitions. They claim that rituals are based on luck and give athletes a false sense of confidence.

SOURCE 2 Michael Jordan won six NBA championships wearing the same 'lucky' shorts under his uniform.

4.12 Check your learning

Engage and understand

1 **Identify** the elements considered necessary for an effective pre-competition routine.
2 **Explain** what is meant by 'Embracing the feelings' as part of a pre-competition routine.
3 **Explain** when a pre-competition routine should be taken and how long it should take.

Analyse and apply

4 Read 'A case of lucky underwear', then conduct some additional research into rituals in sport. Based on your research, **reflect on** whether you think rituals are beneficial routines that can have a positive impact on athletes' confidence or inadvisable routines that give athletes a false sense of confidence. Compare examples from your research in a written response of 150 words.

Evaluate and justify

5 **Create** your own pre-competition routine for the sport that is the focus of your study this term.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  4.12 Check your learning
- **» Video weblink**
  Michelle Jenneke pre-competition dance
- **» Weblink**
  Designing a pre-competition routine
- **» Weblink**
  Michael Jordan's lucky shorts

4.13 Relaxation and energiser techniques

Pre-performance psychological techniques

That's a goal!

By the end of Section 4.13, you should be able to:

→ **identify** and **define** a range of relaxation and energiser techniques (i.e. meditation, progressive muscle relaxation [PMR], deep breathing, music and visualisation)

→ **explain** how relaxation and energiser techniques can optimise performance.

relaxation and energiser techniques
a range of different techniques aimed at optimising athletes' arousal levels

Relaxation and energiser techniques are often used as a way to optimise arousal levels prior to performance. They can also contribute to better concentration, motivation and confidence. These techniques can be adapted to suit the individual needs of athletes and the situation in which they find themselves.

Relaxation and energiser techniques are most commonly used immediately prior to performance or competition. However, a number of these techniques can also be applied in an ongoing sense and/or during performance. It is recommended that athletes practice these techniques regularly so that they can apply them effectively whenever they are required.

Effective relaxation and energiser techniques

Effective relaxation and energiser techniques include:

- meditation
- progressive muscle relaxation (PMR)
- deep breathing
- music
- visualisation.

meditation
the practice of focusing attention on a single point of reference to create calmness and clarity

Meditation

Meditation is the practice of focusing the mind to achieve clarity and a sense of calm by reducing 'noise' or stimulation to the brain. Meditation allows you to turn attention away from distracting thoughts and focus on the present moment. It can involve focusing on breath or bodily sensations, or a word, phrase or image.

Athletes can use meditation to prevent the build-up of pre-competition anxiety. Meditation can also help athletes gain greater control of their emotions and focus during performance. For example, a softball pitcher may experience a natural increase in arousal before a crucial pitch. If the players practised effective meditation beforehand, their strengthened mind–body connection will enable them to resist the heightened external and internal distractions and remain connected to the task in the present. This will in turn allow them to stay more relaxed as a performer.

To be most effective, meditation should initially be practised:

- in a quiet environment
- for 10 to 30 minutes, two to three times a day initially
- with a focus on breathing
- with a clear mind (i.e. without holding onto distracting thoughts).

FOR THE RECORD!

Phil Jackson, former NBA coach of the Chicago Bulls and the Los Angeles Lakers, used to invite all his players into a meditation circle before important playoff games to help players focus on the task and ensure they were mentally present. Over his nine seasons as coach of the Chicago Bulls, Chicago won the NBA championships six times.

Progressive muscle relaxation (PMR)

Progressive muscle relaxation (PMR) is a popular relaxation technique used by athletes. It involves the systematic tensing and releasing of muscles, which is beneficial to athletes both before and after a sporting performance. PMR can reduce respiration, blood pressure, muscle tension and negative thoughts. An athlete who engages in PMR regularly can manage anxiety better and their performance is therefore optimised.

progressive muscle relaxation (PMR)
a stress-relief technique that involves the systematic tensing and relaxing of particular muscle groups in the body

To be effective, it is recommended that athletes spend 10 minutes engaging in PMR in the quiet of their home before and after competitions, at least two to three times each week. Athletes lie on the floor and progressively tense and then relax particular muscle groups. Starting with the arms, the athlete can make a fist and tighten the arm muscles for approximately 5 seconds and then relax for 30 seconds. Repeating this several times will help athletes become more familiar with the sensations and feedback from the muscles. The same can be done for the neck, face, shoulders and upper back and then the lower back and abdominals, as well as the legs and hips. To finish, athletes tense their whole body and then relax completely.

With practice, athletes will be able to relax the muscles without tensing them first; sometimes a cue word is enough to produce the feeling of relaxation. This technique is particularly useful for neck and shoulder tension, tension headaches and tight jaw muscles.

SOURCE 1 Practising progressive muscle relaxation (PMR) prior to a performance can induce feelings of relaxed energy.

Deep breathing

Deep breathing is an important relaxation technique that is often performed in conjunction with meditation and PMR but it is also effective on its own.

Practising effective deep breathing techniques prior to a performance can help decrease stress and muscle tension, calm nerves and reduce negative or unhelpful thoughts; it can induce feelings of relaxed energy.

To practise deep breathing:

- Sit or lie in a relaxed position with bent knees.
- Relax your shoulders.
- Place your dominant hand just below your navel and your other hand just above it.
- Breathe deeply through your nose, filling the area under your dominant hand with air first, then the area under your other hand (lower rib cage) and finally the upper portion of your lungs.
- Exhale slowly, squeezing your belly, pushing the air out.
- Focus on each inhalation and exhalation.
- Repeat for 10 minutes.

Music

Music is a powerful tool for both increasing and decreasing athletes' arousal levels before training or competition. The effect of music differs from athlete to athlete.

Prior to performance, it is more common for athletes to listen to music with a fast beat – this type of music generally increases arousal levels.

SOURCE 2 Athletes use relaxation and energiser techniques such as deep breathing and listening to music to prepare for performances.

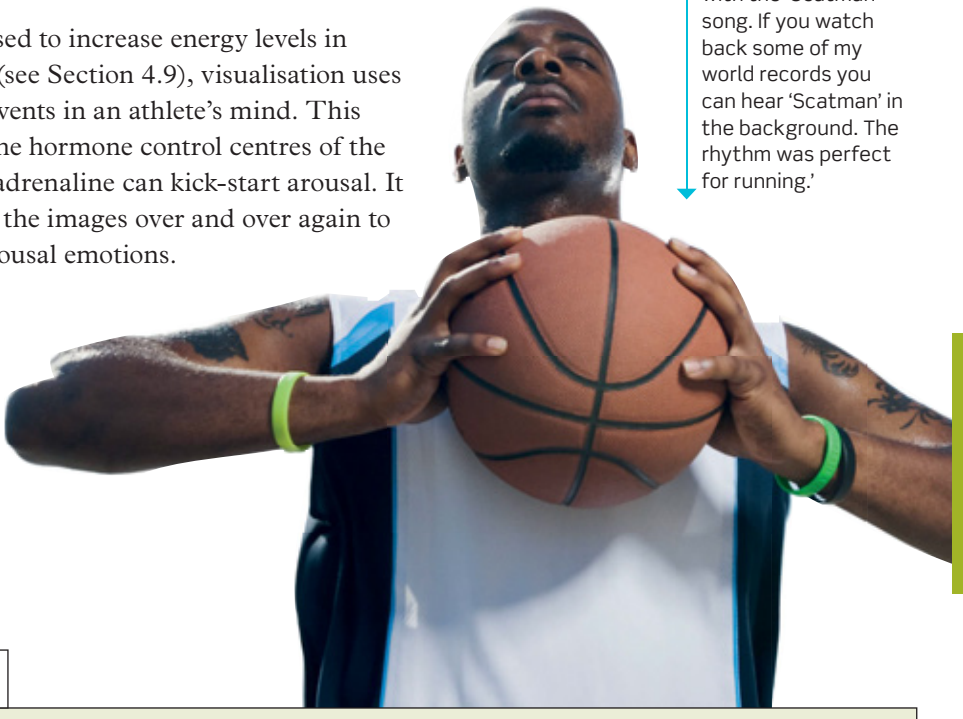
However, some athletes respond well to relaxation music (such as nature sounds like whales or water) or the mellow tunes of their favourite artist prior to performance.

The Brunel Music Rating Inventory

The Brunel Music Rating Inventory was created by sport psychologist Costas Karageorghis to help athletes choose the ideal music to listen to as part of their pre-performance routine. One of the most important elements of Karageorghis' research was that a song's tempo (i.e. speed) should be between 120 and 140 beats per minute (BPM) for optimum arousal. That pace coincides with the range of most commercial dance music and rock songs.

Visualisation

Visualisation is another technique used to increase energy levels in athletes. A type of mental rehearsal (see Section 4.9), visualisation uses mental imagery to create powerful events in an athlete's mind. This can 'trick' the body into activating the hormone control centres of the brain and the subsequent release of adrenaline can kick-start arousal. It is recommended that athletes repeat the images over and over again to flood the mind with the powerful arousal emotions.



SOURCE 3 Visualisation creates powerful events in an athlete's mind. A basketball player might visualise the sweetest point they ever scored and the subsequent celebration of this basket.

FOR THE RECORD!

Haile Gebrselassie, a retired long-distance runner and Olympic gold medallist, often requested that the 90s hit 'Scatman' (with a BPM of around 135) be played during his events. Gebrselassie says: 'I did many records with the 'Scatman' song. If you watch back some of my world records you can hear 'Scatman' in the background. The rhythm was perfect for running.'

4.13 Check your learning

Engage and understand

1 In your own words, **explain** how meditation can help an athlete to control their anxiety.

2 True or false? To be most effective, athletes should practise meditation two to three times a day initially. **Explain** your response.

Analyse and apply

3 **Analyse** PMR and deep breathing techniques. **Reflect on** which technique would have the greatest impact on optimising your arousal levels prior to performance.

4 **Compare** and **contrast** the types of music that increase athletes' arousal levels and the types of music that decrease arousal levels.

Evaluate and justify

5 'Music with a tempo of 120 to 140 BPM will optimise arousal levels for all athletes.'

Do you agree or disagree with this statement? **Justify** your response, using examples.

Check your obook assess for the following additional resources and more:

- **» Student book questions** 4.13 Check your learning
- **» Video weblink** Progressive muscle relaxation training
- **» Weblink** The benefits of visualisation
- **» Weblink** The benefits of deep breathing

4.14 Positive self-talk techniques

In-performance psychological techniques

That's a goal!

By the end of Section 4.14, you should be able to:

→ **identify** and **define** a range of positive self-talk techniques (i.e. positive self-talk, positive cue words, trigger words and positive emotions)

→ **explain** how self-talk techniques can optimise performance.

positive self-talk
saying encouraging and motivating messages to yourself

Positive self-talk techniques are known to increase feelings of confidence and motivation, optimise arousal and improve concentration. They can have a significant impact on the performance of athletes. Positive self-talk is the practice of saying encouraging and motivating messages to yourself, either silently or out loud.

Positive self-talk techniques are most commonly used during performance or competition. However, a number of these techniques can also be applied in an ongoing sense and/or immediately prior to performance. It is recommended that athletes practise these techniques regularly so that they can apply them effectively whenever they are required.

Effective positive self-talk techniques

self-talk
words and thoughts directed towards yourself

negative self-talk
saying negative comments to yourself

Self-talk consists of the words and thoughts that athletes direct towards themselves. Self-talk can be positive or negative. It is linked strongly to an athlete's core self-belief and motivation.

When self-belief is low, an athlete is more likely to engage in **negative self-talk,** with comments such as 'I'm just hopeless!', 'This will be a double fault' or 'You're never going to win!' They are also more likely to see strong emotions as negative threats rather than positive challenges. However, an athlete who chooses to use positive self-talk can help to shift the negative self-beliefs they may have learned over time.

SOURCE 1 Sally Pearson has often publically spoken about the impact positive self-talk had on her career as an elite hurdler.

Effective positive self-talk techniques and skills include the use of:

- positive cue words
- trigger words
- positive emotions.

Positive cue words

Positive cue words are one component of positive self-talk. Positive cue words are single words or short statements (see Source 2) that athletes can say to themselves to help refocus their attention and combat negative thoughts or emotions that would otherwise distract them and negatively affect their performance. Positive cue words can lift players out of low moods during competition and bring them back to the present moment.

positive cue words single words or short statements to help refocus attention and combat negative thoughts or emotions

The use of positive cue words not only helps athletes to focus but also elicits positive emotional feelings for the athletes in the game. For example, a basketball player might shout out 'STTE!' (strong to the end) to encourage their teammates not to give up and to play with confidence, even when defeat looks inevitable.

Athletes can often be seen talking to themselves throughout their performance. During the televised coverage of the 2016 Rio Olympic Games, US gymnastics gold medallist Laurie Hernandez could be seen whispering to herself: 'I got this.'

Positive cue words should be:

- short and clear
- relevant and meaningful to the individual athlete
- repeated regularly during training so they can be instantly called upon during competition
- written out and displayed in various prominent places.

Mental state	Examples of positive cue words
Over-arousal (e.g. anxiety or panic)	Calm down Relax Easy Relax and breathe Calm, confident, in control
Under-arousal (e.g. wakefulness or boredom)	Go for it Drive hard Get in the game Get after it
Distraction or lack of focus	Eye on the ball Focus Keep it simple Focus on every play Stay in the game
Low confidence	You've got this You can do this Ball is going in the hoop Reach my full potential Dig deep Dominate

SOURCE 2 Positive cue words can motivate athletes to work hard and give them confidence to meet their potential.

Theory in action | Why do tennis players talk to themselves?

Tennis players are renowned for using a range of self-talk techniques. Singles tennis is an individual sport, rare in that it is one of only a few sports where you can score more points than your opponent and still lose the match. There are many mind games players have to work through as they experience both wins and losses at crucial stages of each match. Unlike many other sports, tennis players are banned from receiving support and guidance from their coaches during the match. Therefore, the onus is on the players to coach themselves through the difficult periods of a match.

Makis Chamalidis, a psychologist with the French Tennis Federation, explains: 'After each point, you have 20 to 25 seconds where there isn't much happening. It's quite normal to talk to yourself then. You have things to deal with, you need to analyse what happened or evacuate your frustration. There are no such breaks in other sports, or an external person like a coach.'

Performance psychologist Dr Melissa Weinberg explains that while it appears that only some tennis players are self-talkers, in reality even the seemingly quiet players use self-talk – they just do it more covertly.

Roger Federer, who is renowned for his quiet mental strength during matches, admitted in a post-match interview at the 2017 Australian Open that he was talking to himself internally after losing a crucial fourth set against Stan Wawrinka: '... in the fifth set ... I was talking to myself in my head, saying "Just relax, man. The comeback is so great already. Let it fly off your racquet and just see what happens."'

Unlike Federer, other tennis players such as Andy Murray and Serena Williams talk aloud to themselves during matches. For these players, the act of speaking the words aloud is more effective. It also makes it easier for spectators to figure out what's on their mind!

SOURCE 3 Roger Federer is renowned for his composed demeanour on the court, but he admits to using self-talk techniques to keep himself motivated.

Trigger words

Trigger words are used by athletes to focus their attention on a specific task during or before the completion of a skill. This self-talk technique is often linked to specific instructions or cues athletes have been given by their coaches. For example, a sprinter might use trigger words such as 'posture', 'knees' or 'drive with the elbows'. In essence, these words serve as reminders for what to do. For example, Professional golfer and former world number one Rory McIlroy uses the words 'process' and 'spot' to keep himself focused. He reminds himself to focus on the process rather than the outcome, and uses 'spot' to help him pick a spot while putting. He has won many majors using this aspect of positive self-talk.

trigger words
words or short statements used to focus attention on a specific task during or before the completion of a skill

Positive emotions

Positive emotions are an important aspect of an athletes' sporting experience. Positive emotions build stronger self-belief, which in turn contributes to more positive emotional experiences. The athlete who draws on positive emotions can rise above slumps in their performance and use a **growth mindset** to avoid succumbing to the negative emotions that naturally arise during low points in competition. With a growth mindset, an athlete sees dips in their performance as interesting challenges that they have control over. This can transform feelings of frustration or anger into excitement and hope. Experiencing sport as an enjoyable challenge is highly motivating and has a positive effect on an athlete's confidence.

positive emotions
emotions that create an uplifting effect

growth mindset
a belief that one's own abilities can be developed through hard work

4.14 Check your learning

Engage and understand

1 Using examples from the text, **describe** why self-talk is more than simply having a chat with yourself.

2 **Identify** a positive cue word (or statement) that could assist an athlete in each of the following mental states:
- **a** over-arousal
- **b** under-arousal
- **c** distraction or lack of focus
- **d** low confidence.

Analyse and apply

3 **Differentiate** between positive cue words and trigger words by making a list of key points.

4 Read 'Why do tennis players talk to themselves?' This article mentions two methods of self-talk: internal (spoken in your head) and external (spoken aloud). Use a PMI analysis framework to identify the strengths and weaknesses of both methods (an example is provided in your obook assess). Use it to **determine** which method would work best for you.

Evaluate and justify

5 **Create** a set of four positive cue words or phrases that you can use during this unit. **Justify** your choice of words.

6 Kayla and Lizzie are playing in their high school basketball final. Neither of them has played well in the first half of the game. Kayla feels defeated and, each time she misses a shot, she mutters to herself: 'See? You're just hopeless at basketball!' She thinks she should probably quit the team. Lizzie is also upset that she isn't playing well but after missing a shot, she shouts to herself: 'Come on. You can do better than that! You've got this. Focus!' Lizzie feels she is in a slump and decides to push herself to work hard and get back in the game. From a sport psychology perspective, **discuss** the difference between the players' reactions to their poor performance. **Justify** which athlete is more likely to experience success in the second half of the match.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  4.14 Check your learning
- **» Video weblink**
  The importance of positive self-talk
- **» Weblink**
  Positive cue words
- **» Weblink**
  Trigger words

4.15 Pre-task routines

In-performance psychological techniques

That's a goal!

By the end of Section 4.15, you should be able to:

→ **identify** and **define** a range of pre-task routines (i.e. taking a deep breath; focusing on a cue word; having temporal consistency; performing a set of steps in a specific order)

→ **explain** how pre-task routines can optimise performance.

Pre-task routines (also known as pre-performance routines) are actions performed by athletes immediately prior to performing a task within a performance (i.e. a closed skill such as a serve, a free kick or a pitch). Pre-task routines can help an athlete steady their mind and take control of their performance before they execute the skill. Pre-task routines can also help athletes to increase their concentration under pressure.

Pre-task routines are an in-performance psychological technique, meaning that they are most effective when applied during an activity or performance but like most psychological techniques, it is important to develop and practise pre-task routines outside of performance times. Many sport psychologists – and athletes – would argue that the pre-task routine is just as important as the task itself!

Effective pre-task routines

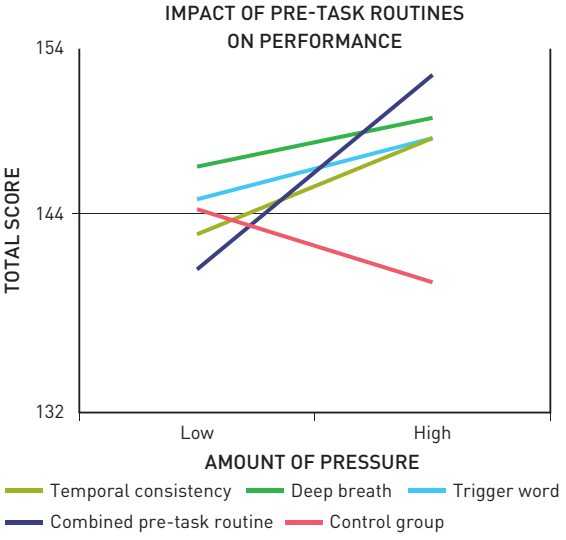
The ability to perform successfully under pressure is a crucial aspect of sport performance. Effective pre-task routines can help athletes improve their overall performance and reduce the risk of choking under pressure.

The Mesagno and Mullane-Grant experiment

In 2010, Australian sport scientists Christopher Mesagno and Thomas Mullane-Grant conducted an experiment to assess the effectiveness of incorporating pre-task routines into pressured performances. A group of 60 skilled soccer players were placed into five equally sized groups. Four of the groups were assigned a different pre-task routine to perform in the same way before each kick. The fifth group was a control group that received no pre-task routine. The pre-task routines were:

- Group 1: taking a deep breath
- Group 2: focusing on a trigger word
- Group 3: having temporal consistency (e.g. performing a countdown before executing the skill)
- Group 4: performing a combined pre-task routine (i.e. combining all the routines above in a specific sequence as well as adding a physical action e.g. tapping a boot twice before kicking).

Participants in each group were asked to kick 20 balls into a goal, firstly, under low pressure (i.e. no consequences for success or failure) and, secondly, under high pressure (i.e. in front of an audience and with cash prize for the highest score).



SOURCE 1 The Mesagno and Mullane-Grant experiment reveals the importance and effectiveness of pre-task routines.

Source 1 shows that when the results of the four pre-task groups were compared against the control group:

- the performances of the players in the four pre-task groups increased under high pressure when compared to the control group
- the most significant increase in performance was experienced by athletes who performed the extensive pre-task routine
- the performance of the players in the control group (with no pre-task routine) decreased under pressure.

The experiment indicated that these types of pre-task routines are effective in helping players manage their arousal and concentration levels before completing closed skills. It also highlighted that the use of an extensive pre-task routine is highly beneficial.

SOURCE 2 Jonny Wilkinson uses an extensive pre-task routine for goal kicking. After lining the ball up, he takes 4 steps away from the ball, one deep breath and relaxes his shoulders, 5 steps towards the try line, clasps his hands, stares at the goal and then kicks.

Tips for establishing an effective pre-task routine

- Choose actions that mimic (or are part of) the task you must complete – e.g. if your task is driving a golf ball, then the pre-task routine might be standing two steps back and practising the swing.
- Keep the routine short, with consistent timing between each step – e.g. take 5 seconds between each practice swing and the actual task.
- Include a breathing rhythm and a trigger word.
- Practise and refine the routine until it becomes habitual.

PERFORMANCE | SKILL DRILL 4.15 | Determine the impact of pre-task routines on performance

>> Turn to pages 348–349 to complete this integrated physical performance activity.

4.15 Check your learning

Engage and understand

1 **Explain** the purpose of pre-task routines.

2 **Summarise** the findings of the Mesagno and Mullane-Grant experiment. What conclusion did they draw about the effectiveness of pre-task routines?

Analyse and apply

3 Based on the results of the Mesagno and Mullane-Grant experiment, **consider** what inferences can be made about the impact of pre-task routines on the mental state of athletes during performance.

4 **Compare** and **contrast** the types of pre-task routines commonly carried out by tennis players prior to serving and rugby players prior to kicking for goal. **Consider** things such as the consistency, timing and scope of the routines.

Evaluate and justify

5 a **Design** a pre-task routine.

b **Predict** whether you think your pre-task routine will be successful.

c **Justify** your prediction based on statistics.

Check your obook assess for the following additional resources and more:

- **Student book questions** 4.15 Check your learning
- **Skill Drill worksheet** Determine the impact of pre-task routines on performance
- **Video weblink** How routines help athletes get consistent results
- **Weblink** The Mesagno and Mullane-Grant experiment

4.16 Breathing techniques

In-performance psychological techniques

That's a goal!

By the end of Section 4.16, you should be able to:

→ **identify** and **define** a range of breathing techniques (i.e. deep breathing)

→ **explain** how breathing techniques can optimise performance.

breathing techniques
any form of breathing exercise in which an athlete consciously regulates their breathing to stimulate a desired response

Breathing techniques have been proven to help athletes relax their bodies and minds, increase focus and ultimately contribute to better performance. They include any form of breathing exercise in which an athlete consciously regulates their breathing (by controlling the rate and depth of their breaths) in order to stimulate a desired response.

When breathing is performed in a deep rhythmic pattern (often referred to as diaphragmatic breathing), the 'primitive' parts of the brain that control the fight or flight response are given a signal that the threat of danger has passed.

Effective breathing techniques

Breathing techniques are effective when applied during an activity or performance but, like many psychological techniques, athletes need to practise and perfect them. Effective breathing techniques include deep breathing (see Section 4.13), as well as those that are intended to have specific effects on the athlete's body (such as those shown in Source 1).

Technique	Method	Effect
4–7–8	→ Inhale deeply for 4 seconds → Hold breath for 7 seconds → Exhale for 8 seconds	→ Calms the athlete quickly in a high-pressure moment.
6–2–8	→ Inhale deeply for 6 seconds → Hold breath for 2 seconds → Exhale for 8 seconds	→ The short hold refreshes the nervous system and refocuses the athlete.
Measured breathing	→ Customised to the athlete → Inhale and exhale for the same count (e.g. 5 in and 5 out) → No breath holding	→ The rhythm encourages relaxation and focus.

SOURCE 1 Athletes who can master their breathing tend to perform better.

4.16 Check your learning

Engage and understand

1 In your own words, **explain** the benefits of deep breathing techniques.

Analyse and apply

2 **Compare and contrast** the three deep breathing techniques provided in Source 1. **Consider** which techniques you think would be most beneficial to you as an athlete. Why?

Check your obook assess for the following additional resources and more:

» Student book questions
4.16 Check your learning

» Video weblink
Effective breathing techniques

» Weblink
How breathing techniques help athletes perform

4.17 Performance segmenting

In-performance psychological techniques

That's a goal!

By the end of Section 4.17, you should be able to:

→ **define** the technique of performance segmenting

→ **explain** how performance segmenting can optimise performance.

performance segmenting
the process of breaking up a performance into more manageable periods in one's mind

Performance segmenting is the process of breaking up extended periods of training or competition into smaller, more manageable periods of time (known as segments). Each segment should be short enough for the athlete to totally focus on what needs to be done during that period. Performance segmenting is designed to help athletes stay confident and motivated, and to focus their attention and concentration.

Performance segmenting is an in-performance psychological technique, meaning that it is most effective when applied during an activity or performance.

FOR THE RECORD!

Australian cricket player Steve Smith has been a successful performance segmenter since his early days playing the sport. His junior coaches and teammates claim that he would regularly steer his team to victory by 'winning' one over at a time. After each over, he would yell out from the crease: 'What's our run rate now?'

Effective performance segmenting

A sporting event that takes place over a long period of time can be overwhelming for the players or athletes taking part in it – think of a marathon runner at the start of an event or a cricket player at the start of a run chase. If an athlete performs below expectations in the early stages of an event, feelings of panic and anxiety can set in and influence the outcome of the entire event. Effective performance segmenting aims to prevent this from happening. By dividing an event up into segments, athletes can narrow their focus and fully concentrate on the demands of that smaller period of play or activity.

There are no set rules on how short or long each segment should be, as this will depend on the individual and the sport or physical activity. The marathon runner might break his event into 10 km sections while the cricket player embarking on an Ashes series will likely think of one game at a time. They may even break it down further into days, innings or sessions.

4.17 Check your learning

Engage and understand

1 **Summarise** the concept of performance segmenting.

Analyse and apply

2 The phrase 'play one hole at a time' describes the concept of performance segmenting. **Consider** the activity you are currently studying and **assess** the opportunities for performance segmenting.

Evaluate and justify

3 Australian cricketer Steve Smith is a master of performance segmenting. Conduct some online research to identify two other Australian sporting identities that use performance segmenting. **Compare** the data you have collected and **analyse** how it has helped these athletes to optimise their performance. Provide one or more credible source to support your answer.

Check your obook assess for the following additional resources and more:

» **Student book questions**
4.17 Check your learning

» **Weblink**
Effective performance segmenting

CHAPTER 4 REVIEW

Sum it up!

4.1 **Sport psychology** is a field of science that investigates how an athlete's mental processes influence their participation and performance in sport and physical activity. It aims to assist athletes to achieve optimum mental health and improve performance.

4.2 **Motivation** refers to the drive within us to behave in a particular way to achieve our goals. There are two types of motivation: **extrinsic motivation** and **intrinsic motivation**.

4.3 **Confidence** is the belief that a person can have faith in (or rely on) themselves, someone or something. An athlete's overall level of confidence is made up of three factors: **self-confidence, self-belief** and **self-efficacy**.

4.4 **Arousal** is a feeling of mental and physical alertness or excitement.

4.5 **Attention** is the ability of an athlete to respond to specific internal and external stimuli during training and competition. **Concentration** is the everyday term used to describe how a person focuses their mental energy.

4.6 **Team dynamics** describes the relationships between all of the different members of a group. **Team cohesion** is the extent to which individual members of a team can work together as a unified whole. There are **four distinct stages** teams go through to reach cohesion: **forming**, **storming**, **norming** and **performing**.

4.7 There are many psychological techniques athletes can use to optimise performance. These techniques can be: **ongoing**, **pre-performance** and **in-performance**.

4.8 **Goal setting** is used to identify things you want to achieve and to establish measures to track progress. There are three types of goals: outcome goals, performance goals, process goals. The **SMARTER** principle is a popular technique for developing realistic and achievable goals

4.9 **Mental rehearsal** is a technique used by athletes to develop skills, reduce anxiety, increase confidence and concentration, and ultimately improve performance.

4.10 **Affirmations** are positive statements designed to help train an athlete's brain into believing that they possess the skills, abilities, attitudes and beliefs necessary to achieve whatever goal they have set.

4.11 **Team dynamics** and **cohesion techniques** help the individual members of a team develop strong relationships, establish clear roles and expectations, and maintain high levels of communication so that they can work together and function as a unified whole.

4.12 **Pre-competition routines** are sequences of actions and/or thoughts (performed in order) that an athlete follows just prior to an event or competition.

4.13 **Relaxation and energiser techniques** are used to optimise arousal levels prior to performance. They include: **meditation**, **progressive muscle relaxation (PMR)**, **visualisation** and **breathing techniques**.

4.14 Positive self-talk techniques are known to increase feelings of confidence and motivation, optimise arousal and improve concentration. Positive self-talk techniques include: positive cue words, trigger words, positive emotions.

4.15 **Pre-task routines** are actions performed by athletes immediately prior to performing a task (i.e. a closed skill such as a serve, a free kick or a pitch) within a performance.

4.16 **Breathing techniques** include any form of breathing exercise in which an athlete consciously regulates their breathing (by controlling the rate and depth of their breaths) in order to stimulate a desired response (e.g. relaxation and/or focus).

4.17 **Performance segmenting** is the process of breaking up extended periods of training or competition into smaller, more manageable pieces (known as segments).

Dig deeper!

Exam-style revision questions and tasks

SECTION A

→ Ten multiple-choice questions

QUESTION 1

The main objective of sport psychology is

(A) to positively affect an opponent's performance.
(B) to increase the chance of optimum performance.
(C) to assist athletes to achieve optimum mental health and improve performance.
(D) to assist athletes to achieve optimum mental health and guarantee optimum performance.

QUESTION 2

Motivation is

(A) a general desire, need or want that drives a person to behave in a particular way.
(B) a belief that a person can have faith in (or rely on) themselves, someone or something.
(C) the level of focus and attentiveness a person dedicates to a task or stimulus.
(D) the relationships between members of a group of people (who are working together to achieve a common goal).

QUESTION 3

Arousal is

(A) a general desire, need or want that drives a person to behave in a particular way.
(B) a belief that a person can have faith in (or rely on) themselves, someone or something.
(C) the level of focus and attentiveness a person dedicates to a task or stimulus.
(D) the relationships between members of a group of people (who are working together to achieve a common goal).

QUESTION 4

Which of the following cannot be categorised as a type of goal?

(A) Outcome
(B) Performance
(C) Achievement
(D) Process

QUESTION 5

Extrinsic motivation is

(A) a type of motivation driven by internal factors.
(B) a type of motivation driven by external factors.
(C) a type of amotivation.
(D) at the lower end of the motivation continuum.

QUESTION 6

An athlete's overall confidence is made up of

(A) self-confidence, self-belief and self-respect.
(B) self-confidence, self-belief and self-efficacy.
(C) self-belief, self-efficacy and self-esteem.
(D) self-belief, self-efficacy and resilience.

QUESTION 7

Progressive muscle relaxation (PMR) is a popular technique used by athletes to

(A) reduce respiration, core body temperature, perspiration and negative thoughts.
(B) reduce respiration, core body temperature, perspiration and positive thoughts.
(C) reduce respiration, blood pressure, muscle tension and core body temperature.
(D) reduce respiration, blood pressure, muscle tension and negative thoughts.

QUESTION 8

According to Nideffer's Attentional Model, attention exists in two dimensions:

(A) direction and width.
(B) length and width.
(C) intrinsic and extrinsic.
(D) broad and narrow.

QUESTION 9

_____ is the strategy that allows an athlete to maintain concentration and focus by breaking up a performance into manageable sections.

(A) Body movement segmenting
(B) Performance segmenting
(C) Progressive muscle relaxation
(D) Pre-task routines

QUESTION 10

According to Tuckman's Stages of Group Development, group norms should be developed during the _____ stage.

(A) forming
(B) storming
(C) norming
(D) performing

SECTION B

→ Two short-response questions
→ One extended written response question

QUESTION 11 (150 words)

Goal setting is a technique used to help athletes identify things they want to achieve and establish measures to monitor and track progress.

a Identify the three main types of goals and compare each one using examples to support your answer.

b The SMARTER principle is often used to help athletes generate effective goals. Write a goal that incorporates aspects included in the SMARTER principle.

QUESTION 12 (150 words)

During a match, a tennis player can be heard saying 'I love taking shots under pressure.'

a Identity what psychological technique is being used here.

b Explain how this psychological technique is used by athletes to increase confidence and motivation and, ultimately, improve performance.

QUESTION 13 (400 words)

At the Gold Coast 2018 Commonwealth Games, Australian javelin thrower Kathryn Mitchell won her first gold medal. Mitchell had failed to earn a medal in three previous Commonwealth Games and the Rio 2016 Olympic Games.

After performing a throw of over 68 metres on her first attempt at the Gold Coast 2018 Commonwealth Games – the longest distance to be thrown by a woman in the sport in over 5 years – Mitchell had this to say about her preparation:

> *'I have worked a lot this season not to focus too much on results and more on the process. It has worked and it's a little bit unbelievable. If I put all distances out of my mind, I knew I could throw the Australian record eventually but said to myself, "Just allow it to happen and it will come."'*

SOURCE 1 Australian javelin thrower Kathryn Mitchell

Reflecting on her thoughts during the event, Mitchell said:

> *'I just tried to concentrate on what I was doing, and I did that on the first throw. Then it was awfully distracting for me for the next three throws as I was trying to get calm again. It took quite a while to get the adrenalin down again because I need to be so relaxed and calm when I throw, so that was a challenge. Once I relaxed again I threw another 68.'*

Evaluate how Kathryn Mitchell's preparation for the Gold Coast 2018 Commonwealth Games affected her performance. In your response, refer to the stimulus provided and comment on the application of sport psychology concepts such as confidence, motivation, arousal, attention and concentration.

Check your obook assess for the following additional resources and more:

- **assess quiz** — Test your skills with this auto-correcting multiple-choice quiz for Chapter 4
- **Revision notes** — Make your own revision notes for assessment tasks with this handy template
- **Data analysis worksheet** — Chapter 4 review – Practice your data analysis skills with this worksheet
- **Practice assessment task ISMG** — Instrument-specific marking guide for the practice assessment task in Chapter 4

Practice assessment task

Subject	Physical Education	**Instrument number**	
Technique	Project – folio		
Unit	2 Sport psychology, equity and physical activity		
Topic	1 Sport Psychology integrated with a selected physical activity		

Conditions			
Duration	5 hours		
Mode	Multimodal (visual and written or spoken)	**Length**	Multimodal 9–11 minutes
Individual / Group	Individual	**Other**	Examples of multimodals include: → a pre-recorded presentation submitted digitally → a presentation conducted in front of an audience (class or teacher) → a digital portfolio of video, images and diagrams with annotations or commentary → a multimedia movie or slideshow that may combine images, video, sound, text and a narrative voice.

Context

Throughout this unit, you have been applying and evaluating the effectiveness of various psychological techniques for optimising performance, including those that are available before an event (i.e. pre-performance) and during an event (i.e. in-performance). The success of these techniques will be determined by an analysis of primary data collected over the course of Unit 2, both before and during performance.

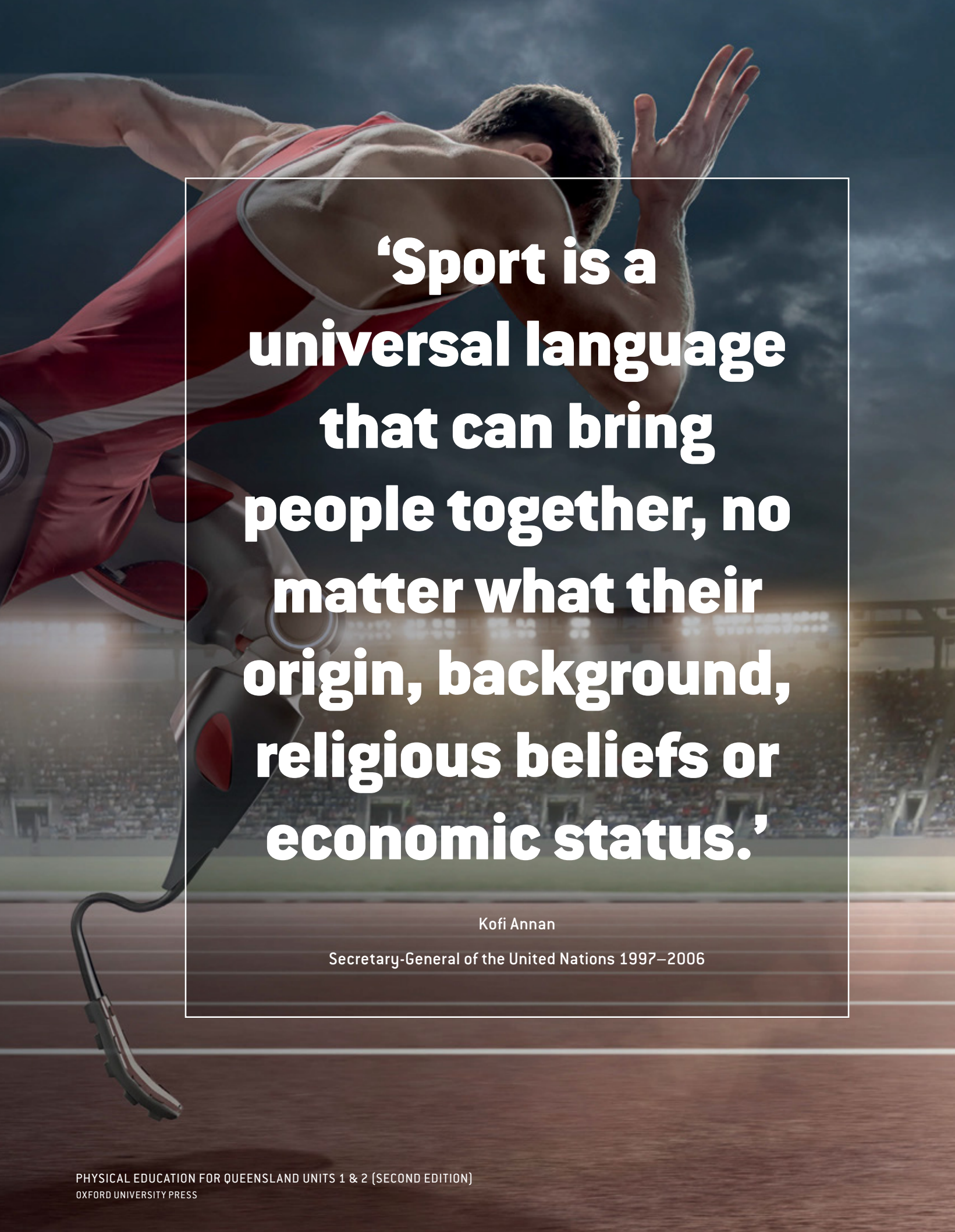
Task

Evaluate whether pre-performance or in-performance psychological techniques had the greatest impact on improving your performance in authentic environments. Synthesise primary and secondary data to justify your conclusion.

To complete this task, you must

- → Recognise and explain:
  - → Performance can be analysed and improved using pre-performance techniques or in-performance techniques.
  - → Pre-performance techniques
  - → In-performance techniques
  - → Body and movement concepts about the specialised movement sequences
    - quality of movement
    - body awareness
    - space awareness
    - relationships
- → Analyse primary and secondary data to show how sport psychology techniques can influence performance.
- → Implement the sport psychology strategies and movement strategies to gather primary data about the outcomes, implications and limitations of decisions.
- → Evaluate the effectiveness of sport psychology techniques to:
  - → improve personal performance of the specialised movement sequence
  - → optimise personal performance using two body and movement concepts (quality of movement and one other).

You can find a detailed instrument-specific marking guide (ISMG) for this task on your obook assess.



‘Sport is a universal language that can bring people together, no matter what their origin, background, religious beliefs or economic status.’

Kofi Annan

Secretary-General of the United Nations 1997–2006

CHAPTER 5

EQUITY – BARRIERS AND ENABLERS

KEY TERMS

By the end of this chapter, you should understand the meanings of the following key terms. They are defined throughout the chapter, as well as in the glossary. Use this handy checklist to test your understanding.

- ☐ access
- ☐ agents of socialisation
- ☐ Australian Bureau of Statistics (ABS)
- ☐ barriers
- ☐ built environments
- ☐ Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- ☐ cultural factors
- ☐ demographic change
- ☐ diversity
- ☐ ectomorph
- ☐ enablers
- ☐ endomorph
- ☐ environmental factors
- ☐ equality
- ☐ equity
- ☐ gender
- ☐ generational change
- ☐ genetic disposition
- ☐ green space
- ☐ institution
- ☐ intrinsic and extrinsic motivation
- ☐ mass media
- ☐ megatrend
- ☐ mesomorph
- ☐ mindset
- ☐ motivation
- ☐ natural environments
- ☐ norm
- ☐ personal ability
- ☐ personality traits
- ☐ physical activity preferences
- ☐ sex
- ☐ social construction of gender
- ☐ social factors
- ☐ socialisation
- ☐ somatotype
- ☐ Sport Australia
- ☐ stereotype

SUBJECT MATTER OUTCOMES COVERED IN CHAPTER 5

The following tables list all of the subject matter dot points you are required to cover in **Unit 2 – Topic 2** of the Physical Education General Senior Syllabus. They also show you exactly where that subject matter is provided in this Student book.

Unit 2 – Topic 2: Equity – barriers and enablers

In Unit 2 – Topic 2, students engage in learning that involves the integration of equity subject matter and the subject matter from a selected physical activity.

Stage 1: Engage and understand

Subject matter	Section/s	Page/s
In this area of study, students will:		
→ recognise and explain that equity is concerned with giving value to, and celebrating, personal, social and cultural differences in society	5.1	256–261
→ 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		
→ 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		
→ identify and explore information about personal factors acting as barriers and enablers for self or others to influence equity and access, including – motivation	5.2 5.2A	262 263–265
– confidence	5.2B	266–267
– personality traits e.g. enjoyment, temperament or preference, self-esteem and self-concept	5.2C	268–269
– personal ability	5.2D	270–271
– genetic disposition	5.2E	272–273
– gender	5.2F	274–276
– previous experiences of physical activity	5.2G	277
→ identify and explore information about social factors acting as barriers and enablers for self or others to influence equity and access, including – agents of socialisation	5.3	278
– siblings, peers, parents, teachers and coaches	5.3A	279–283
– the social construction of gender	5.3B	284–286
– diversity	5.3C	287–291
– physical activity preferences	5.3D	292–293
→ identify and explore information about cultural factors acting as barriers and enablers to influence equity and access, including – demographic, generational and cultural change	5.4 5.4A	294 295–299
– the role of government funding	5.4B	300–301
– mass media promotion and marketing of physical activity	5.4C	302–305
– institutional rules, policies and procedures	5.4D	306–309
→ identify and explore information about environmental factors acting as barriers and enablers to influence equity and access, including built and natural environments, and green space	5.5 5.5A 5.5B	310 311–312 313

Subject matter	Section/s	Page/s
→ investigate the emerging megatrends in Australia of 'being physically active', including – personalised sport for health and fitness – the rise of lifestyle sports – demographic, generational and cultural change – the attainment of health and community objectives via physical activity	5.6	314–317
→ identify and explore how the emerging megatrends may interact as barriers or enablers to influence personal, social, cultural and environmental factors related to engagement in 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	Skill Drill 5.3B Skill Drill 5.3C Skill Drill 5.5	350–351 352–353 354–355
→ use secondary data to analyse how equity and access concepts and principles influence engagement in physical activity.	Chapter 5	252–321

Stage 2: Apply and analyse

Subject matter	Section/s	Page/s
In this area of study, students will: → analyse and synthesise primary data and secondary data about access, equity and engagement in a physical activity context	Skill Drill 5.3B Skill Drill 5.3C Skill Drill 5.5	350–351 352–353 354–355
→ identify relationships between personal, social, cultural and environmental factors, including – personal factors e.g. enabling choice of activities to suit personal preference; acknowledging personal attitudes, values and beliefs – social factors e.g. grouping and team selection, performance environment modifications, manipulation of rules and constraints in physical activity – cultural factors e.g. community promotion and engagement related to physical activity, media and marketing strategies, rules, policies and procedures, risk assessment within a school context – environmental factors e.g. active travel, planning of walkways and cycleways, design of green public spaces		
→ 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		
→ implement equity strategies to gather primary data about the outcomes, implications and limitations of decisions		
→ analyse primary data and secondary data to identify relationships between the equity strategies and engagement in a physical activity context.		

Stage 3: Evaluate and justify

Subject matter	Section/s	Page/s
In this area of study, students will: → reflect on primary data and secondary data to evaluate the effectiveness of the equity strategies to achieve a determined outcome	Skill Drill 5.3B Skill Drill 5.3C Skill Drill 5.5	350–351 352–353 354–355
→ make decisions to maintain or modify the equity strategies to optimise engagement in the physical activity context → justify the development of the equity strategies using evidence from primary data and secondary data → justify maintenance or modification of the equity strategies using evidence from primary data and secondary data → make decisions about and use language, conventions and mode-appropriate features to convey meaning for particular purposes and contexts.	Chapter 5 review – Practice assessment task	318–321

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Check your obook assess for the following additional resources and more:

» **Chapter glossary**
Learn key terms from Chapter 5

» **Flashcard glossary**
A digital interactive to help you test your knowledge of key terms

» **Weblink**
QCAA Physical Education General Senior Syllabus

5.1 Introduction to equity in physical activity

That's a goal!

By the end of Section 5.1, you should be able to:

→ **define** the terms 'equity' and 'access' and **explain** the importance of these concepts in the context of sport and physical activity

→ **define** the terms 'barriers' and 'enablers' in the context of sport and physical activity

→ **identify** different factors (i.e. personal, social, cultural and environmental) that act as barriers and enablers to equity and access

equity
a concept that relates to fairness and justice in the way all people are treated; equity means striving for fairness and justice by treating people differently (based on their individual needs and personal differences)

equality
a concept that relates to being equal in terms of status, rights or opportunities; equality means striving for fairness and justice by treating people the same (regardless of their personal differences)

access
the opportunity a person is given to make use of something or take part in something; in a sporting context, access refers to the ways in which different institutions (e.g. schools, sporting clubs, organisations and governments) make sure that all people have the same opportunities to participate in sports and activities of their choice

Defining equity

In simple terms, **equity** is a concept that relates to fairness and justice in the way all people are treated. Equity means acknowledging that all people are different and taking these individual differences into account when allocating resources and providing opportunities for them.

Equity is a complex and challenging concept to define. It is multifaceted and involves many competing personal, social, cultural and environmental factors. In fact, many experts today still don't agree completely on its meaning. In everyday conversation, it's also very common to hear the word equity being used interchangeably with words like **equality**, equal opportunity and social inclusion. While all of these concepts might share some common characteristics, they are different in many ways.

One of the best ways to clearly understand the concept of equity is to explore the similarities and differences between equity and equality. As shown in Source 1:

- equality is about **sameness** – this means striving for fairness and justice by treating everyone the same. In Source 1, equality is achieved by ensuring that each person is given the same bicycle
- equity is about **fairness** – this means striving for fairness and justice by treating people differently (based on their individual needs and personal differences). In Source 1, equity is achieved by ensuring that each person is given a different bicycle (designed to meet their specific needs).

Defining access

Access is central to the concept of equity. In the context of sport and physical activity, access is a measure of the opportunity a person is given to:

- use something (e.g. a piece of sporting equipment or sporting facilities)
- participate in something (e.g. take part in a game, become a member of a club or sporting team).

SOURCE 1 Equity aims to achieve fairness and justice in the way all people are treated by acknowledging their individual needs and personal differences. One of the best ways to clearly understand the concept of equity is to compare it with the concept of equality.

Access refers to the ways in which different **institutions** (e.g. schools, sporting clubs, companies and governments) make sure that all people – regardless of their age, religion, gender, sexual orientation, level of ability, language ability, location, income, or level of education – have the same opportunities to participate in sports and physical activities of their choice. The concept of access is central to discussions around equity in sport, because it encourages us to:

- identify people who have opportunities to participate in physical activity
- identify people who do not have opportunities to participate in physical activity
- consider the reasons why these differences exist
- reflect on how fair (i.e. equitable) we think this is as a society
- devise strategies (e.g. at an individual, community, state or national level) to address any inequities.

institution
a general term used to describe any organisation (e.g. school, sporting club, company, government or other formalised group) founded for an educational, professional, religious or social purpose

Barriers and enablers to access

There are a whole range of different factors that influence people's decisions to participate in a particular sport and physical activity. These include personal factors (such as age, race, gender, fitness level and personal preferences), social factors (such as influence from friends and family), cultural factors (such as messages in the media, religious traditions and government policies) and environmental factors (such as access to spaces and facilities for sport). All of these factors are commonly grouped into two categories according to whether they make it more or less likely for people to participate. These categories include:

- **barriers** – these are things that discourage or prevent a person from participating in sport or physical activity (i.e. they decrease access)
- **enablers** – these are things that encourage or support a person to participate in sport or physical activity (i.e. they increase access).

barriers
factors that decrease access to resources; barriers discourage or prevent a person from participating in a sport or physical activity (e.g. poor health, high cost of equipment, lack of motivation)

enablers
factors that increase access to resources; enablers encourage or support a person to participate in a sport or physical activity (e.g. closeness to sporting facilities, encouragement from parents and teachers, having friends on the team)

While this sounds simple enough, it is important to recognise that:

- a factor that acts as a barrier to participation in one physical activity can be an enabler to participation in another physical activity (e.g. a tall person's height may act as a barrier to a career as a jockey but may also act as an enabler to a career as a basketball player)
- a factor that acts as barrier for one person might act as an enabler for another person (e.g. the constant media attention and fame that is part of a professional tennis player's life may act as a barrier for a naturally shy and introverted person and an enabler for a naturally outgoing and extroverted person).

Recognising that every person has their own needs and requirements and addressing (or removing) barriers to participation is one way of achieving equity in sport and physical activity.

SOURCE 2 A tall person's height may act as a barrier to a career as a jockey but may also act as an enabler to a career as a basketball player.

Why study equity and access?

Sport Australia (formerly known as Australian Sports Commission) a government agency in Australia responsible for providing strategic leadership and allocating funding for sporting activities at a national level

According to data released by the **Sport Australia** (formerly known as Australian Sports Commission) in 2016, over 17 million Australians aged 15 or over (i.e. 87% of the population) had participated in some kind of sport or physical activity in the last 12 months. This is a large majority of people. Furthermore, while not all Australians participate actively in sport, many spend significant amounts of time watching and talking about sport, helping out at local sporting clubs and organisations, or supporting family and friends who play sport.

In short, sport is an essential part of our national identity as Australians. It is something that unites us as a country and has many benefits. Some of these benefits include:

- **physical benefits** – e.g. maintaining and improving people's health and fitness
- **psychological benefits** – e.g. providing opportunities for relaxation and stress relief
- **social benefits** – e.g. providing opportunities for people to make friends and build a sense of team and community spirit
- **cultural benefits** – e.g. preserving or establishing shared cultural values and traditions
- **economic benefits** – e.g. providing opportunities for people to earn an income in the sport, fitness and recreation industries.

For these reasons, it's important that all Australians are given the same opportunities to participate in sport and physical activities if they want to. In this chapter, we will be learning in detail about a range of different factors – both positive and negative – that affect people's ability to take part in sport and physical activity.

Equity in sport and physical activity

When it comes to sport and physical activity, equity involves more than just treating people fairly and acknowledging their differences. It involves celebrating personal, social and cultural differences at all levels of sport – from the athletes themselves, through to spectators, coaches, training staff and management. Assigning value to these differences and respecting them means keeping an open mind about the kinds of rules, values, beliefs and behaviours that govern different sports and not regarding these as superior to the rules, values, beliefs and behaviours of people from other groups, communities or countries.

To achieve equity in sport, it is not always as simple as giving people access to the same resources (such as a ball to play soccer or access to a swimming pool to go swimming). Instead, equity requires you to take their personal differences, experiences and circumstances into consideration and support them (possibly in very different ways) to reach the same outcome. Having access to a swimming pool, for example, is not adequate for the individual who has never learnt to swim, fears water or is unable to wear traditional swimming attire. Because there are so many different factors that affect people's decisions to participate in sport and physical activity, they are generally grouped in the following way:

- **personal factors** – these include things like age, race, gender, self-esteem, personality traits and motivation
- **social factors** – these include things like the influence of friends, family members or the wider community
- **cultural factors** – these include things like the influence of mass media, advertising, religious and cultural traditions, and government policies and programs
- **environmental factors** – these include things like access to appropriate spaces (e.g. level grassed areas) and facilities (e.g. tennis courts) needed to participate in particular sports.

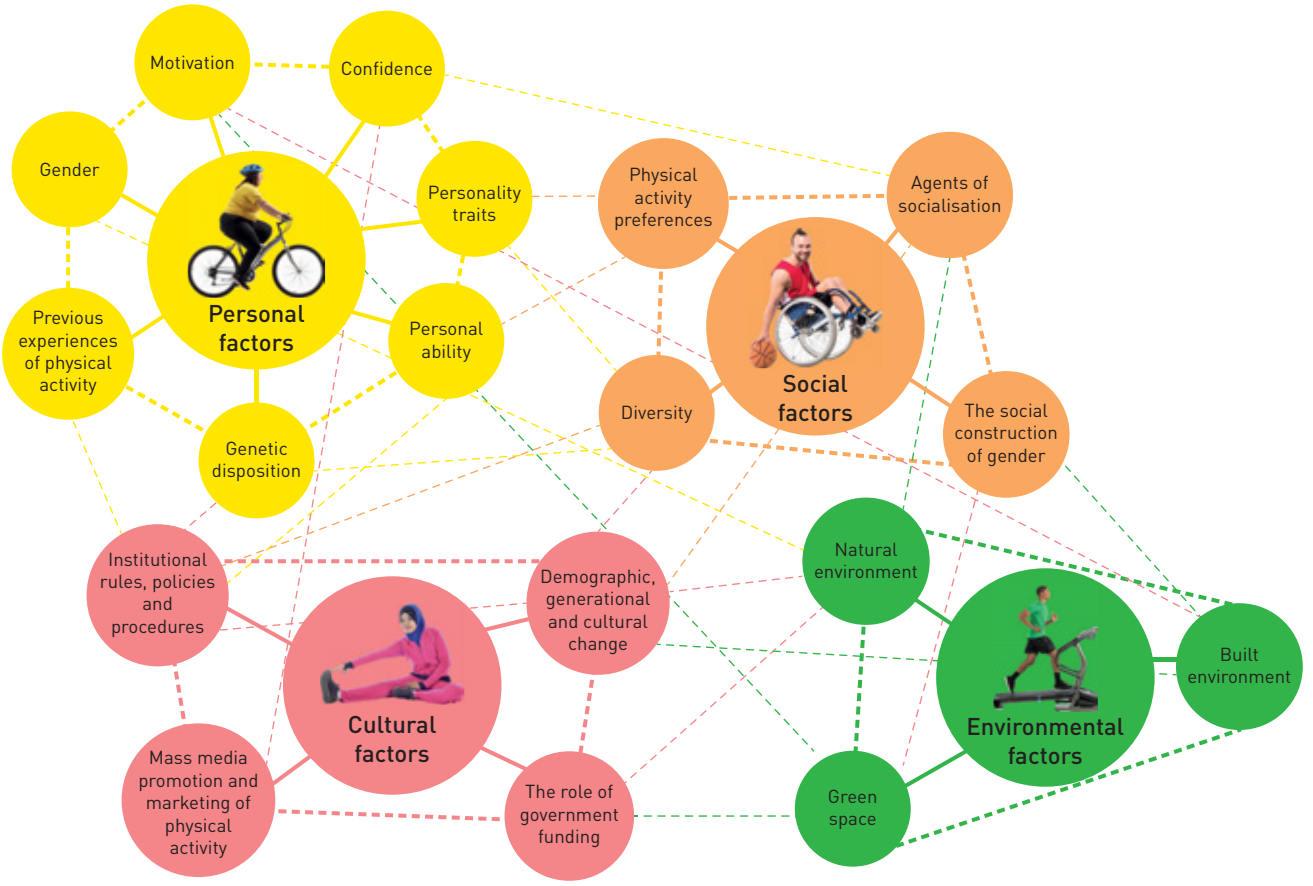
SOURCE 3 The burkini – a type of swimsuit designed to cover the whole body except for the face, hands and feet – is an example of an enabler for Muslim women wishing to access the beach and public swimming pools. It was designed to remove a barrier to participation for Muslim women; namely the religious requirement to dress modestly in public.

STUDY TIP

Equity in sport and physical activity is a controversial subject that is often in the news. Setting up automatic alerts – via Google Alerts – is a great way of keeping up to date with current stories and developments.

To set up an automatic alert, just enter the keywords you want to search for (e.g. equity in sport; access to sport) and type in your email address. You'll receive regular updates on anything you're interested in. Best of all, it's free!

A link to Google Alerts is provided on your obook assess.



SOURCE 4 Personal, social, cultural and environmental factors all affect people's decisions to participate in sport. We are almost always influenced by a combination of these factors all working on us at the same time.

We will spend the remainder of this chapter looking at each of these factors in more detail and analysing their roles as barriers and enablers to sport and physical activity. By doing this, we can begin to build a more accurate and informed understanding of:

- why some people participate in certain physical activities over others
- why some people participate in very little physical activity at all
- what can be done to increase access to and participation in physical activities
- what can be done to celebrate personal, social and cultural differences in society.

Before we begin looking at each of these factors separately in more detail, it is important to note that in reality all of them are acting on us (i.e. affecting our decisions and behaviours) simultaneously. That is, our decisions are almost always influenced by a combination of personal, social, cultural and environmental factors at the same time (see Source 4). For example, a person's decision to learn how to swim will generally be influenced by more than just the fact that there is a swimming pool nearby (i.e. environmental factor). Instead, the decision will often be influenced by a combination of additional factors like a desire to get fit (i.e. personal factor), encouragement from a friend (i.e. social factor), and a local council advertising campaign designed to get people active (i.e. cultural factor).

PERFORMANCE | SKILL DRILL 5.1

Implement an equity strategy in your PE class

>> Turn to pages 350–351 to complete an integrated physical performance activity.

5.1 Check your learning

Engage and understand

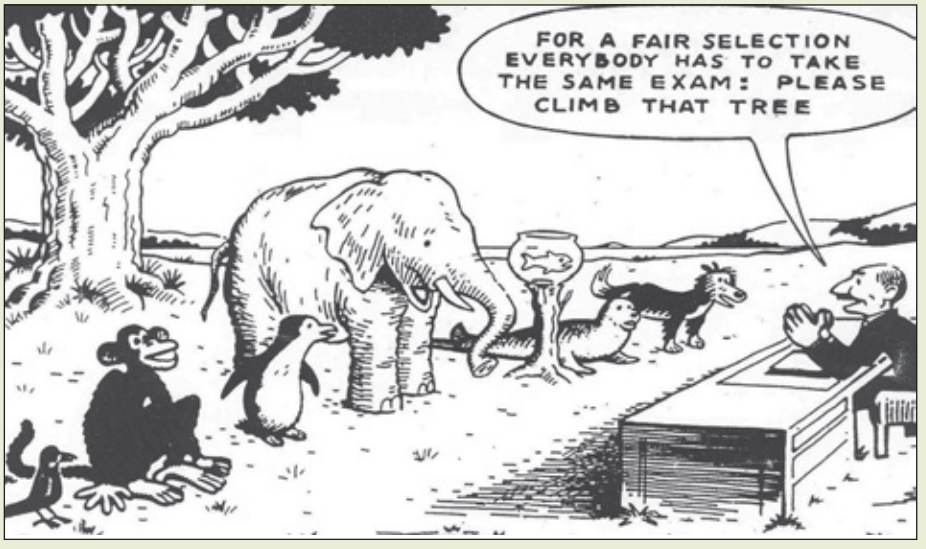
1 **Define** the term equity and **explain** how it is different from equality.
2 **Explain** the relationship between access and equity.
3 **Identify** five examples of barriers and five enablers that can impact an individual's access to physical activity.

Analyse and apply

4 Look at Source 5 and complete the following tasks with a partner.
   a **Interpret** whether the cartoon best reflects equity or equality. **Explain** why.
   b Some people may argue that this 'exam' is fair for each of the animals – because they are being treated equally. **Consider** this argument and **identify** arguments against this view of 'fairness'.
   c **Analyse** the situation presented and suggest changes to make the 'exam' more equitable. **Determine** the format and conditions of your improved exam in a written response of 150 words.

Evaluate and justify

5 'When we celebrate diversity, all members of society are included and valued.' **Assess** the degree to which your school's sports program supports this statement in a written response of 150 words.
6 Conduct independent **research** to find an example of when stereotypes around race or gender have been challenged through Australian sport. **Discuss** if this example was representative of changes within Australian society.



SOURCE 5 The terms 'equity' and 'equality' are oftern used interchangeably, but they are not the same thing.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  5.1 Check your learning
- **» Student worksheet**
  5.1 Equity in physical activity worksheet
- **» Skill Drill worksheet**
  5.1 Implement an equity strategy in your PE class
- **» Video weblink**
  Changing the game: Increasing female participation in sport initiative

5.2 Personal factors that influence equity and access

That's a goal!

By the end of Section 5.2 you should be able to:

→ **identify** a number of personal factors that act as barriers and enablers to equity and access

→ **define** the following terms and **explain** how they affect equity in sport and physical activity:

- motivation
- confidence
- personality traits
- personal ability
- genetic disposition
- gender and sex
- previous experiences of physical activity

intrinsic motivation
a type of motivation driven by internal factors (i.e. factors that come from inside a person) such as fun, enjoyment and personal satisfaction

personal factors
a range of influences at an individual level that can act as barriers or enablers to participation in sport and physical activities (e.g. age, personality traits, personal ability, gender, past experiences)

There are many **personal factors** that act as barriers and enablers to participation in sport and physical activity. Personal factors include a whole range of influences at an individual level (e.g. a person's likes and dislikes, their personality type, their thoughts, feelings and past experiences). Some of the most important personal factors that influence access include:

- **motivation** – the drive or willingness a person has to do something
- **confidence** – the belief a person has in their own abilities
- **personality traits** – the range of personal qualities and characteristics that a person possesses
- **personal ability** – the level of talent, skill or proficiency a person has
- **genetic disposition** – the range of biological qualities and characteristics that a person possesses (that make them more or less suited to a particular activity)
- **gender** – the state of being male or female (more typically used with reference to social and cultural differences rather than biological ones)
- **previous experiences of physical activity** – the level of exposure and practice that an individual has had with a particular activity.

SOURCE 1 A range of different personal factors play a role in influencing a person's decision to participate in sport and physical activity.

In this section we will look at each of these factors in detail and examine how they act as barriers and enablers to sport and physical activities for different people. Although we will be learning about each factor separately, it's important to keep in mind that – in reality – these personal factors are acting on us (i.e. affecting our decisions and behaviours) simultaneously. Not only that – we are also almost always influenced by a combination of other factors at the social, cultural and environmental level at the same time.

5.2A Motivation

motivation
a desire, need or want that causes a person to behave in a particular way

self-determination theory (SDT)
a theoretical framework used to analyse human behaviour and explain what motivates people

amotivation
the total absence of motivation

extrinsic motivation
a type of motivation driven by external factors (i.e. factors that come from outside a person) such as money and fame

Motivation is the drive or willingness a person has that causes them to act or behave in a particular way. It is one of the key personal factors affecting participation in sport and physical activity. The level of motivation to perform a particular task varies from person to person depending on the situation and priorities. As discussed in detail in Section 4.2 on page 196, one theory used for understanding what motivates people to participate in sport and physical activity is **self-determination theory (SDT)**. According to SDT, an individual's motivation sits on a continuum from **amotivation**, through **extrinsic motivation** to **intrinsic motivation:**

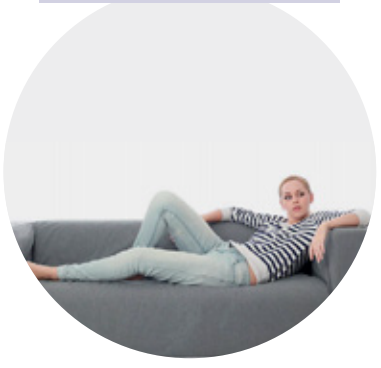
- When self-determination sits at the low end of the continuum a person displays a total absence of motivation – known as amotivation.
- Moving through extrinsic motivation, self-determination increases as the athlete gets past externally controlled forms of motivation and begins to internalise and integrate the external factors motivating their participation and performance.
- At the other end of the continuum a person displays a high level of self-determined motivation driven mainly by internal factors (such as personal satisfaction and enjoyment) – known as intrinsic motivation.

The motivation continuum

Low motivation
Non-self-determined behaviour

High motivation
Self-determined behaviour

Amotivation



Motivation is absent.

Extrinsic motivation

Motivation is non-self-determined.

Intrinsic motivation

Motivation is self-determined.

SOURCE 2 According to self-determination theory, an individual's motivation sits on a continuum from amotivation to intrinsic motivation based on how self-determined the motivation is.

Motivation as a barrier and enabler

Motivation plays a significant role in people's decisions to participate in sport and physical activity. As shown in Source 2, some people have no desire at all to participate in physical activity while others engage in a wide range of different sports and make it the focus of their daily lives.

People who lack all motivation to participate in physical activity are said to have 'amotivation'. Amotivation acts as a significant barrier to participation for these people – they see no point in it and do not see any potential value in it. They may participate in physical activity on the odd occasion, but generally this will be motivated by an external factor (e.g. a compulsory event at school or work).

SOURCE 3 Dylan Alcott is an Australian wheelchair tennis and basketball player, radio host and motivational speaker. He competed successfully at an elite level by combining a range of extrinsic and intrinsic motivating factors.

People who are self-driven to participate in physical activity sit at the intrinsic end of the continuum. Intrinsic motivation acts as a significant enabler to participation for these people – they have a strong intrinsic drive to be physically active because they enjoy it and gain personal satisfaction from it. They exercise regularly and rely on no external factors for motivation (e.g. the reward for going for an early morning run is the run itself).

People in the middle of the motivation continuum represent the largest group. They sit somewhere in between amotivation and intrinsic motivation when it comes to their engagement with sport and physical activity. These people are generally motivated to participate in physical activity, but the source of that motivation varies based on a number of external factors. Some motivations such as winning trophies, are more externally controlled than others, such as playing for fitness. This type of motivation can act as both a barrier and an enabler. External factors such as trophies, praise or punishment (from coaches and parents) can be strong extrinsic motivators for certain people initially, but they are not enough to sustain a person's motivation levels over longer periods of time.

Very few individuals remain at the same point on the continuum over time. Instead, most people move up and down the continuum based on a range of factors. For example, people who are intrinsically motivated are not immune to losing motivation at times. Studies have shown a correlation between a drop in physical activity rates and major life changes (e.g. starting a new job, periods of serious illness, graduating from high school or university, moving to a new house). Being aware of this pattern can help individuals to put plans in place to maintain their motivation levels throughout times of change.

FOR THE RECORD!

In October 1980, Japan's Minoru Yoshida set the World Record for the most consecutive push ups. He was able to perform 10 507 push ups without a rest. That would require some considerable motivation!

5.2A Check your learning

Engage and understand

1 **Define** motivation and **explain** how it can act both as a barrier and an enabler to participation in sport and physical activity.

2 **Identify** three extrinsic motivators and three intrinsic motivators for a teenager to participate in sport.

Analyse and apply

3 Read the following scenarios and complete the tasks below:

→ Claudia is a 15-year-old girl who loves to participate in all kinds of physical activities – from rugby league to dance and swimming. She loves competing against her friends and has won the sports award at her school for the past two years. However, Claudia is concerned that her extracurricular activities are affecting her studies and her chance to win an academic scholarship.

→ Salim is a 15-year-old boy who enjoys gaming and watching eSports. He particularly enjoys the team camaraderie he experiences when playing computer games. Salim thinks he would enjoy participating in team sports but is reluctant to try out because he has been teased in the past for being 'nerdy'.

a **Compare** the personal factors that might be influencing Claudia and Salim's participation in sport by completing this table:

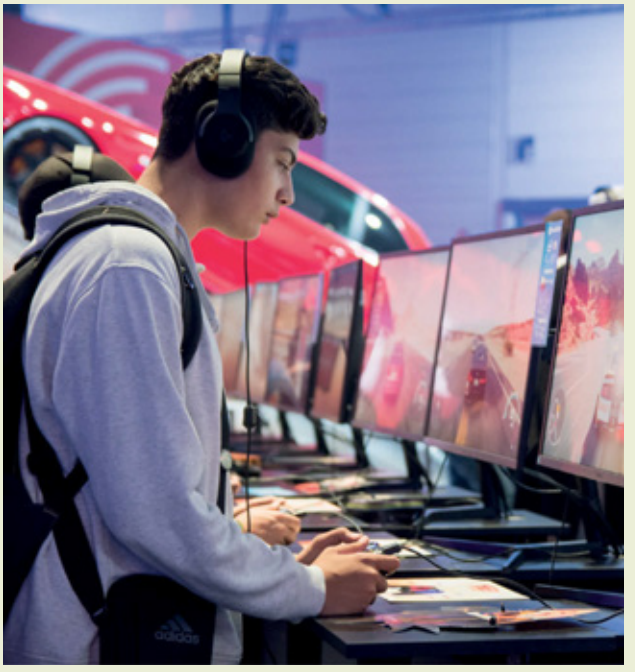
	Claudia	Salim
Personal factors		

b **Analyse** the information provided and decide where Claudia and Salim would be positioned on the motivation continuum. Justify your decisions.

c **Identify** two strategies that might increase Salim's motivation to participate in sport.

Evaluate and justify

4 **Construct** an argument to support the idea that excessive praise from parents and coaches can be a barrier for young athletes hoping to form a lifelong love of sport and physical activity. Use examples to illustrate your point of view.



SOURCE 4 A number of personal factors influence Claudia and Salim's participation in sport.

5.2B Confidence

confidence
the belief that that an individual can have faith in (or rely on) themselves, someone or something

Confidence is one of the key personal factors affecting participation in sport and physical activity. When we talk about confidence in a sporting context, we are generally referring to three elements:

- **self-confidence** – an athlete's conviction that they have the skills, abilities and talent to succeed
- **self-belief** – an athlete's trust in their ability to succeed, regardless of past performances and experiences
- **self-efficacy** – an athlete's belief that they have the ability to perform a task.

These concepts are discussed in detail in Section 4.3 on pages 201–203 and each one contributes to an athlete's overall level of confidence.

Many athletes express their confidence through their actions in public – how they walk, talk and act in front of others before, during and after a game. However their inner dialogue – the thoughts and discussions they have inside their heads about their ability to perform well and succeed – is often a more accurate indicator of their true confidence. This internal dialogue forms a set of personal attitudes commonly referred to as a **mindset** and it is a good indicator of how confidence can act as a barrier and enabler to sport and physical activity.

mindset
an established set of attitudes that determine how a person may interpret a situation and respond to it

Mindset and confidence

The application of theories about mindset has become increasingly popular in sporting contexts over the past few years – particularly as a way of understanding and developing the motivation and confidence of athletes. US psychologist Carol Dweck is known for her research into the psychology of mindset. According to her studies, individuals can possess one of two basic mindsets. These include:

- **a fixed mindset** – a mental state in which the individual believes that their abilities (e.g. intelligence and talent) are set (i.e. fixed), without any room for change or development
- **a growth mindset** – a mental state in which the individual believes that their abilities (e.g. intelligence and talent) can be changed and developed (i.e. grown) over time.

fixed mindset
a mental state in which the individual believes that their abilities (e.g. intelligence and talent) are set (i.e. fixed), without any room for change or development

growth mindset
a belief that one's own abilities can be developed through hard work

A fixed mindset is more than likely to act as a barrier to participation in sport and physical activity. A person who doesn't possess the talent or skills to succeed in a particular sport may never join in, because they believe they will not be able to develop these skills. Likewise, a person who is struggling to perform well in a sport they are already playing is more likely to give up, because they believe they will never improve.

A growth mindset is more than likely to act as an enabler to participation in sport and physical activity. A person who doesn't possess the talent or skills to succeed in a particular sport will probably join in anyway, because they believe they will be able to develop these skills over time with hard work.

Source 5 provides some examples of the different ways in which people with fixed and growth mindsets may respond in similar situations.

Common responses	Fixed mindset	Growth mindset
Common responses to challenges	→ 'I will avoid signing up for that new activity/sport in case I look stupid.' → 'I would rather stick to things I am good at.'	→ 'OK, I will give that new activity/sport a go!' → 'I'm going to take a risk and step outside my comfort zone.'
Common responses to obstacles	→ 'I'm out – this is too hard.'	→ 'This is just a bump in the road.' → 'I'm not going to let this stop me.'
Common attitudes towards effort	→ 'You're either good at it or you're not. Effort is pointless.' → 'Only unskilled players need to put effort in.'	→ 'Effort is required for growth.' → 'If I apply myself, I will get better.'
Common responses to criticism	→ 'I'm no good at this. There's no point in continuing.' → 'The coach/teacher doesn't like me. I am not playing if I am under their instruction.'	→ 'I can learn from this and improve.' → 'This criticism isn't a personal attack; it is designed to help me.'

SOURCE 5 Fixed mindsets and growth mindsets result in very different patterns of thought.

Confidence as a barrier and enabler

Confidence plays a significant role in people's decisions to participate in sport and physical activity. How much confidence we have in relation to a particular sport or physical activity can be a barrier to, or an enabler of, our participation. In this way, high levels of confidence generally become an enabler to participation, while low levels generally become a barrier.

People who take up a new sport (or participate in a physical activity for the first time) need to confront and overcome many challenges. Facing these challenges with a growth mindset can boost confidence and act as an enabler. Facing these challenges with a fixed mindset can erode confidence and act as a barrier.

It is also important to recognise that external factors (i.e. those outside individual's mindset) can also affect confidence. For example, a confident and competent athlete may be teased and humiliated by peers, teachers or coaches. This ultimately damages their confidence and acts as a barrier to participation. In contrast, an athlete that lacks confidence and skill may be positively praised for their efforts and made to feel part of a team. This ultimately boosts their confidences and can act as an enabler to participation.

SOURCE 6 The level of confidence we have in our own abilities can act as a barrier or an enabler to participation in sport and physical activity.

5.2B Check your learning

Engage and understand

1 **Define** confidence and **explain** how it can act both as a barrier and an enabler to participation in sport and physical activity.

Analyse and apply

2 Refer to Source 5 and **determine** whether you possess a fixed mindset or a growth mindset when it comes to sport and physical activity. Provide examples from your selected physical activity to justify your decision.

Evaluate and justify

3 **Develop** a brief dialogue to illustrate the key differences between a fixed mindset and a growth mindset. The dialogue should be between two competitors as they prepare to compete against each other in their first competition:

→ Competitor A possesses a growth mindset.

→ Competitor B possesses a fixed mindset.

Refer to Source 5 to help you. Once complete, perform your dialogue for your class.

5.2C Personality traits

personality traits psychological qualities and characteristics that determine our patterns of thinking, feeling and behaving

Personality traits are psychological qualities and characteristics that determine our patterns of thinking, feeling and behaving. There are literally thousands of different personality traits commonly displayed by human beings in different combinations. Some of these traits are commonly considered to be positive, while others are considered negative. Most people display a combination of both positive and negative personality traits. A small selection of each of these traits is provided in Source 7.

It is also important to note that people display different personality traits in different ways (e.g. at different times and in different situations). Some personality traits are more dominant than others – meaning that a person may display a particular trait much more often than another – but this does not mean that they cannot also display traits that are less dominant. For example, a person who often displays the traits of bossiness and forcefulness in certain situations (e.g. at work or during sport) may also display the traits of shyness and indecision in other situations (e.g. at home with family and friends).

STUDY TIP

A good way to remember the five-factor model of personality is to use the mnemonic (i.e. memory trick) – 'OCEAN':

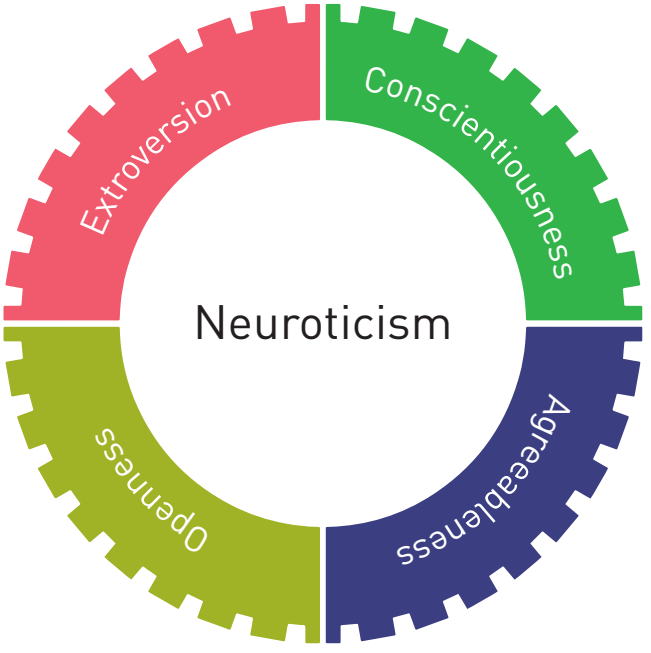
Openness
Conscientiousness
Extraversion
Agreeableness
Neuroticism.

The five-factor model of personality

The five-factor model of personality was proposed by US psychologist John M Digman in 1990 is a useful way of think about the relationship between personality traits and participation in physical activity. According to this model, an individual's personality is broadly comprised of 'the big five' personality traits. These 'big' traits are broad categories into which the thousands of individual personality traits (like those shown in Source 7) can be organised. In this way, the model is a helpful tool for classifying personality traits and making predictions about how people with different personality types will act in certain situations. The five big personality traits are:

- **openness** – the tendency of a person to be open to new experiences and try new things
- **conscientiousness** – the tendency of a person to work hard and be dependable
- **extraversion** – the tendency of a person to be outgoing and socially confident
- **agreeableness** – the tendency of a person to cooperate and get along with others
- **neuroticism** – the tendency of a person to experience unpleasant feelings (e.g. anxiety, worry, fear, anger, frustration, jealousy, guilt, depression).

By applying the five-factor model of personality, we can get a better idea of how likely certain people are to participate in sport and physical activity and the types of sports they might be best suited to.



SOURCE 7 The five-factor personality model can be used to predict how individuals might engage with sport and physical activity.

Personality traits as a barrier and enabler

Particular personality traits may make some people more suited to high-adrenalin, contact sports that are played in teams, such as rugby league and water polo.

These personality traits (e.g. energetic, team-spirited and forceful) act as enablers to participation in those sports. Other personality traits may make some people more suited to sports that are individual sports that require more patience and precision, such as archery, lawn bowls or golf. Again, these personality traits (e.g. calm, independent and strategic) act as enablers to participation in those sports.

Despite this, there are also some personality traits that all athletes commonly share. These traits increase the likelihood that those athletes will start participating in a sport or physical activity in the first place and continue that participation in all kinds of sports and physical activities. For example, many successful athletes share personality traits such as enthusiasm, determination and resilience. It is these traits that enable athletes to overcome challenges and setbacks during their careers.

SOURCE 8 Personality traits are psychological characteristics that make us who we are. They can also make us more or less suited to particular sports. For example, a person who is calm, strategic and independent may be more suited to a sport such as lawn bowls, while a person who is energetic, team-spirited and forceful may be more suited to a sport such as rugby.

STUDY TIP

Journal entries are an effective way in which you can personalise your learning and increase your understanding of key concepts.

Consider how you would score on the five-factor personality model and write a journal entry that details how your personality traits have impacted your engagement with sport and physical activity.

This journal may help inform your equity strategy for assessment.

5.2C Check your learning

Engage and understand

1 **Define** the term 'personality trait'.

2 **Identify** three personality traits that are commonly displayed by most successful athletes, regardless of the sports they play.

Analyse and apply

3 **Determine** how certain personality traits can act as both barriers and enablers to sport and physical activity. Refer to an example from your chosen sport and physical activity.

Evaluate and justify

4 Go online and complete the five-factor personality test. A link is provided on your obook assess.

a **Decide** whether you think the results are an accurate reflection of your personality. Provide possible reasons for this.

b **Compare** and **contrast** your scores (i.e. high or low) for each of the personality traits listed in the five-factor model of personality traits with one other student in your class.

c **Discuss** whether your results (and the results of other students in your class) are useful for predicting the types of sports and physical activity you are suited to. Provide reasons for your point of view.

d **Assess** the reliability and validity of an online test such as this and suggest how these factors could be improved.

5.2D Personal ability

personal ability
a term used to describe the combination of inherited qualities and learned skills a person uses to complete a task or achieve a goal

Personal ability is a term used to describe the qualities and skills a person uses to complete a task or achieve a goal. Personal ability is a product of both nature and nurture. In other words, it is a combination of both inherited qualities (e.g. what some may call natural talent) and learned skills (e.g. developed through training and coaching).

Personal ability is another personal factor that can act as a barrier or enabler to participation. Every sport and physical activity has its own set of unique requirements and demands. As a result, certain sports are more suited to athletes with specific kinds of personal abilities. For example, some sports like rugby league and gymnastics require large amounts of speed, strength and flexibility. For an athlete to compete successfully in these sports, they need to possess a certain inherited physical qualities (such as muscular power and agility) combined with a range of learned skills such as motor skills (i.e. specific techniques and movement sequences relevant to a particular sport) and timing skills (i.e. the ability to implement the right skills at the right time). Examples of some common qualities and skills are provided in Source 10.

Examples of inherited qualities (i.e. natural talent)	Examples of learned skills (i.e. training and coaching)
→ Flexibility	→ Ball handling skills
→ Balance	→ Tactics and strategies knowledge
→ Muscular power	→ Technical ability
→ Body shape and size	→ Implementation ability (e.g. timing)
→ Coordination	

SOURCE 9 Personal ability is a term used to describe the combination of inherited qualities and learnt skills a person uses to complete a task or achieve a goal. Personal ability is a product of both nature and nurture.

SOURCE 10 When the requirements for success in an activity match a person's physical competence, their personal ability is said to enable their participation.

When the requirements for success in an activity match a person's physical competence, their personal ability is said to enable their participation. By contrast, when the demands of an activity exceed a person's physical competence, their personal ability can be a barrier to participation.

Personal ability as a barrier and enabler

Personal ability plays a significant role in people's decisions to participate in sport and physical activity. How much personal ability we have in a particular sport or physical activity can be a barrier to, or an enabler of, our participation.

SOURCE 11 Personal ability combines inherited qualities (e.g. muscle strength) and learnt skills (e.g. technique) required to perform skills such as the Maltese cross.

Generally, high levels of personal ability become an enabler to participation, while low levels of personal ability become a barrier.

It is important to acknowledge the role that perception of personal ability plays as a barrier or enabler to participation in some sports. For example, the perceptions formed by coaches and selectors about an athlete's personal ability directly influence their decisions about whether to pick that athlete for their team or program. Similarly, an athlete's own perception of their personal ability can exert a strong influence on their decisions to take up or keep participating in a sport. Indeed, many studies have shown that a perceived lack of personal ability is a major cause of dropout in children's sport. When children think that they cannot do something, they often stop trying, to avoid embarrassment or humiliation.

5.2D Check your learning

Engage and understand

1 **Define** personal ability and **explain** how it can act both as a barrier and an enabler to participation in sport and physical activity.

2 **Identify** the two elements that combine to form personal ability.

Analyse and apply

3 **Identify** a situation in which you think a perception about personal ability has affected a person's participation in a particular sport of physical activity.

a Was the perception by the person themselves or by another person (e.g. coach, teacher, selector)?

b Did the perception act as a barrier or an enabler to participation? **Justify** your answer.

5.2E Genetic disposition

genetic disposition
the physical and psychological characteristics that every person inherits from their biological parents

somatotype
a term used to help describe and classify human body shape and physique type

endomorph
a body type that is stockier, wider and shorter with a high tendency to build muscle and store body fat

mesomorph
a body type that is lean and muscular

ectomorph
a body type that is leaner, longer and narrower with a low tendency to build muscle and store body fat

Genetic disposition is a term used to describe the physical and psychological characteristics that every person inherits from their biological parents (and the degree to which those characteristics make them think or act in particular ways).

Many of our physical and psychological characteristics – such as our height, weight, body type, eye and hair colour, and certain personality traits – are determined by the genes we inherit from our biological parents. These are the physical and mental qualities that each person is born with. Although it's possible to change or limit the effects of some of these characteristics (e.g. weight and muscle tone) through training and diet, certain characteristics (e.g. height and limb length) are fixed.

Genetic disposition as a barrier and enabler

Genetic disposition is one of the most significant factors influencing people's decisions to participate in sport and physical activity. The biological characteristics we inherit make us more or less suited to particular sports and physical activities and act as both barriers and enablers to participation.

For example, naturally tall people are generally well suited to sports such as basketball, volleyball or Australian football due to the natural advantages that height offers to succeed in these sports. Their height acts as an enabler to participation in these sports. On the other hand, tall people are often less suited to sports like weight lifting or gymnastics due to the natural disadvantages caused by their height. Their height acts as a barrier to participation in these sports. In both examples above, the opposite is true for shorter people. The Theory in action below further explores how genetic disposition is used to identify potential success in particular sports.

Theory in action — Using body shape to identify talent

An athlete's body shape is one indicator of potential success in particular sports. Sports Australia is the organisation responsible for managing and administering sport in Australia. It has long used a range of techniques and programs to identify sporting potential. Such programs use a series of physical tests and measurements to help determine what sport a person may be best suited to.

Somatotype as an indicator of success

One genetic indicator of a person's potential for success in a particular sport and physical activity is known as **somatotype**. It was developed as a system for classifying human physical types (from earlier theories) by a US psychologist William Sheldon in 1954. According to this theory of somatotypes, there are three body types:

- → **ectomorph** people who are naturally leaner, longer and narrower with a low tendency to build muscle and store body fat
- → **mesomorph** people who are naturally more muscular, athletic and lean and commonly described as being of medium build
- → **endomorph** people who are naturally stockier, wider and shorter with a high tendency to build muscle and store body fat.

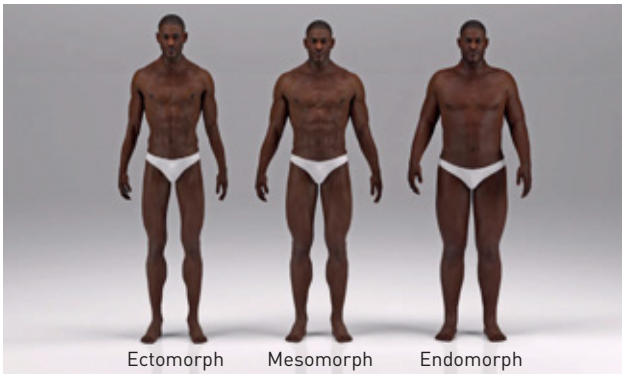
Subsequent researchers developed Sheldon's work further in an attempt to pair particular Olympic sports and events with particular somatotypes.

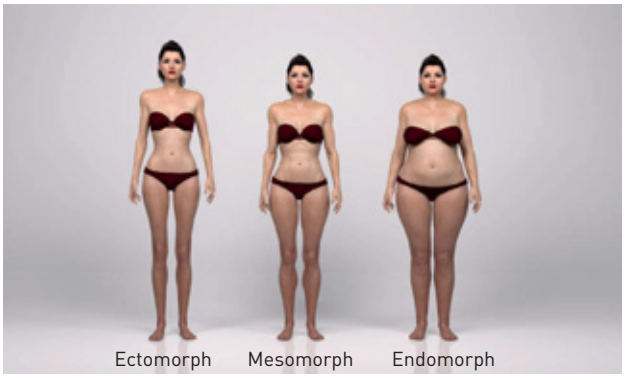
Sports scientists working within talent identification programs also study how the changing nature of sport affects the type of physical build most suited to each activity. This allows them to identify the best talent for future competitions. For example, researchers at the

Queensland Academy of Sport recorded the physical characteristics of elite volleyballers and found that players are getting taller and heavier. They found that to be successful in future volleyball competitions, such as the 2020 and 2024 Olympics, Australian volleyball teams will need players who are even taller than those who competed in the 2016 Olympics.

Although talent identification programs cannot predict with certainty whether an athlete will become successful, they do offer a good initial indication of the potential for success, and help coaches and athletes make more informed decisions. While some testing programs that identify future talent by genetic-based selection have been successful to date, criticism still exists about the possibility of some exceptionally skilled athletes getting overlooked because they don't meet the set criteria.

SOURCE 12 Skinfold tests such as the one being carried out here at the Australian Institute of Sport (AIS) are used to help determine a person's somatotype.





SOURCE 13 US psychologist William Sheldon proposed that there exist three body types: endomorph, mesomorph and ectomorph.

5.2E Check your learning

Engage and understand

1 **Define** genetic disposition and **explain** how it can act both as a barrier and an enabler to participation in sport and physical activity.

2 **Identify** two examples of genetic disposition that would act as:
   - **a** a barrier to participation in your selected physical activity this term
   - **b** an enabler to participation in your selected physical activity this term.

Analyse and apply

3 Read 'Using body shape to identify talent'.
   - **a** **Determine** why talent identification programs are used to recruit children into elite sports.
   - **b** **Reflect on** the role of somatotyping in talent identification using examples related to your current sport.
   - **c** Consider the potential problems and limitations of talent identification programs such as this.

Evaluate and justify

4 Use the information provided together with additional information gathered through research to **determine** your personal somatotype.
   - **a** Does your somatotype act as a barrier or an enabler to your participation and performance in your selected physical activity (or any other sports or physical activities you participate in outside of school)? **Justify** your response and provide examples to support your position.

5.2F Gender

gender
the combined product of a person's biological characteristics (i.e. their sex) together with their social and cultural roles and identities that are formed in response to their environment (e.g. through interactions with family, friends, teachers and coaches, religious institutions, the media, and so on)

sex
the biological and physical characteristics of males and females (i.e. their genitalia and genetic differences); either of the two main categories, male and female, into which humans and most other living things are divided on the basis of their reproductive functions

stereotype
a widely held but fixed and oversimplified image or idea of a particular type of person or thing

Gender is a term used to refer to the state of being male or female. It is more commonly used to refer to the social and cultural differences between men and women, but it can also be used to refer to the biological differences. In many situations, the terms gender and **sex** are used interchangeably even though there are clear differences between them. To avoid confusion, we will explain how they are used throughout this topic:

- **gender** is used to describe the combined product of a person's biological characteristics (i.e. their sex) together with their social and cultural roles and identities that are formed in response to their environment (e.g. through interactions with family, friends, teachers and coaches, religious institutions, the media, and so on).
- **sex** is used to describe the biological and physical characteristics of males and females (i.e. their genitalia and genetic differences).

Gender – and in particular the social construction of gender – is a complex social phenomenon and will be explained in greater detail in Section 5.3B. Here, we will consider the role of gender and sex as a barrier and enabler to participation.

Gender as a barrier and enabler

Gender and sex both play significant roles in influencing people's decisions to participate in sport and physical activity. In the past, many sports tended to be classified as either 'male/masculine' or 'female/feminine'. Today, many **stereotypes** relating to gender that once existed have now been broken and the situation has improved. More sports today are regarded as 'gender neutral' and are considered appropriate for both men and women. Despite these improvements, stereotypes still persist in some sports (see Source 14). The perceptions created by these stereotypes can act as an instant barrier for men who are interested in playing a sport that is still widely considered to be 'for girls' – such as gymnastics or dance – and for women who are interested in playing a sport that is still widely considered to be 'for boys' – such as rugby, boxing or Australian football.

SOURCE 14 Today, many of the gender stereotypes that were once associated with particular sports have been broken down. Despite this, a perception still persists in certain parts of the community that some sports are 'for girls' (e.g. netball) and other sports are 'for boys' (e.g. sumo wrestling). These public perceptions can act as barriers to participation for certain people.

In contrast, many advances have been made to address these barriers and improve access for both men and women. One example of this is the establishment of official women's premiership competitions in traditionally male dominated sports such as AFL and NRL (see Source 15). While women have competed for many years in both of these sports, the creation of national competitions with major sponsors and broadcast rights validates these sports as options for women and acts as an enabler for those who may wish to pursue a career in these sports. Moves like this also help to ensure that all athletes – regardless of their gender or sex – have the same opportunities to participate in all forms of sport and physical activity.

SOURCE 15 AFL Women's is Australia's national Australian football league for female players. The first season of the league began in February 2017 with eight teams – including the Brisbane Lions. The establishment of the league acts as an enabler for girls and women looking to participate in the sport.

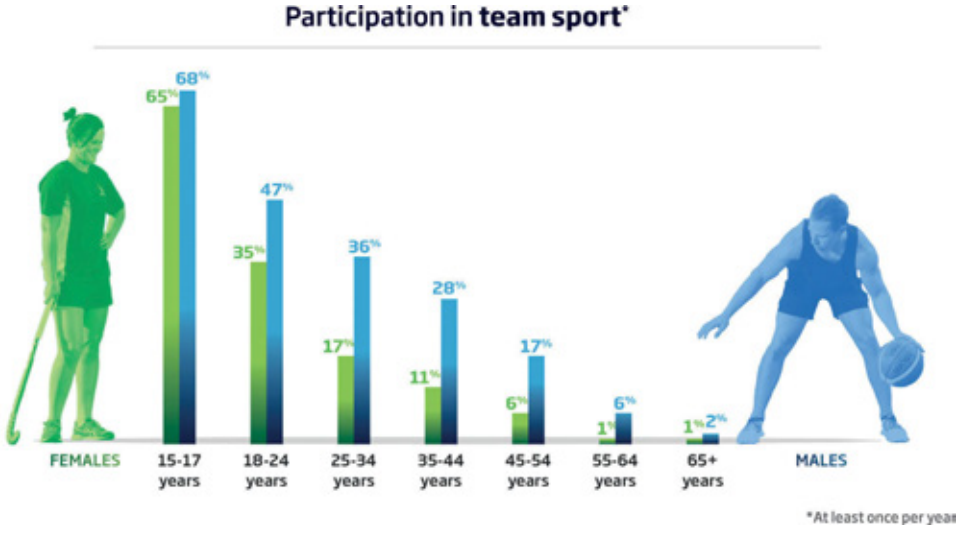
Despite the breakdown in many stereotypes relating to gender and sport, recent studies carried out by Sports Australia and **Australian Bureau of Statistics (ABS)** show that national participation rates for girls and women continue to be lower than those for boys and men (see Source 16). Furthermore, women also continue to be under-represented in positions of leadership and management when it comes to sport.

On the other hand, women are much more likely to take part in non-sport-related activities such as gym, fitness and walking than men. In fact, when it comes to non-sport-related physical activity, women have a higher participation rate than men.

The factors that motivate men and women to participate in particular sports also vary between men and women (see Source 17). Campaigns encouraging more men and women to take part in physical activity are welcomed and encouraged at many levels of government. Such research provides an opportunity for sporting clubs and government agencies to better understand the motivations of both sexes and better cater to their needs.

These statistics indicate that there is still work to be done to remove barriers and create enablers for women to participate in more sport and physical activity. Examining the role that gender and sex play in accounting for differences in participation rates is one way to address inequity in sport.

Australian Bureau of Statistics (ABS)
an independent statistical agency of the government of Australia that provides key statistics on a wide range of economic, population and social issues (including information on sport and physical activity trends)



Source: AusPlay Focus - Women and Girls Participation (Sport Australia), 2017

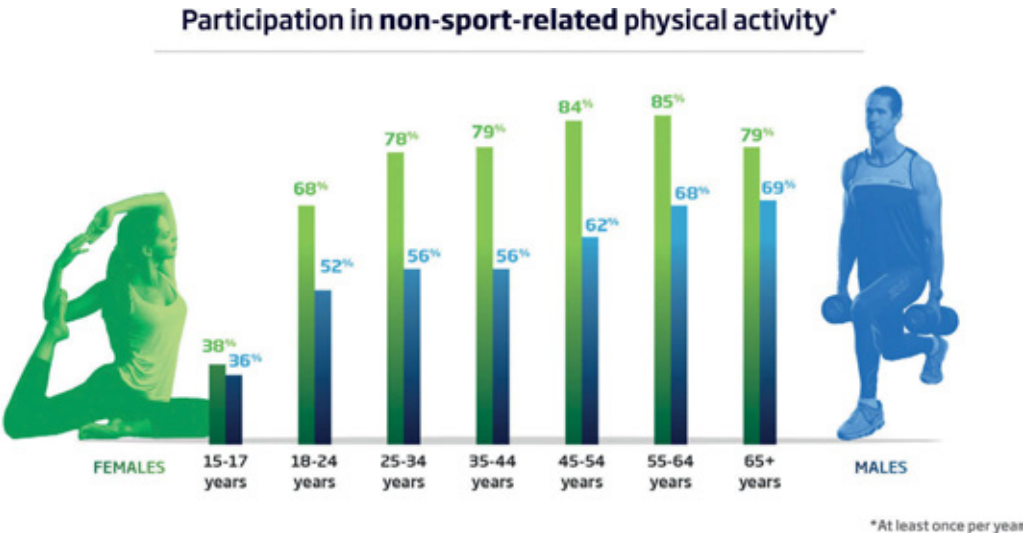
SOURCE 16 Research shows that while sport clubs are the main avenue for physical activity for both girls and boys (aged 0–14), throughout childhood boys (50%) are more likely to be active through club sport than girls (33%).

FOR THE RECORD!

In 2012, the Australian men's basketball team – which has never won an Olympic medal – flew first class to the London Olympics. Meanwhile, the Australian women's basketball team – silver medallists at the past three Olympics – flew to London in economy class.

SOURCE 17 Studies have identified the top 10 motivators for women to participate in sport.

Source: AusPlay – Summary of key national findings (Sport Australia), 2016



SOURCE 18 Research shows women have a higher participation rate in non-sport-related physical activity than men.

Source: AusPlay Focus – Women and Girls Participation (Sport Australia), 2017

5.2F Check your learning

Engage and understand

1 **Explain** the difference between the terms 'gender' and 'sex'.

2 **Describe** how gender and sex can act both barriers and enablers and an enabler to participation in sport and physical activity.

Analyse and apply

3 **Reflect** on a number of sports and physical activities that you believe are still regarded as 'masculine', 'feminine' or 'gender neutral'. **Consider** some possible reasons why this kind of gender stereotyping still exists in society and suggest what could be done to address these stereotypes.

Evaluate and justify

4 Use the information provided in Sources 16–18 together with additional information gathered online to complete the following tasks:

- **a** **Discuss** possible reasons (i.e. barriers) for the lower rates of participation in team sports among females aged 25–34 compared with males.
- **b** **Propose** two strategies that may act as enablers for girls and boost participation rates. Justify your strategies using information from your research.
- **c** **Explore** the possible reasons females are more likely to participate in non-sport-related physical activities than males.

5.2G Previous experiences of physical activity

Previous experiences of physical activity are the memories we have of participating in certain sports and physical activities in the past. These experiences can act as significant barriers and enablers to participation in sport and physical activity later in life.

Previous experiences as barriers and enablers

Generally speaking, people's attitudes to sport and physical activity form in the early years of their lives when their minds are impressionable and their bodies are still developing. Positive experiences of physical activity at a young age tend to be an enabler of future participation, while negative past experiences tend to be a barrier to future participation (see Source 19).

For these reasons, care should be taken to ensure that the exposure of children to physical activity is safe, nurturing and positive. First experiences of school and community-based organised sport have the power to form attitudes towards sport – both positive and negative – that can last for many years or even a lifetime.

SOURCE 19 Previous experiences of physical activity are the memories we have of participating in certain sports and physical activities in the past. In general, positive experiences of physical activity at a young age (such as winning or success) tend to be an enabler of future participation, while negative past experiences (such as serious injury or failure) tend to be a barrier to future participation.

5.2G Check your learning

Engage and understand

1 **Explain** how previous experiences of physical activity can act both as a barrier and an enabler to participation in sport and physical activity.

Analyse and apply

2 **Reflect on** your personal experiences of sport and physical activity from your early childhood. **Compare** one positive experience and one negative experience and **consider** the ways in which these acted as enablers or barriers to future participation.

3 **Identify** an example of a negative experience that could prevent an individual from re-engaging with that sport. **Devise** a strategy to help the individual overcome this barrier.

Check your obook assess for the following additional resources and more:

» **Student book questions**
5.2 Check your learning

» **Student worksheet**
5.2 Personal factors that influence equity and access worksheet

» **Weblink**
Born to win: Top athletes don't share a single talent gene, but hundreds of them

5.3 Social factors that influence equity and access

That's a goal!

By the end of Section 5.3, you should be able to:

→ **identify** a number of social factors that act as barriers and enablers to equity and access

→ **define** the following terms and **explain** how they affect equity in sport and physical activity:

- agents of socialisation
- diversity
- the social construction of gender
- physical activity preferences.

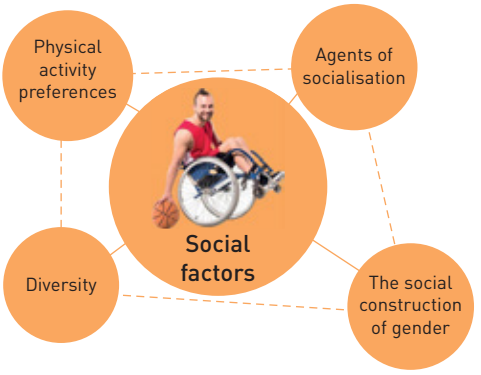
STUDY TIP

Social learning can influence your academic life as well as your sporting one. Working with a partner when doing your school work can help to keep you motivated and broaden your scope to be creative and innovative in your thinking.

social factors
a range of influences at a social level that can act as barriers or enablers to participation in sport and physical activities (e.g. influences at the community level such as the opinions of friends, parents, teachers and coaches, social expectations, gender roles, levels of diversity in the community)

There are many **social factors** that act as barriers and enablers to participation in sport and physical activity. Social factors include a whole range of influences at a social level (e.g. our relationships with our friends, family, community and broader society). Some of the most important social factors that influence access include:

- **agents of socialisation** – the people in our lives that teach us how to act and behave in a society, including our family, friends, teachers, and coaches
- **the social construction of gender** – the ways in which men and women in a society are expected to act and the types of behaviours that are typically considered to be feminine or masculine
- **diversity** – the ways in which people in a society differ (in terms of race, ethnicity, religious beliefs, socioeconomic status, language, physical and mental ability, geographical location, gender and/or sexual orientation)
- **physical activity preferences** – the types of sports and physical activities that a person likes to engage in (i.e. prefers) over other types of sports and physical activities in relation to others in their community.



SOURCE 1 A range of different social factors play a role in influencing a person's decision to participate in sport and physical activity.

In this section we will look at each of these factors in detail and examine how they act as barriers and enablers to sport and physical activity for different people. Although we will be learning about each factor separately, it's important to keep in mind that – in reality – these social factors are acting on us (i.e. affecting our decisions and behaviours) simultaneously. Not only that – we are also almost always influenced by a combination of other factors at the personal, cultural and environmental level at the same time. Source 4 on page 260 provides a visual representation of this complex interrelationship of factors.

5.3A Agents of socialisation

socialisation
the process of learning to behave in a way that is acceptable to other people in the society in which we live

agents of socialisation
the people in our lives from whom we learn the types of behaviours that are expected of us in society (e.g. parents and guardians, siblings, friends, teachers and coaches)

norm
a standard or pattern of behaviour that is typical or expected

Socialisation is the process of learning to behave in a way that is acceptable to the society in which we live. As humans, we all begin to learn the types of behaviours expected of us from a very early age from the people around us. Initially we learn directly from our parents or guardians, siblings (i.e. brothers and sisters), relatives and close family friends. Later in life, we learn from our friends, teachers and other people in the community (such as coaches, religious leaders and other people that we are in regular contact with). Because all of these people have a direct influence on the way we are socialised, they are referred to as **agents of socialisation**. They teach us the values, attitudes and **norms** specific to the social groups of which we are a part. Agents of socialisation are one of the key social factors affecting our participation in sport and physical activity. In this section we will learn about the ways in which they act as barriers and enablers to access.

In addition to the direct agents of socialisation introduced above, there are a number of other indirect agents of socialisation. These include the books we read (and the authors who write them), the TV shows and movies we watch (and the actors who star in them), the news we consume, and the people we follow on social media. We continually learn and grow from all of these agents of socialisation, but in this topic we will focus on direct agents of socialisation. Indirect agents of socialisation will be discussed in more detail in Section 5.4. The direct agents of socialisation include:

- parents and siblings
- friends/peers
- teachers
- coaches.

Social cognitive theory and socialisation

There are many theories that seek to explain how humans learn – and become socialised – through their relationships with others. One such theory – known as social cognitive theory – was developed by Canadian-born US psychologist by the Albert Bandura in 1986. The theory proposes that humans learn behaviours by observing, watching and absorbing other people's social interactions and experiences.

SOURCE 2 From a young age humans begin to learn behaviour from the people around them. These people include parents and siblings, friends, teachers and coaches. They are referred to as agents of socialisation.

From birth, we watch those around us, taking in overt (i.e. obvious) and covert (i.e. subtle) messages about the world in which we live. We observe people modelling particular behaviours and attitudes, and store that information. Consider the expressed wishes from parents for the use of 'please' and 'thank you' to teach their child manners. This would be considered an overt message of socialisation. The parent who always helps others and shows kindness to everyone they interact with sends a more covert message to the child about the way to engage in society. The kinds of attitudes and behaviours we observe are many and varied. They relate to things like ways of behaving towards people of different genders, ethnicities and ages, to name but a few. We later make decisions about which of those behaviours or attitudes are appropriate for us to imitate or reproduce, based on our observations of their consequences and the extent to which we identify with the people we have observed.

Agents of socialisation as barriers and enablers

Parents and siblings

Parents and siblings have the earliest and most significant influence on an individual's attitude towards physical activity. Parents can pass on attitudes and values relating to physical activity in general, or for specific sports and physical activities. Either way, these influences can have a lifelong impact on an individual's choices and behaviours.

In some cases, a parent's influence can be a direct enabler – e.g. a parent can make physical activity choices on their child's behalf by signing them up for a competitive or recreational sport. In other cases, a parent's influence can be an indirect enabler – e.g. the parent models positive behaviours for the child by participating in regular physical activity. Furthermore, the type of sport a parent is involved in will also be an influencing factor for the child's sport participation and sporting values. Parents who play touch football regularly will naturally encourage their children to develop a preference for this sport.

Parents can also act as barriers to participation. Some parents may actively discourage or restrict their child's access to opportunities for a number of reasons (e.g. out of fear they may get hurt or be teased, or due to negative previous experiences of their own as children). More commonly, a parent has other interests (e.g. music) and/or priorities (financial or time-based), which means that sport access is not made available to their children.

Parents can also act as barriers to participation when they engage in negative behaviour in front of their children (e.g. yelling abuse from the sidelines, acting aggressively towards coaches and other parents, etc.). This type of behaviour has become such a concern in the community recently that national media campaigns have been launched to combat the issue. The 'Let Kids Be Kids' initiative by Sport Australia is designed to combat abusive or negative parent behaviour at sporting games (see Source 3). It uses sport stars to advocate good behaviour. The 'Positive or it's pointless' campaign is another such initiative run throughout Queensland that aims to teach parents about positive sideline etiquette.

SOURCE 3 Parents and siblings can act as both barriers and enablers to children's participation in sport and physical activity. Recent media campaigns have been designed to combat abusive or negative parent behaviour at sporting games as this can be a serious barrier to continued participation.

Parents and siblings who are overly critical of their child's performance and set unrealistic expectations at home or in private can also act as a barrier to continued participation.

The influence of siblings is also significant in determining a child's sporting choices. It is common for younger children to be interested in the same sports and activities as their older siblings. Parents often encourage this, as having two children choosing the same sport can be more convenient and offer cost savings. This can be a barrier for some younger siblings who may not end up pursuing the sport they would prefer. In some cases, siblings can also be a negative influence. For example, when there is a clear difference in ability from one sibling to another, the less-able sibling can feel inadequate. This has been known to discourage young athletes from trying their hardest or continuing in the sport. The Theory in action below further explores how parents and peers act as enablers of physical activity.

Theory in action | Agents of socialisation as barriers and enablers of physical activity

Siblings Ella and Liam Green from Siena Catholic College on the Sunshine Coast reflect on the ways in which agents of socialisation have acted as barriers and enablers of physical activity.

Ella Green, 17 years old

'Both of my parents were very athletic growing up and continue to follow sports today, so when they heard that I wanted to take on competitive running they were ecstatic. My parents supported me financially. Most importantly, my parents emotionally supported me; always making the time to come and watch me train and compete, rain, hail or shine. When training became a challenge, or my performance dipped, the support from my parents was crucial to helping me keep sight of my goals. When I reflect on my athletics experiences – my opportunities to participate at a regional, state and national level – my parents are a part of those wonderful memories'.

Liam Green, 15 years old

In Term 1 of Year 7, we were told to select a Wednesday afternoon sport option for the semester and I chose rugby league. I had never played a contact sport before and wanted to try it out, so after a bit of convincing and pleading with my mum I tried out for the team and was successful.

I played on the wing and in the first game I scored two tries and was instantly hooked, even though the tries were nothing to do with skill – they were more about speed and size, as I was taller than the average for boys of my age. After that game, all my friends wanted me to play rugby union for school and club. At the time, my sister was involved with multiple sports, mainly athletics, and we couldn't make it to many of the games so that meant I couldn't play. However, a few years later I was finally able to sign up and I am now playing in the U/16 rugby team. All the boys from my school that were playing for the University Club aren't playing now, because they want to concentrate on their studies, but I'm grateful to them for their encouragement in Year 7 because I may never have given rugby union a go otherwise. Now it's a sport that I have come to love and will continue to play for as long as possible.

SOURCE 4 The support from Ella Green's parents has been a strong enabler for her participation and success in athletics.

SOURCE 5 Liam Green was enticed into the game of rugby union by his friends. Peer influence, when positive, can act as a strong enabler.

Friends

After parents and siblings, friends are generally the most influential agents of socialisation in a person's life. Research shows that as children get older, the influence of parents and siblings decreases and the influence of close friends becomes more important. As a result they can act as significant barriers and enablers to participation in sport.

Many children and adolescents report that the desire to 'fit in' and 'belong' plays an important role in their decisions to participate in sport. The same young people have a tendency to make decisions about sports based on what is considered socially acceptable (i.e. 'cool') among their peer group. Teenagers may also drop a sport they have participated in throughout their childhood if it is deemed socially unacceptable (i.e. 'uncool') by their friends. Research shows that as children get older and approach adolescence, their participation rates in sport decreases. This is especially common among females.

Friends can also influence the type of behaviour displayed on the sports field. Negative influences can exist within teams, and the desire to fit in can cause adolescents to tolerate or even take part in anti-social behaviour (such as bullying or teasing others). While bullying and victimisation from teammates can be serious barriers for some young athletes, peers who demonstrate strong leadership qualities and strong ethics can have a positive influence on teammates' behaviour and act as enablers for others to enter the sport.

Teachers

For many adolescents, school provides their only exposure to recreational or competitive physical activity. While a school's curriculum plays a role in shaping attitudes to physical activity, it is the teachers at the school who will ultimately influence the opportunities provided to the students. As such they can act as significant barriers and enablers to participation.

SOURCE 6 Teachers can have a profound impact on their students' attitudes towards physical activity.

Different teachers will place different emphases on what they see as the most important outcome of physical activity. Some view winning competitions as the most important aspect of sport and physical activity, while others believe that developing social skills and working as a team are more important goals. Some teachers might focus on sport's ability to help students achieve their personal, physical, mental and social goals.

When teachers have a passion for sport, they use their expertise, enthusiasm and commitment to give students positive experiences in that sport. In other words, they can act as strong enablers. For example, a teacher with a passion for volleyball is more likely to enter teams into volleyball competitions and provide expert coaching in that area. This may be at the expense of other sports, limiting students' choices, or it might complement other sports already offered at the school.

Teachers have the opportunity to motivate students, teach physical and social skills, and provide new experiences that can lead to a lifelong relationship with sport and physical activity. However, some teachers may not provide positive experiences for all students owing to the fact that the values and individual physical needs of these students differ. Unless teachers can find ways to tailor their instruction to suit these individual needs, some students can have negative experiences of sport. Likewise, if a teacher only provides limited opportunities to participate in a range of sports – choosing instead to teach only a few sports with which they are comfortable – then this may act as a barrier to those students who do not like those sports.

Finally, if a teacher chooses to focus their efforts exclusively on students who demonstrate a particular level of skill or talent (or fit a certain stereotype of fitness), then this can also act as a barrier for students who do not fit the stereotype but may otherwise succeed and develop the positive social attributes associated with teacher support.

Coaches

Coaches have great influence on equity and participation in the sports that they coach. More than being responsible for guiding an athlete in their chosen sport, coaches often support other aspects of the athlete's life too. As a result, coaches can play many roles in the life of an athlete, such as instructor, assessor, friend, mentor, facilitator, chauffeur, demonstrator, supporter, motivator and counsellor.

One important responsibility of coaches of school-aged children is to ensure that children are not pressured into specialising in sport when they are too young. Although having a passion to improve the outcomes of athletes makes for a good coach, overzealous coaches run the risk of causing 'athlete burnout', meaning that an athlete becomes fatigued and de-motivated in a sport due to being overworked or stressed.

5.3A Check your learning

Engage and understand

1 **Explain** what is meant by 'agents of socialisation'. Identify four examples of such agents.
2 **Explain** how learning occurs as a result of social relationships. Make reference to social cognitive theory in your response.
3 **Describe** two ways a parent can act as an enabler for access to sport and physical education and two ways a parent can act as a barrier.

Analyse and apply

4 **Reflect on** the social relationships that have had the greatest impact on your sport and physical activity access. Rank, in order of most influential, three social relationships that have been important in your sporting participation so far.
5 **Analyse** how the teachers in your life have contributed to the sporting pathway you have chosen from primary school through to your senior schooling.
6 **Reflect on** the sporting participation of your closest peers and how they have impacted on your access to sport and physical activity.

Evaluate and justify

7 **Consider** the coaches you have had over the past few years of secondary school. **Assess** how supportive they have been to fostering a positive association with your selected physical activity. **Discuss** what they have done well and what they could do better.
8 Read 'Agents of socialisation as barriers and enablers to physical activity'. **Evaluate** how agents of socialisation have acted as barriers and enablers to participation in physical activity for Ella and Liam Green. **Justify** your response.

5.3B The social construction of gender

social construction of gender
the idea that society and culture create gender roles and that these roles (and the behaviours associated with them) are prescribed as ideal or appropriate for individuals of a particular sex

The **social construction of gender** is the theory that society and culture create gender roles and that these roles (and the behaviours associated with them) are prescribed as ideal or appropriate for individuals of a particular sex. In Australian society, some of the most important and influential attitudes and behaviours we learn through our interactions with other people (i.e. through socialisation) relate to the ways in which men and women are expected to act in society. As a result, the social construction of gender can play an important role in our decisions to participate in sport and physical activity.

As discussed in Section 5.2E, gender is a term used to describe the combined product of a person's biological characteristics (i.e. their sex) together with their social and cultural roles and identities, which are formed in response to their environment (e.g. through interactions with family, friends, teachers and coaches, religious institutions, the media, and so on). Gender is also used to refer to the characteristics of masculinity and femininity and – in particular – the socially valued and accepted ways of expressing masculinity and femininity.

SOURCE 7 Female participation rates in physically combative sports like rugby have grown substantially in recent years.

For this reason, we refer to gender as a 'socially constructed' concept. This means that it is a concept created and perpetuated by society, rather than existing in nature. In other words, while we are *born* a particular sex, we *learn* what it means to be a particular gender. As a result, while there are just three biological sexes recognised under Australian law (i.e. male [M], female [F], and indeterminate/intersex/unspecified [X]), there are countless interpretations of what it means to be masculine or feminine.

Gender is part of an individual's personal and social identity. It refers to the way a person feels, presents and is recognised within the community. A person's gender may be reflected in outward social markers, including their name, outward appearance, mannerisms and dress. A person's sex and gender may not necessarily be the same. Some people may identify as a different gender to their birth sex and some people may identify as neither exclusively male nor female.

Despite the existence of a range of different interpretations of what it means to be masculine or feminine – and changing social attitudes towards them in some sectors of the

FOR THE RECORD!

The term intersex refers to people who are born with genetic, hormonal or physical sex characteristics that are not typically 'male' or 'female'. Intersex people have a diversity of bodies and gender identities, and may identify as male or female or neither.

community – other sectors of the community prefer to hold on to more traditional views about what it means to be a woman and a man. To these sectors of the community, these new ideas are seen as 'abnormal' or socially unacceptable.

Many of the more traditional views about what it means to be a man or a woman are narrow or exaggerated views and rules about the 'proper way' that each sex should behave and act in society. These views and ideas are known as stereotypes. An understanding of gender as a social construct helps us to see that although stereotypes often seem 'natural' or 'just the way things are', they are really just a set of guidelines and expectations created by society. In fact, many sociological and historical studies have shown that behaviours considered to be masculine or feminine in certain countries and societies may be very different in other countries and societies. Similarly, these perceptions can vary over time in the same society.

Social construction of gender as a barrier and enabler

Gender can be either a barrier to or an enabler of participation in sport and physical activity. Consider how specific physical activities are often associated with particular attitudes and behaviours. For example, sports like rugby are typically associated with displays of physical strength and aggression. These traits are typically associated with men rather than women, which often results in rugby being thought of as a 'masculine' sport. In this way, the social construction of gender and masculinity acts as an enabler to participating in rugby if you are a man, but as a barrier if you are a woman. Similarly, if a man expresses traits that are traditionally regarded as 'feminine' (such as gentleness and sensitivity) this can act as a barrier to participate in sports that are traditionally regarded as 'masculine'.

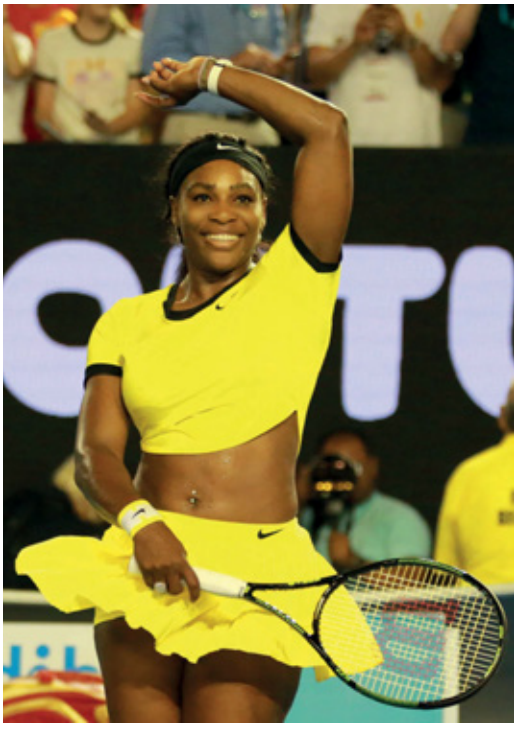
Gender tends to be a strong enabler of access to a particular sport or physical activity when there is alignment between:

- the gender of the participant
- the gender that the sport or physical activity is commonly associated with
- the expression of this gender in a way that is in line with social norms.

For example, a girl who expresses 'feminine' traits may find that her gender is an enabler to participation in ballet, as this is generally perceived as a 'feminine' physical activity.

Conversely, gender tends to be a barrier to participating in a physical activity where there is a misalignment between a person's gender, gender expression and the stereotypes surrounding their chosen activities.

As sports often reflect society in general, it is important to point out that a number of gender stereotypes in sport have been broken down in recent years (see Source 7). However, you only need to look at the representation of male and female athletes in the media to notice that both sexes are still expected to adhere to established gender roles in many ways. One example of this is the official uniforms that male and female athletes are required to wear when competing. These often work to reinforce gender stereotypes rather than break them down. Tennis and beach volleyball are examples of sports where women are required to wear traditionally feminine outfits (like skirts), or expose more of their bodies than their male teammates (see Source 9). For some women who choose to express



Source 8 Over the course of her career, Serena Williams has faced criticism from certain commentators and media outlets who have labelled her muscular physique 'manly'.

SOURCE 9 Although many gender stereotypes have been broken down in recent years, you only need to look at the official uniforms that male and female athletes are required to wear during competition to realise that differences still persist. Official uniforms for men and women competing at the Olympic level in beach volleyball reflect traditional constructions of gender. Tight fitting and revealing uniforms can act as a barrier to participation for some women.

themselves in ways that are not traditionally considered 'feminine' a tight fitting or revealing uniform can act as a significant barrier to participation. Similarly, women whose bodies may not match the physical 'ideals' perpetuated by the media may also regard this as a barrier. In order to remove these barriers, for men and women, it is crucial that parents and coaches are aware of any potential gender stereotypes and prejudices.

PERFORMANCE

SKILL DRILL **5.3B**

Investigate the impact of the social construction of gender

>> Turn to pages 352–353 to complete an integrated physical performance activity.

5.3B Check your learning

Engage and understand

1 In your own words, **explain** what is meant by the term 'social construction of gender'.

2 **Identify** five gender stereotypes about:
- → girls and sport
- → boys and sport.

Analyse and apply

3 **Analyse** your selected physical activity this term. **Consider** whether there are any particular rules, requirements or perceptions about the sport that influence (or are influenced by) the social construction of gender for boys and girls. Present your analysis in a written response of 400 words and provide evidence or examples to support your position.

Evaluate and justify

4 Consider the uniform worn at an elite level for the sport which is the focus of your studies this term. Now consider the uniform worn by students participating in the same sport at your school for representative sport and in PE classes. **Evaluate** the choice of uniform at all three levels in terms of perpetuating the social construction of gender. **Make recommendations** for modifications to the uniform to enhance equity and access for all participants in this sport.

5 Take a position on the introduction of non-gender specific sport. Instead of gender divisions, should all sporting competitions be organised by weight, height and skill? **Justify** your response by drawing on appropriate sections from this chapter plus additional secondary sources.

5.3C Diversity

diversity
a term used to describe difference; when used to describe people in a society, diversity means empowering people by respecting and appreciating the characteristics that make them different (e.g. age, sex, race, ethnicity, religious beliefs, gender, sexual orientation, socioeconomic status, physical and mental ability, geographical location)

In general terms, **diversity** simply means difference. However, when used to describe people living together in society, diversity takes on a much more complex and multi-dimensional meaning. It is one of the most significant social factors affecting participation rates in sport and physical activity. It is also an issue that people at all levels of society (e.g. at a personal, community, state and national level) have been working hard to address. In a social context, diversity is about:

- accepting that every person in society is unique
- recognising the characteristics that make people – and groups of people – within society different. These characteristics include (but are not limited to) things like:
  - **age**
  - **race and ethnicity**
  - **cultural identity**
  - **religious beliefs**
  - **gender identity and sexual orientation**
  - **physical and mental ability**
  - **socioeconomic status**
  - **geographical location.**
- empowering people by respecting and appreciating the characteristics that make them different
- working together as a group to value, celebrate and learn from each other's differences
- understanding and learning from each other – moving from simply tolerating those who are different to embracing and celebrating those differences and becoming a stronger, more cohesive society as a result
- developing a mutual respect for qualities and experiences that are different from our own
- recognising that all forms of discrimination (i.e. at the personal, club, school, or government level) create advantages for some people in society while creating disadvantages for others
- working together to remove all forms of discrimination.

It is important to note that all of the points listed above apply equally to the context of sport and physical activity as they do to society in general.

FOR THE RECORD!

Australia is one of the most culturally diverse countries on Earth:

- One in four of Australia's 25 million people was born overseas.
- 46 per cent have at least one parent who was born overseas.
- Around 20 per cent of Australians speak a language other than English at home.

Diversity as a barrier and enabler

Diversity plays a significant role in people's decisions to participate in sport and physical activity. As mentioned, there are many different characteristics that make individuals unique. Acknowledging these differences and celebrating them is key to improving access and equity to sport and physical activity.

When physical activity and sport is accessible for everyone, it can be an extremely effective vehicle for strengthening communities. However, factors like racism, sexism and homophobia can also create barriers to participation for some people. A range of brief examples of the types of barriers and enablers experienced by people based on their particular differences is provided in Source 10.

When consideration is given to the diversity of interests, abilities, ethnicities and genders of the Australian population, there is a greater chance of providing people with opportunities they find personally meaningful and that are relevant to their personal circumstances. In this way, their participation is enabled. Conversely, when a one-size-fits-all approach is taken to the provision of opportunities, the result is likely to be the creation of barriers to participation because of a lack of personal meaning and relevance.

Characteristic	Definition	Brief examples of barriers and enablers to participation in sport and physical activity
Age	The length of time a person has been alive	A person's age can act as both a barrier and enabler to participation. For example: → a lack of opportunities for older people (e.g. clubs and facilities offering appropriate activities) can act as a barrier → community programs, government funding campaigns and events designed to engage older people in sport (e.g. Australian Masters Games) can act as enablers.
Race and ethnicity	The physical characteristics that a person has; and/or the cultural traditions, history, language and shared experiences of a group to whom a person belongs or that they identify with	A person's race and ethnicity can act as both a barrier and enabler to participation. For example: → in a survey conducted by the Australian Human Rights Commission in 2013, 18 per cent of Australians said they had experienced discrimination because of skin colour or ethnic origin. Many Indigenous Australians are also subjected to this kind of discrimination. Discrimination against people based on their race or ethnicity, whether direct (i.e. in person) or indirect (e.g. in the media), can act as a barrier → community programs and national events designed to educate the public on racial and cultural diversity (e.g. Harmony Day and the annual AFL and NRL Indigenous Round) and eliminate racial discrimination. These factors act as enablers.
Cultural identity	The ideas, customs, language and social behaviours of a particular people or society that a person belongs to or identifies with	A person's cultural identity can act as both a barrier and enabler to participation. For example: → people from different cultural and language groups who have recently arrived in Australia can find it difficult to access sport and physical activities because they are unfamiliar with the language and culture and they lack social networks (e.g. friends and family). These factors can act as barriers → many cultural groups have their own sporting traditions and community organisations that offer opportunities for people from those cultures to participate in a range of sporting and cultural activities. These factors act as enablers.
Religious beliefs	The system of faith and worships	A person's religious beliefs can act as both a barrier and enabler to participation. For example: → certain religions place restrictions on the types of physical activities that adherents can participate in and the types of clothing they are able to wear. Alternatively, people from some religions may be made to feel unwelcome at certain sporting clubs. These factors can act as barriers → many religions promote healthy lifestyle choices in their teachings. They also commonly organise and encourage participation in a range of group sporting and cultural activities for their followers. These factors can act as enablers.

Characteristic	Definition	Brief examples of barriers and enablers to participation in sport and physical activity
Physical and mental ability	The ability of a person to carry out physical activities and the degree to which they possess the power to learn and retain knowledge	A person's physical and mental ability can act as both a barrier and enabler to participation. For example: → people with a physical or mental disability can experience difficulties accessing traditional sporting events. In many cases, facilities and equipment do not cater to their specific needs, funding for programs may not be provided and they may experience discrimination. These factors are all barriers. → many sporting clubs, competitions and programs are now focusing on including people with different physical and mental abilities. Many clubs are also improving facilities and offering more programs designed to meet the needs of all. National and international sporting events also help to break down stereotypes and educate the public (e.g. the Commonwealth Games integrating disabled and non-disabled athletes). These factors are all enablers.
Gender identity and sexual orientation	The sexual identity of a person and the gender they are attracted to (e.g. lesbian, gay, bisexual, transgender, intersex and other sexuality, sex and gender diverse people [LGBTI+])	Gender identity and sexual orientation can act as both a barrier and enabler to participation. For example: → discrimination directed at people on the basis of their sexual orientation (i.e. homophobia) by teammates, coaches or spectators can act as a barrier → sporting clubs and competitions established by LGBTI+ people and community groups that are inclusive and welcoming to all people (e.g. Gay Games) can act as enablers.
Socioeconomic status	The economic and social position of a person (and a person's family) in relation to others based on level of income, education, and occupation	Socioeconomic status can act as both a barrier and enabler to participation. For example: → ABS data shows that people living in low-income households with low education levels and unskilled employment are the least likely to participate in sport and physical activity. These people do not have the financial means to participate in sports of their choice. These factors act as barriers → ABS data shows that people living in high-income households with high education levels and skilled employment are the most likely to participate in sport and physical activity. These people have the financial means to participate in sports of their choice. These factors act as enablers.
Geographical location	The place where a person lives and the types of resources (e.g. shops and sporting facilities) that are available there	A person's geographical location can act as both a barrier and enabler to participation. For example: → people living in rural or remote areas may have fewer opportunities and access to sporting clubs and sporting facilities. There may also be a lack of qualified coaches and training staff available. These factors act as barriers → people living in urban areas (i.e. cities and large towns) may have greater access to a broader range of sporting clubs and sporting facilities. Similarly, people living in rural locations close to natural environments ideal for certain sports (e.g. the ocean, mountains, rivers) may have greater opportunities to engage in physical activities that make use of these environments. These factors act as enablers.

SOURCE 10 Diversity is about recognising the characteristics that make people different. All of these characteristics can act as barriers and enablers to participation in sport and physical activity.

SOURCE 11 The Gay Games is a worldwide sporting and cultural event that promotes sexual diversity and inclusion. It is open to all people regardless of ability or sexual orientation. Events such as the Gay Games act as enablers to participation for LGBTI+ people.

SOURCE 12 Each year, the AFL and NRL honour and celebrate Indigenous players and culture through the Indigenous Round. Events such as this educate the public on the benefits of diversity and act as enablers to participation for Indigenous Australians.

Theory in action | Diversity in the news

It is important for sport and recreation organisations to reflect Australia's diverse and multicultural population. The media often addresses contemporary issues that impact on diversity and inclusion in sport. Research 'diversity in sport' to read more about the latest news articles covering the diversity issues like those shown in Sources 13–15.

SOURCE 13 Autistic man Connor Whelan plays for the University of Queensland Rugby Club

SOURCE 14 NRL Greg Inglis racial abuse investigation

SOURCE 15 Transgender athlete Hannah Mouncey banned by AFLW

PERFORMANCE

SKILL DRILL **5.3C**

Analyse the role of social factors on access

>> Turn to pages 354–355 to complete an integrated physical performance activity.

5.3C Check your learning

Engage and understand

1 **Define** the term 'diversity' in the context of sport.

2 **Identify** three characteristics of diversity in the Australian population and provide an example of how each one acts as a barrier to participation and an enabler to participation using the table below.

Characteristic	Barrier	Enabler

Analyse and apply

3 **Analyse** the ways in which diversity can act as a barrier to sport and physical education at your school.

- a **Identify** characteristics about yourself that you believe may be acting as barriers to participation. Consider what could be done to remove these barriers and improve access for you.
- b **Identify** characteristics of other students (or groups of students) that may act as barriers to participation. Consider what could be done to improve access for these students.

4 **Critique** your school's provision of access to physical activity for students with a disability. Are these students given equitable access to the social and health benefits of physical activity as other non-disabled students? If not, make suggestions for how barriers to participation could be removed.

Evaluate and justify

5 **Research** news articles relating to diversity in sport online and complete the tasks below.

- a Assess whether you believe that the issue of racial abuse should be tackled at the elite level of rugby league, at the participation level or both.
- b Based on your position, develop a strategy to encourage inclusion of different racial groups in rugby league. Present this in a series of dot points that summarise your key ideas.
- c Evaluate the AFLW's transgender policy and discuss the issues surrounding the rejection of Hannah Mouncey from the elite level of competition.

5.3D Physical activity preferences

physical activity preferences
the types of sports and physical activities that we choose to participate in (i.e. the sports we have a natural preference for over other sports)

Physical activity preferences refer to the particular types types of sports and physical activities that we choose to participate in (i.e. the sports we have a natural preference for over other sports). On a personal level, we generally tend to be drawn to sports and physical activities based on factors such as our personality, genetics and personal abilities. On a social level, the sports we often develop a liking for tend to be the same as those that are popular and/or considered appropriate by the agents of socialisation in our lives (i.e. our parents and siblings, friends, teachers and coaches).

It is important to note that physical activity preferences are influenced by more than just our own personal likes and dislikes or the opinions of our friends and family. In fact, they are a result of many other factors such as:

- **culture** – certain sports have evolved over centuries to play an important cultural role in particular communities and countries. As a result they become a source of pride (e.g. wrestling is a sport central to Turkish culture, winter sports such as skiing are culturally significant in Scandinavian countries)
- **environment** – weather conditions in certain countries are more or less suited to particular sports and have an impact on what becomes popular (e.g. water sports such as surfing and swimming have higher participation rates and are more popular in Australia than snow sports)
- **history** – certain sports have developed over time in particular places. These traditions are passed on from one group to another and evolve over time (e.g. the popularity of cricket in countries like Australia and India are the result of our colonial ties to England).

SOURCE 16 It is important to note that physical activity preferences are influenced by more than just our own personal likes and dislikes or the opinions of our friends and family. In fact, they are a result of many other factors, including environment.

Physical activity preferences can also vary on many different levels, including at:

- a personal level – from one person to another
- a social level – from one family to another, or from one group of friends to another
- an institutional level – from one school to another, or from one company to another
- a regional, national and international level – from one region or state to another, or from one country to another.

Physical activity preferences as a barrier and enabler

If a person's preference for a particular sport aligns with the preferences of people in their life who they consider important (and whose opinions they value), it can be an enabler for participation in that sport. For example, if a girl is naturally interested in playing soccer, and her family and friends are also interested in soccer, this shared affinity (i.e. preference) can generate feelings of belonging and acceptance that act as an enabler for participation. It can boost confidence levels and also satisfy needs for socialisation with others.

On the other hand, if a person's preference does not align with the preferences of the people in their life who they consider important (and whose opinions they value), it can be a barrier for participation in that sport. For example, if the same girl is naturally interested in playing soccer, but her family and friends insist that it is an inappropriate sport for girls and instead have a preference for tennis, this creates a barrier to participation.

SOURCE 17 Feelings of belonging and acceptance can act as enablers for participation in sport.

5.3D Check your learning

Engage and understand

1 **Explain** what is meant by the term 'physical activity preferences'. **Clarify** how it can act both as a barrier and an enabler to participation in sport and physical activity.

2 **Identify** the factors that influence our physical activity preferences at:
   - **a** a personal level
   - **b** a social level
   - **c** an institutional level
   - **d** a national level.

Analyse and apply

3 **Consider** whether your own physical activity preferences have acted as barriers or enablers to participation in the past. Was there ever a time when you passed up an opportunity to participate in a sport you were interested in because the sport was not popular or considered appropriate by friends or family members? **Explain** using examples to illustrate your point.

4 Conduct some research to **determine** why rugby league is played in Queensland and New South Wales more commonly than Australian football. **Consider** the reasons for this preference.

5 **Evaluate** the popularity of your current physical activity at your school. **Determine** the likelihood that you would participate in this sport at school (you may already) and **justify** whether the physical activity preferences of your peers has had an influence on your decision.

Check your obook assess for the following additional resources and more:

- **» Student book questions**
  5.3 Check your learning
- **» Student worksheet**
  5.3 Social factors that influence equity and access worksheet
- **» Skill Drill worksheet**
  5.3B Investigate the impact of the social construction of gender
- **» Skill Drill worksheet**
  5.3C Analyse the role of social factors on access

5.4 Cultural factors that influence equity and access

That's a goal!

By the end of Section 5.4, you should be able to:

→ **identify** a number of cultural factors that act as barriers and enablers to equity and access

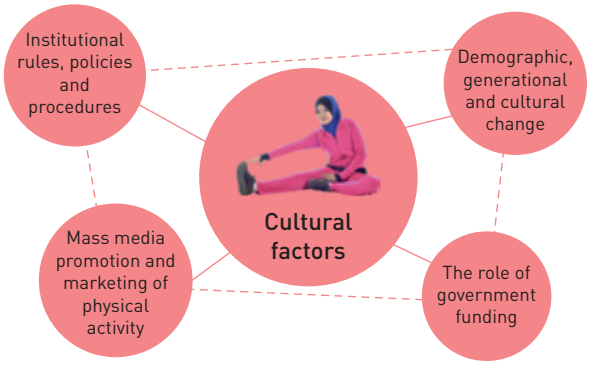
→ **define** the following terms and **explain** how they affect equity in sport and physical activity:

- demographic, generational and cultural change
- the role of government funding
- mass media promotion and marketing of physical activity
- institutional rules, policies and procedures.

cultural factors
a range of influences at a cultural level that can act as barriers or enablers to participation in sport and physical activities (e.g. influences nationally and internationally such as population changes, the role of institutions such as the government, the church and the mass media)

There are many **cultural factors** that act as barriers and enablers to participation in sport and physical activity. Cultural factors include a whole range of influences at a cultural level (e.g. national and international influences such as population changes, the role of institutions such as the government, the church and the mass media). Some of the most important cultural factors that influence access include:

- **demographic, generational and cultural change** – the changes that take place at a national and international level that affect participation rates in certain sports and physical activities (e.g. changes in popularity of certain sports over time or in certain sectors of society)
- **government funding** – the amount of government money allocated to certain sports over others and the promotion of certain sports over others
- **mass media promotion and marketing of physical activity** – the messages and information that the mass media chooses to promote about certain sports over others
- **institutional rules, policies and procedures** – the roles that organisations (e.g. schools, sporting clubs, companies) play in promoting certain sports and physical activities.



SOURCE 1 A range of different cultural factors play a role in influencing a person's decision to participate in sport and physical activity.

In this section we will look at each of these factors in detail and examine how they act as barriers and enablers to sport and physical activities for different people. Although we will be learning about each factor separately, it's important to keep in mind that – in reality – these cultural factors are acting on us (i.e. affecting our decisions and behaviours) simultaneously. Not only that – we are also almost always influenced by a combination of other factors at the personal, social and environmental level at the same time. Source 4 on page 260 provides a visual representation of this complex interrelationship of factors.

5.4A Demographic, generational and cultural change

demographic change
a general term used to describe changes in the size, age, composition and structure of a population

generational change
a term used to describe the changing tastes, influences and preferences that take place within a population over time

cultural change
a term used to describe the changing levels of cultural diversity that take place within a population over time

Demographic, generational and cultural changes are all terms used to describe changes that take place within human populations. A population refers to a group of people who live in the same place (e.g. a town, a city, a regional area, a country or even a planet). Because populations are made up of individuals, they are constantly changing. People join populations by being born into them or joining them from other places, and people leave populations by dying or moving away. These changes are all cultural factors affecting participation in sport and physical activity.

Although demographic, generational and cultural change are all related terms that describe changes that take place within populations – and are often used interchangeably – they each have a distinct meaning.

- **Demographic change** – is a general term used to describe changes in the size, age, composition and structure of a population. In fact, 'demography' is a word that comes from ancient Greek and literally means 'describing the population'. Common demographic changes in many industrialised countries around the world today include things like declining birth rates, longer life expectancy and increasing immigration.
- **Generational change** – is a term used to describe the changing tastes, influences and preferences that take place within a population over time. A generation is defined as the average period (generally considered to be about 30 years) in which children grow up, become adults, and have children of their own. As generations of people in a population age and die, and as new generations follow them, values, styles, attitudes, interests and trends change in response to a number of factors (such as the environment, the economy and social, cultural and historical events).
- **Cultural change** – is a term used to describe the changing levels of cultural diversity that take place within a population over time. As people of different cultural and ethnic backgrounds join a population over time, the culture of that population often changes with them. Data collected by the Australian Bureau of Statistics (ABS) in 2016 shows that 26.4% of people living in Australia were born overseas. The different cultural traditions, languages, preferences, beliefs and values of those people influence the overall culture of Australia over time.

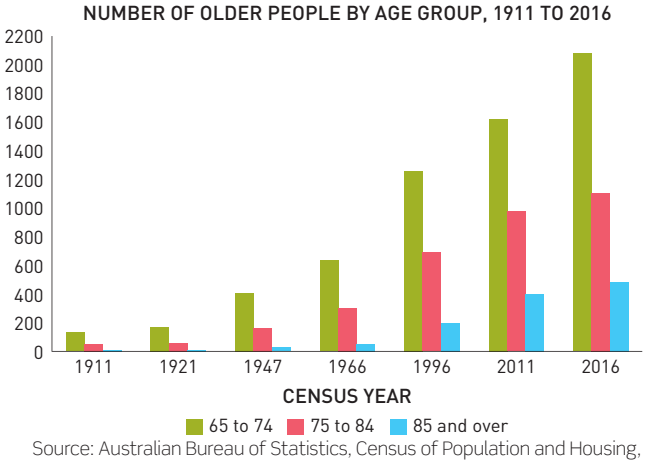
SOURCE 2 Demographic, generational and cultural changes are all factors used to analyse and describe changes that take place in human populations over time. These are all cultural factors that can affect participation rates in sport and physical activity – as well as the popularity of particular sports – over time.

Demographic, generational and cultural change as a barrier and enabler

Demographic, generational and cultural change play a significant role in people's decisions to participate in sport and physical activity. Australia's population – and its culture – is shaped by many different factors. Through our interactions with each other and with institutions (such as schools, clubs, community groups, the government, the law) we come to an understanding about who we are as a nation and tend to establish common values and goals. In Australia, sport represents a relatively large part of our culture. This is demonstrated in various ways, such as:

- the level of funding allocated to sport and physical activity by various levels of government (e.g. local, state, federal)
- the amount of time allocated to sport in school
- the amount of time and prominence devoted to sport in the media.

These factors can act as barriers and enablers to participation in many ways.



Source: Australian Bureau of Statistics, Census of Population and Housing, 1911–2016

SOURCE 3 Around 15% of Australia's population consists of people aged 65 and older – a significant increase from 100 years ago.

SOURCE 4 Older Australians are now staying active for longer, with an unprecedented number seeking to be involved in competitive sport.

Demographic change

Older people make up a considerable proportion of Australia's population. A person's age can act as a barrier or an enabler to participation. According to census data collected by the ABS, over 1 in 7 Australians were aged 65 and over in 2016. As shown in Source 3, that's around 3.7 million people (or 15% of the total population). Source 3 also shows the significant increase in older people in Australia over the last 100 years.

Involvement in organised sport and physical activity generally decreases with age. For example, people aged 15–24 years had the highest rate of sport participation (43%) and the highest rate of involvement overall (44%). In comparison, people aged 55–64 and 65 years and over had the lowest rate of sport participation (18% and 17% respectively) and the lowest involvement overall in sport (19% and 18% respectively). Age in this sense acts as a barrier.

While senior citizens have traditionally preferred non-organised recreational activities (such as swimming and dancing), a significant proportion of this group is now seeking greater access to competitive sport. This is reflected in the growing number of senior citizens competing in masters-level competitions (i.e. competitions for those aged 35+), where Australia is ranked as the second highest participating nation worldwide. Access to organised events has ensured continued growth in such events will further enable this trend.

Interestingly, while our older citizens have stayed more physically active for longer, our younger generations are becoming increasingly sedentary. Younger people work longer hours and spend more of recreational time indoors (e.g. in front of technological devices) than any previous generation.

This type of lifestyle often acts as a barrier to physical activity as people struggle to find the time to participate in sport and physical activity.

While the growing popularity and reliance on technology as a recreational activity is often a barrier to physical activity, the use of technology can also be an enabler. For example, increase in the use of fitness devices designed to monitor, track and record physical activity (e.g. smart watches, fitness apps, heart rate monitors and wearable technology) can educate and motivate younger people to engage in physical activity (see Source 5).

Generational change

As well as affecting participation rates on the whole, the changing age of a population also influences the types of sports that are played and how these sports are organised.

Data collected by Roy Morgan Research – an Australian market research company that monitors participation trends in over 60 sports and physical activities – reveals that over the past 15 years, more Australians have started participating in walking for exercise, jogging, cycling, going to the gym and doing yoga, while overall, fewer are participating in competitive sports (see Source 6). Roy Morgan cite soccer as the big winner of the new century so far, gaining almost 200 000 regular participants (up 46% to 623 000) since 2011. Now the most-played competitive sport in Australia, in 2001 soccer was fourth on the list, with only slightly more players than basketball, cricket and netball. As Source 6 shows, demand for certain sports increases and decreases.

SOURCE 5 Technology can act as either a barrier and an enabler to physical activity, depending on how individuals use it.

Rank	Sport	Number of regular participants		
		2001	2016	Change
1	Soccer	428 000	623 000	46%
2	Golf	814 000	621 000	-24%
3	Tennis	711 000	463 000	-35%
4	Basketball	422 000	438 000	4%
5	Cricket	418 000	377 000	-10%
6	Martial arts	281 000	321 000	14%
7	Netball	414 000	315 000	-24%
8	Australian football	256 000	253 000	-1%
9	Lawn bowls	312 000	233 000	-25%
10	Darts	238 000	232 000	-3%

Source: Roy Morgan Single Source Australia. Base: Australians aged 14+, January to December 2001 (sample = 26,198) and January to December 2016 (sample = 14,330)

SOURCE 6 The most-played competitive sports in Australia

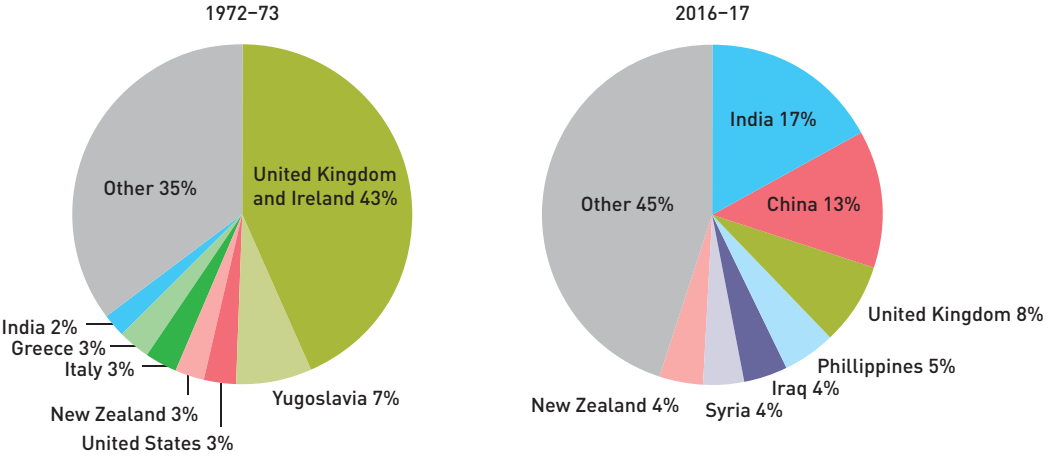
Cultural change

Since 1945, over 7.5 million people have settled in Australia from countries overseas, helping to establish it as one of the most culturally diverse countries in the developed world. Currently, the ABS estimates that 28% of Australia's population was born overseas.

The increasing numbers of Australians who were born overseas has a significant effect on the way we access sport as a nation. As Australia becomes more culturally and ethnically diverse, the types of sports we are interested in as a nation evolve and change.

As people from different parts of the world settle in Australia, we must try to offer access to new types of sports and physical activities that people from those cultural backgrounds will want to participate in. Different cultures have different sporting preferences. Australian sporting organisations need to accommodate people with different recreational interests and habits; otherwise, a lack of suitable opportunities will act as a barrier to participation for those coming here.

Sporting clubs and organisations also need to make an effort to welcome newcomers who have not previously been exposed to popular Australian sports. Offering introductory courses and events to teach newly arrived Australians the rules of popular sports and the etiquette that surrounds them is key – this is further explored in the news article below. This is particularly the case for adults who may have missed the opportunity to develop fundamental motor skills through childhood – due to extreme hardships such as famine and war in their home countries. The fact that introductory sport programs usually only target children is a barrier for these adults.



Source: Australian Government Department of Home Affairs, 'Historical Migration Statistics' 2018, and Department of Immigration and Border Protection 'Permanent Additions to Australia's Resident Population' 2017

SOURCE 7 Migration statistics describing Australia's resident populations

In the news

Aquaversity – a 'learn to swim' initiative removing barriers for Sudanese Australians

GLENNIE ENEWS 18 MAY 2018

Toowoomba swim school, The Glennie Aquatic, are celebrating national success after being awarded the Swim Australia's Outstanding Community Service Award for their latest swim program initiative, Aquaversity – a learn-to-swim program aimed at giving Sudanese Australians the opportunity to develop the essential life skill.

Run in partnership with the Royal Life Saving Society Queensland Inc, Toowoomba Regional Council and the Toowoomba African Community, Aquaversity commenced in September 2017 and was also held in the 2018 January school holidays.

'We have quite a few schools that use our Centre for swimming lessons and swimming carnivals, and our instructors

SOURCE 8 The Aquaversity program has given some members of the Sudanese Australian community access to the physical activity of swimming, a sport they had little access to previously.

notice the alarming number of Sudanese children either frightened of the water or simply not confident in basic swimming skills. Sadly, this becomes more of an issue when the parents and families of these children are also not confident in or around water' said Shannon Townsend, Centre Manager for Glennie Aquatic.

Local African Women's Association advocate Sisilia Ajang works closely with members of her community sharing opportunities to integrate into the Toowoomba community and the Australian lifestyle. Sisilia spread the word about Aquaversity, and as a result, the instructors introduced 15 babies to their first learn to swim experience, 70 children aged 3 to 17 experienced learn to swim classes, and 12 adults were welcomed to the pool environment.

Through programs like this, participants get to be involved in a popular Australian sport, experience achievement in a supportive and inclusive environment, and learn a skill for life.

5.4A Check your learning

Engage and understand

1 **Define** the term 'demographic change'.
2 **Describe** some of the main the demographic changes taking place in Australia at the moment.
3 **Identify** how old age can be both a barrier and an enabler for access to physical activity. Provide examples to support your response.

Analyse and apply

4 **Analyse** the graph in Source 7 (page 298) that shows immigration rates in 1972–3. **Consider** which sports might have shown significant growth in participation numbers. Support this by referencing secondary data.
5 **Compare** the two graphs in Source 7. Determine which era was the most equitable for accessing physical activity.

Evaluate and justify

6 Using the information provided together with additional data gathered online, **predict** how demographic, generational and cultural change in Australia will affect access to sport and physical activity over the next 100 years. **Justify** your response, using examples.
7 Refer to the article 'Aquaversity – a learn-to-swim initiative removing barriers for Sudanese Australians'. In a 200-word written response, **assess** whether other sporting organisations should implement programs like Aquaversity to welcome people from various cultural backgrounds. Alternatively, if you are aware of a similar program offered by another club or organisation, **justify** why it has been successful.

5.4B Government funding

Government funding
any financial assistance (i.e. money) from the government received by non-government institutions in the form of local, state or federal grants, loans, property, or other assistance

Government funding is any financial assistance (i.e. money) from the government given to non-government institutions in the form of local, state, or federal grants, loans, property, or other assistance.

One of the primary roles of any government is to collect funds (e.g. in the form of taxes) and determine how these funds should be distributed for the greater good of the people. There are many government departments, agencies and public sector organisations in Australia. Many of these are owned and operated by the government and exist to provide services for all Australians, including opportunities to participate in sport and physical activity. These organisations regularly compete for government funding to ensure they have the money they need to provide the types of services and facilities for the people and communities they serve.

Government funding as a barrier and enabler

The total amount of government funding allocated to sport and physical activities can act either as a barrier or an enabler to participation.

Governments at a federal, state and local level regularly make decisions about how our taxes are spent. They do this based on the likelihood of receiving some kind of return on that investment. For example, most Australians would agree that it makes sense to spend money on things like education, health, job creation and infrastructure (such as roads, public transport, power stations, etc.) as these things are necessary in order to keep the country moving forward. The case for investing government funds in other areas can sometimes be more controversial though, as the potential benefits of spending this money may not be obvious to all Australians. Government funding to support sport and physical activity is one such area. Although many people agree that government funding for sport and physical activity is necessary, the amount of funding and the ways in which it is shared can often be a source of disagreement.

SOURCE 9 The Gold Coast 2018 Commonwealth Games cost an estimated $1.5 billion to run, but provided great exposure for Australian sport.

Historically, the majority of government funding for the sports sector has been allocated to high-profile, elite-level and high-performance sports – through organisations such as the Australian Institute of Sport and Sport Australia. This funding helps to support and develop Australian sporting talent and makes it possible for elite athletes to compete successfully at a national and international level. Often, this helps to inspire other Australians and in turn acts as an enabler to participation at an amateur level.

Through this investment, governments are often trying to raise Australia's sporting profile. However, in recent years, questions have been raised about the amount of funding that has been allocated to elite-level sport. In part, these questions have been prompted by the failure of some sports and athletes to translate funding support into sporting success.

The preparation for and hosting of high-profile sporting events creates employment and tourism opportunities that not only benefit the economy of the region but achieve a flow-on effect, enabling increased sports participation rates. The most recent high-profile event to require government funding was the 2018 Commonwealth Games held on the Gold Coast.

Sport Australia was established in 1985 and is the government agency in charge of developing Australian sport at all levels. Since the ASC's conception, Australia has developed and consolidated its reputation as a highly competitive sporting nation. However, the ASC has recently faced criticism over its allocation of funds due to the comparatively poor performances and results of Australian athletes at the London and Rio Olympic Games.

Funding for elite high-performance sports (i.e. at a national and international level)		Funding for participation sports (i.e. at a local and community level)	
Sport	Total funds allocated	Sport	Total funds allocated
1. Swimming	$10 363 787	1. Tennis	$1 123 250
2. Cycling	$9 239 004	2. Netball	$1 010 000
3. Sailing	$8 600 596	3. Football	$1 009 920
4. Rowing	$8 280 004	4. Gymnastics	$1 009 000
5. Athletics	$8 257 706	5. Basketball	$950 000
TOTAL FUNDING	**$44 741 097**	**TOTAL FUNDING**	**$5 102 170**

Source: Australian Sports Commission Annual Report 2016-17, Appendix 1: Funding to sports

SOURCE 10 Funding at national, international, local and community levels

Funding is perhaps one of the most straightforward enablers to participation. However, when one group of participants is being funded at a far higher level – in this case, elite athletes – a barrier to other participants is created. In other words, the existing funding allocation for sports in Australia enables athletes who participate in high-performance, elite-level sport, but lack of government funding may act as a barrier for athletes who participate at the local or community level.

In response to calls for greater equity, in 2018 the ASC reworked some of its strategies in order to increase the amount of money allocated to a number of participation sports. Spending money on participation sports enables better physical and mental health outcomes for Australians and reduces the economic burden of inactivity and sedentary behaviour. In 2018, the ABS found that the estimated cost to Australian society and governments for obesity alone was $58 billion.

STUDY TIP

When making a presentation to the class, consider multimodal forms of digital storytelling. In creating your story, weave together video, photos, narration and print to enhance the message you are sending. Music and sound effects can help add a dramatic or emotional impact, which draws the audience into the story you are telling.

5.4B Check your learning

Engage and understand

1 **Define** what is meant by the term 'government funding'.

2 **Describe** how the Australian government funds various types and levels of sport in Australia.

Analyse and apply

3 **Analyse** the role that Sport Australia plays in ensuring equal access to sport and physical activity for all Australians.

Evaluate and justify

4 Using the information provided in Source 10 – together with the most recent secondary data – **assess** the current model of funding for sport and physical activity in Australia. **Propose** a solution that would make the allocation of government funding more equitable. **Justify** your response using examples, making reference to official data and statistics.

5.4C Mass media promotion and marketing of physical activity

mass media
mass communication to a wide audience through a diverse collection of media technologies

Mass media refers to a collection of technologies used to communicate messages to very large numbers of people. Today, mass media is made up of:

- **broadcast media** – such as TV, film and radio
- **print media** – such as newspapers, magazines, billboards, brochures and pamphlets
- **digital media** – such as the internet, websites and social media.

Information and messages that are communicated via the mass media – including advertisements and marketing materials – have enormous potential to influence the attitudes, opinions, values, thoughts and beliefs of the people that consume (i.e. read, watch, listen to, or interact with) them. For that reason, mass media is one of the most significant cultural factors affecting participation in sport and physical activity.

SOURCE 11 Information and messages communicated through mass media have enormous potential to influence the attitudes, opinions, values, thoughts and beliefs of the people that consume them.

The media has the power to promote certain sports and reinforce certain attitudes to physical activity, while undermining other sports and discrediting other attitudes to physical activity. In addition to this, mass media also has the ability to influence our engagement with sport and physical activity by constructing stereotypes about gender, ethnicity, religion and social class in relation to sport and reinforcing perceptions around issues relating to health and wellbeing (such as ideal body types). All of these factors have the ability to act as barriers and enablers to participation in sport and physical activity.

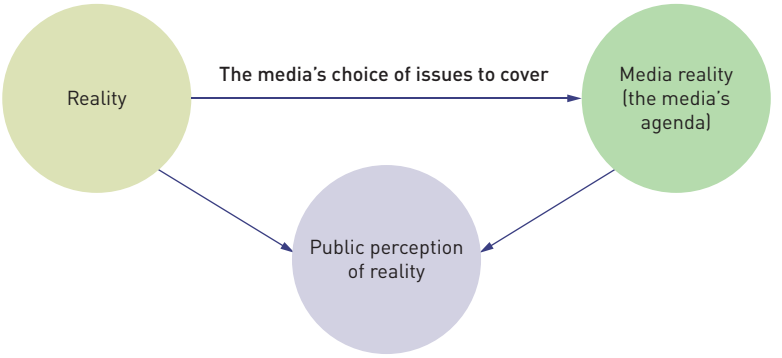
Agenda-setting theory

One theory proposed to help understand and explain the influence of mass media on the attitudes and perceptions of the public is agenda-setting theory. The theory – which was first proposed in 1968 by journalism professors Maxwell McCombs and Donald Shaw in relation to print media – proposes that the power of the media comes from its ability to control and decide which issues it will cover and when. In this way, the media has the ability to influence the public's perception of what is real (see Source 12).

In the context of sport, agenda-setting theory suggests that the popularity and perception of certain sports can be increased when the media chooses to provide lots of coverage of them. When the media gives priority to a select group of sports, it boosts public perception of these sports and validates them. This allows them to thrive. On the other hand, sports and physical activities that receive no media coverage are delegitimised or devalued. As a result, these sports may struggle to attract new participants and fans needed to generate revenue and grow in popularity. Additionally, young, aspiring athletes may be motivated to move to a more 'mainstream' sport because they believe they will have greater chances for career success.

Marketing and promoting sport through mass media

The ability of a sport to elicit an emotional response from those who watch it has contributed to the phenomenon of sport as entertainment. Mass media has tapped into this potential and its coverage has led to a growing fan base for sport as entertainment. With this comes the opportunity to advertise to viewers, readers and listeners, bringing huge commercial value to sport. In economic terms, the process of turning something – in this case, sport – into an object of commercial value is known as **commodification**.



SOURCE 12 Agenda-setting theory helps to explain how the selection of issues covered by the mass media can alter public perception of reality.

Sport is an incredibly lucrative and marketable commodity. The ownership of teams and the ability to broadcast sporting events in real time via multiple media channels (e.g. TV, internet, social media, radio) results in broadcast rights being bought and sold for vast sums of money. For example, in 2015 the AFL signed a six-year $2.5 billion broadcast rights agreement with Channel Seven, Foxtel and Telstra.

As a result, the profiles and salaries of some high-profile athletes in Australia have skyrocketed. Many of these athletes now work with large numbers of support staff such as managers, sponsors and marketing advisors.

SOURCE 13 The average Australian now owns three internet-enabled devices and 79% of the population regularly engage with some form of social media. As a result, there has been a significant shift towards the integration of social media into sports marketing campaigns and promotions.

Sports marketing is the action or business of promoting and selling sports-related products or services (including market research, sponsorship and advertising). Traditionally, sports marketing has involved:

- **securing sports coverage** – gaining the rights to broadcast games and events on television and radio
- **increasing media exposure** – promoting sport through various media outlets such as print news
- **securing sponsorship deals** – arranging payments to athletes or clubs to endorse the products and services of companies (known as sponsors) by carrying their logos or brands on their uniforms and appearing in advertisements
- **increasing advertising** – on television, radio and print
- **selling merchandise** – promoting retail sales of branded team items such as scarfs, hats, flags and t-shirts
- **packaging sport** – adapting sporting events and game formats to be more media friendly, such as the development of Twenty20 cricket or having four quarters in basketball (instead of 2 halves) which offer more opportunities for ad breaks.

In the 21st century, we are seeing a significant increase in the inclusion of new social media channels for sports marketing and promotion. Social media marketing campaigns hold an edge over their traditional media outlets because they are able to personalise and individualise a fan's experience of sport and physical activity.

The rise of social media has changed the way we consume sport as entertainment. Where traditional media (print, radio and TV) engaged people at set times throughout the day and

commodification
the process of turning something into an object of commercial value

sports marketing
the action or business of promoting and selling sports-related products or services (including market research, sponsorship and advertising)

sponsorship
the act of providing money (i.e. to an athlete, club or sport) in exchange for the opportunity to promote or advertise the brand, product or service of a company (i.e. the sponsor)

week, social media delivers news and coverage of events into audience feeds on a continuous basis. This has changed both the way traditional media approaches sport as entertainment (e.g. through social media accounts or live streaming) and the way that audiences interact with the content (e.g. through liking and sharing). In addition, spectators can now create their own videos or written reviews to share on social media platforms.

Mass media promotion and marketing as a barrier and enabler

The mass media and marketing of sport and physical activity plays a significant role in people's decisions to participate in it, but – as with most things – mass media coverage of sport can act as both an enabler of and a barrier to participation.

Media promotion

One of the most obvious ways in which mass media and marketing act as an enabler to participation is through coverage. Large amounts of media attention, promotion and advertisements relating to a particular sport can be a huge enabler to participation at all levels. Increased media prominence attracts fans, drives sponsorship of individual athletes and teams, and ultimately keeps those sports vibrant and growing. Sporting associations and clubs today rely heavily on revenue generated through international media and marketing deals in order to reinvest in the sport and to fund programs – from the grassroots level up – that keep people interested and playing their sports. For example, the 2018 World Cup is estimated to have generated US$6.1 billion in revenue for Fédération Internationale de Football Association (FIFA) compared to US$2.2 billion in expenses. Over the four-year cycle, the event is estimated to have turned a US$2.6 billion profit. FIFA is estimated to have made US$3 billion in TV rights fees, US$1.65 billion in sponsorships, and $527 million in ticket sales.

This revenue can then be allocated towards a whole range of participation campaigns and programs in countries around the world, be used to build world-class facilities (such as stadiums and training camps), attract expert coaching resources, and run international advertising campaigns and targeted and personalised social media campaigns (through a range of different apps and websites). All of these factors act as enablers – keeping the sport vibrant and encouraging the next generation of players to get involved.

There can also be downsides to mass media coverage and marketing promotion for elite sports. For example, in 2015 FIFA was engulfed in accusations of widespread bribery and corruption. Media coverage of the scandal was intense and very public and ultimately resulted in the resignation of FIFA president Seth Blatter who left in disgrace. The scandal also resulted in legal costs and lost earnings from cancelled sponsorship deals – all of which resulted in a US$369 million net loss for football's world governing body in 2016. The intense coverage of such events can severely damage public perception of sports and damage their reputation among fans. As a result, the coverage can act as a barrier to participation.

SOURCE 14 Yoga is an age-old physical activity that has surged in popularity over the past five years, partly fuelled by the work of social influencers on apps such as Instagram and Snapchat.

Sports that are newer, less popular and more recreational (i.e. not competitive team sports) are traditionally less attractive to media companies (due to the limited potential for profit in terms of broadcasting rights and sponsorship deals). This results in an absence of coverage in the mass media that can act as a barrier to participation. However, newer forms of mass media are helping to address this imbalance. Social media has proven to be an inexpensive and successful way of promoting sports that are newer or less popular (i.e. those with smaller fan bases and a lack of public awareness). For example, the rise in popularity of yoga as a physical activity over the past five years has been driven largely by successful social media campaigns, online forums and the work of social influencers.

Sports marketing

Sports marketing can be a great enabler for access, at it makes more people aware of the various activities on offer, whether it is a game that is available to stream online or a new class that has started at the gym.

When it comes to the marketing and promotion of sport, sponsorship is a great enabler to participation. It can:

- be a source of income for athletes – allowing them to participate in a sport or physical activity they otherwise may not be able to afford
- be a source of income for clubs, teams and associations – allowing them to promote their sport or physical activity, run training events, finance the cost of venues, coaches, medical personal or other staff
- be a source of 'free' goods or services to athletes and teams – such as clothes, shoes or training equipment.

Likewise, the inability to attract sponsorship can therefore be a barrier to participation insofar as it denies athletes, teams and sports access to these benefits.

5.4C Check your learning

Engage and understand

1 **Define** the term 'mass media' and **summarise** how it can shape values and attitudes in society.
2 **Describe** the purpose of sports marketing.
3 **Explain** how sport has become a commodity. Provide two examples from your own life that illustrate this point.

Analyse and apply

4 **Compare** and **contrast** two sports that are offered at your school by completing the following tasks.
   a **Identify** any barriers or enablers to each sport that currently exist in your school.
   b Using the table, **assess** the mass media appeal and marketing potential of the sports you have chosen.

	Sport 1	Sport 2
Mass media appeal		
Marketing potential		

5 **Reflect on** the different ways in which fans and athletes engage with traditional media and social media. **Determine** how this impacts the marketing and promotion of different sports.

Evaluate and justify

6 **Predict** the threat that social media may pose to traditional mass media outlets in the future, in terms of the marketing and promotion of sport.
7 **Research** the Australian Government Department of Health's #girlsmakeyourmove campaign. **Evaluate** Federal Health Minister Greg Hunt's decision to stop paying social media influencers to promote the campaign.

5.4D Institutional rules, policies and procedures

institution
a general term used to describe any organisation (e.g. school, sporting club, company, government or other formalised group) founded for an educational, professional, religious, or social purpose.

Institutions are organisations that have been established to serve some kind of educational, religious, professional or social purpose. There are many different types of institutions in Australian society, ranging from small, more informal institutions (such as local clubs and teams) through to large, formal institutions (such as the parliament or the church).

Regardless of their size, all institutions have some kind of agreed set of rules, policies and procedures in place that help to define their purpose and principle, outline their goals, explain how they should be governed and run, and establish expectations about how their members should behave. For small, informal institutions, these rules, policies and procedures may consist of a very brief written statement or a set of agreed rules that aren't even documented. For larger, more formal institutions, rules, policies and procedures can consist of thousands of pages of guidelines, legal requirements, codes of conduct and formal contracts.

Institutions are important and often powerful organisations in sport. There are three main types of institutions that support and influence participation in sport and physical activity in Australia. These include:

- **sporting institutions** – such as local community sporting clubs, regional and state associations, and national/international federations and governing bodies
- **educational institutions** – such as primary and secondary schools, universities and technical colleges
- **religious institutions** – such as religious youth groups, societies and clubs.

SOURCE 15 Most young Australians have their first experiences of sport and physical activities through sporting institutions (e.g. clubs), educational institutions (e.g. schools) or religious institutions (e.g. youth sporting groups).

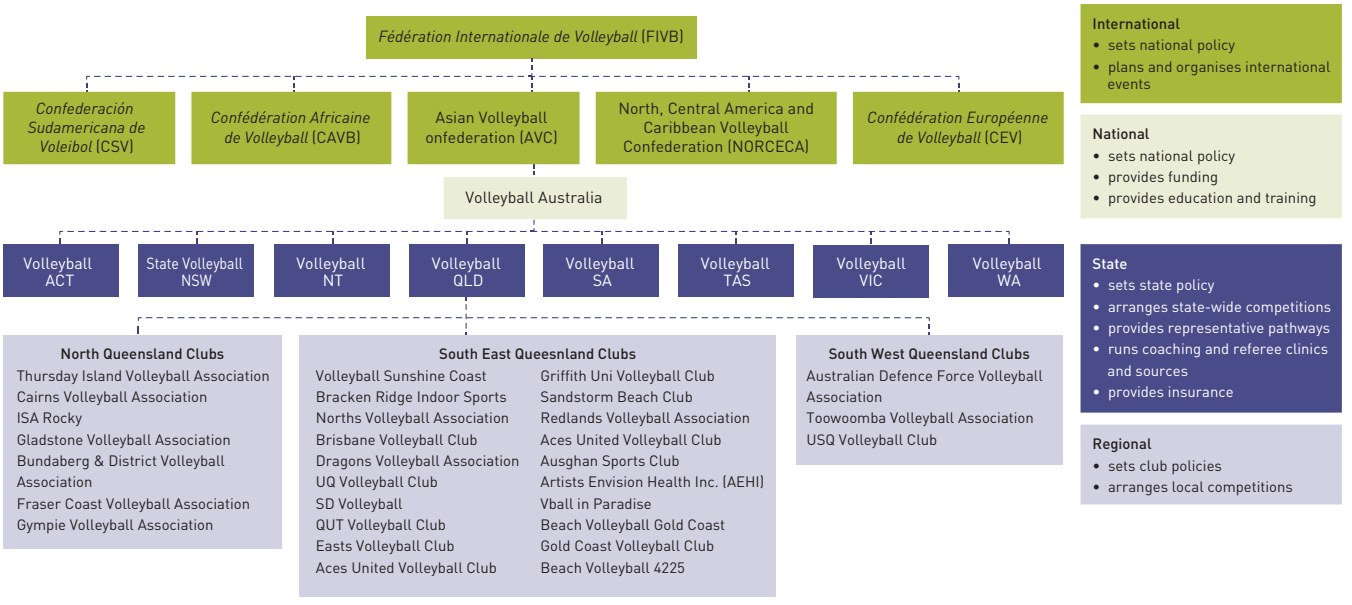
Together, these institutions are one of the key cultural factors affecting participation in sport and physical activity. They exist to ensure:

- sports are promoted and supported
- equipment and facilities are designed for player safety
- players behave appropriately (i.e. engage in sportsmanlike behaviour) and follow established rules
- breaches of established rules are dealt with fairly and consistently
- objective and fair results are achieved in competition.

Most young Australians have their first experiences of sport and physical activities through one or more of these institutions. As such it is important the experiences of these people be as positive and enjoyable as possible – as positive experiences may act as enablers and negative experiences may act as barriers.

Institutional rules, policies and procedures as barriers and enablers

Organised and competitive sports in Australia are run and controlled by national sporting institutions. These institutions work with all levels of government to represent the interests and needs of their members and help ensure that their sport remains popular and profitable. National sporting institutions are responsible for setting the public agenda and goals for their sport by providing vision statements and writing overarching policies for state, territory and local community sporting bodies to adhere to. As shown in Source 17, rules, policies and procedures for an international sport such as volleyball flow from an international governing body down to a national, state and regional level. This centralised approach to rules, policies and procedures ensures consistency, fairness and equity around the world. This is an enabler to participation.



SOURCE 16 Policy flows from the top down to enable safe and fair access for all.

Sporting bodies at all levels have the chance to design and implement equitable, progressive policies that foster social inclusion and enable all people to gain fair access to the benefits of physical activity. Some of the social issues currently guiding policy development include:

- inappropriate spectator/parental involvement from the sidelines
- bullying
- discrimination
- transparent representative selection processes
- age versus weight debate in contact sports
- inclusive participation for people with disabilities
- fair access for people of all genders and identities.

Policies that work to make the sport or physical activity more equitable are all enablers. However, some rules and policies can also have the opposite effect and act as barriers. Rules restricting access to certain people can deter them from participating. One rule that acts as a barrier to children's participation is cost. Policies that increase costs involved with participation (such as having to purchase compulsory uniforms or pay high membership

fees) act as a barrier to children from low income households. Certain institutions can also implement and enforce policies about wearing certain uniforms that make some athletes feel uncomfortable or go against their religious beliefs. These are also barriers.

An example of a sporting institution creating and enforcing a policy is discussed in the following news article.

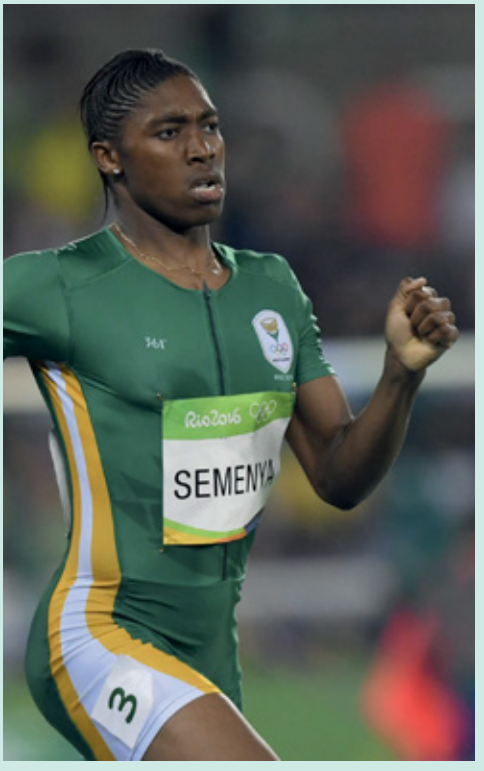
In the news

Caster Semenya: IAAF rules to limit testosterone levels for female runners

AP/REUTERS, ABC NEWS, 26 APRIL 2018

The International Association of Athletics Federations (IAAF) has published new rules for female athletes with high natural testosterone levels which could force two-time Olympic 800-metre champion Caster Semenya to stop running middle-distance races.

From November 1, the IAAF will limit entry for all international events from 400 metres through the mile [1500 metres] to women with testosterone levels below a specified level.



SOURCE 17 Some athletes think that Caster Semenya's high levels of naturally occurring testosterone give her an unfair advantage.

Women with elevated testosterone must reduce their level for 'six months (e.g. by use of hormonal contraceptives)' before being eligible to run, and maintain that lowered level.

IAAF president Sebastian Coe says track's governing body must 'ensure a level playing field where success is determined by talent, dedication and hard work rather than other contributing factors.'

'We want athletes to be incentivised to make the huge commitment and sacrifice required to excel in the sport, and to inspire new generations to join the sport and aspire to the same excellence,' he said.

Semenya now faces taking daily medication or start racing for South Africa at 5000 metres.

Semenya, double Olympic and triple world champion over 800 metres and who completed the 800–1500 double at the Commonwealth Games this month, responded to the new rules on Twitter, saying 'I am 97 per cent sure you don't like me but I'm 100 per cent sure I don't care.'

Athletics authorities have struggled to find a solution to the issue that respected the rights of Semenya while also providing what they say is a 'level playing field'.

Other athletes believe she has an unfair advantage because of the high levels of naturally occurring testosterone in her body. But, under the new rules Semenya will either have to take prescribed medication to compete at her event or move to longer-distance running.

Educational institution rules, policies and procedures also influence participation. Schools that have a successful sporting history often promote their achievements and gain a reputation for opening doors on behalf of students that attend them and play these sports. When this occurs, these celebrated sports thrive, and their participants can continue to access the benefits. But limited resources and funds can mean that the focus a school gives to one sport cannot be replicated for other sports. In this way, school procedures act as enablers for participation in certain sports and barriers to participation in others. A school with strong athletic traditions can also be a barrier for less athletic students who might hesitate to join in out of fear of not being good enough.

SOURCE 18 Schools can act as enablers to sport and physical activity by allocating funding to facilities and dedicating time to sport classes in the timetable.

Despite the wealth of benefits that physical activity provides, studies show that sport is being increasingly marginalised in schools. Fewer hours in the timetable are dedicated to sport and physical education and fewer expert teachers are being employed. This acts as a direct barrier to participation.

Religious institutions also follow procedures in the form of established traditions, some of which can impact on followers' access to physical activity. Many religions, including Christianity, Judaism and Islam, observe regular holy days and religious holidays. Strict followers of these faiths might not be able to participate in physical activity (e.g. training or competitions) on these days as they are expected to take part in traditions of their faith. Scheduling sports competitions on these days can be a direct barrier to participation. For example, Muslim people all over the world observe Ramadan each year – a period of 30 days when Muslims fast between dawn and dusk. The inability to drink makes Ramadan an especially stressful period for Muslims who participate in sport, especially when Ramadan occurs during the summer. Acknowledging religious beliefs and having flexible school and club attitudes can ensure children and adults of all faiths and cultures can have positive experiences in sport.

5.4D Check your learning

Engage and understand

1 **Define** what is meant by 'institution' and **explain** the purpose of rules, policies and procedures.

Analyse and apply

2 **Analyse** the sporting culture at your school and list the sports that receive the most funding and attention. Which sports, in comparison, are marginalised?

3 Read 'Caster Semenya: IAAF rules to limit testosterone levels for female runners'. The article states that 'Women with elevated testosterone must reduce their level for "six months (e.g. by use of hormonal contraceptives)" before being eligible to run, and maintain that lowered level.'

- **a** In one or two paragraphs, take a position on this rule change, **judging** how it may act as an enabler for some members of society and a barrier for others.
- **b** **Consider** if you think these rules make athletics more or less equitable.

Evaluate and justify

4 **Develop** a strategy to enable greater equity and access for students at your school who want to participate in expensive representative sports. Justify your recommendations.

Check your obook assess for these additional resources and more:

- » **Student book questions** 5.4 Check your learning
- » **Student worksheet** 5.4 Cultural factors that influence equity and access worksheet
- » **Weblink** Australia's changing demographics
- » **Weblink** Changing popularity of sports over time

5.5 Environmental factors that influence equity and access

That's a goal!

By the end of Section 5.5, you should be able to:

→ **identify** a number of environmental factors that act as barriers and enablers to equity and access

→ **explain** how the following **environmental factors** affect equity in sport and physical activity:

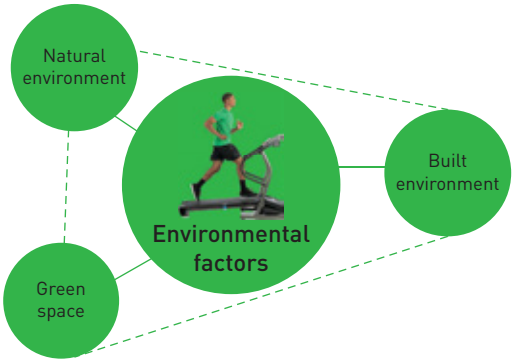
- built and natural environments
- green space.

environmental factors
a range of influences at an environmental level that can act as barriers or enablers to participation in sport and physical activities (e.g. our ability to access the natural and human-made spaces that exist in the world around us)

There are many **environmental factors** that act as barriers and enablers to participation in sport and physical activity. Environmental factors include a range of influences at an environmental level (e.g. the natural and human-made spaces that exist in the world around us and our ability to access these). Some of the most important environmental factors include:

- **built and natural environments** – the spaces that humans have built to provide the setting for physical activity (e.g. gyms, stadiums, playing fields, courts, etc.) versus those spaces that exist naturally (e.g. mountains, rivers, grasslands, oceans)
- **green space** – areas of grass, trees or other vegetation set apart for recreational purposes in environments that are otherwise urban (i.e. built).

In this section we will look at each of these factors in detail and examine how they act as barriers and enablers to sport and physical activities for different people. Although we will be learning about each factor separately, it's important to keep in mind that – in reality – these environmental factors are acting on us (i.e. affecting our decisions and behaviours) simultaneously. Not only that – we are also almost always influenced by a combination of other factors at the personal, social and cultural level at the same time. Source 4 on page 260 provides a visual representation of this complex interrelationship of factors.



SOURCE 1 A range of different environmental factors play a role in influencing a person's decision to participate in sport and physical activity.

SOURCE 2 The environment plays a significant role role in people's decision to participate in sport and physical activity.

5.5A Built and natural environments

built environments
spaces that humans have built to provide the setting for daily life (e.g. houses, office buildings) and physical activity (e.g. gyms, stadiums, playing fields, courts, etc.)

The environment is the surroundings or conditions in which we live our lives. For this reason, it is one of the most significant factors affecting participation in sport and physical activity. The environment is made up of two components:

- the **built environment** – a term used to describe any environment that has been significantly altered by humans (e.g. buildings, cities, parks, schools, etc.)
- the **natural environment** – a term used to describe any environment that has not been significantly altered by humans (e.g. deserts, mountains, coral reefs, forests, oceans, etc.).

SOURCE 3 The environment in which we live is one of the most significant factors affecting participation in sport and physical activity. It is made up of the built environment (e.g. towns, buildings and cities, such as Brisbane) and the natural environment (e.g. rivers, mountains, grasslands and forests, such as the Daintree Rainforest).

natural environments
A term that is used to describe any environment that has not been significantly altered by humans

Built and natural environments as a barrier and enabler

Built and natural environments play a significant role in people's decisions to participate in sport and physical activity. As shown in Source 2, depending on where people live, they will have very different opportunities to participate in sport and physical activity.

On a basic level, it's easy to understand how environments act as barriers and enablers. For example, living close to the beach makes water sports like surfing and swimming highly accessible and is therefore an enabler to these sports. Alternatively, living close to mountains makes participation in activities like mountain climbing, skiing and snowboarding much more accessible and is an enabler to those activities.

The situation becomes more complex when you consider built and natural environments. For example, a person living in central Brisbane has access to a wide range of opportunities to participate in organised sports and physical activities. There are world-class sporting facilities (such as training grounds, stadiums, gyms), coaches and trainers within close proximity, and many different sporting clubs and associations to join. All of these factors act as enablers to participation in a range of different sports. However, depending on people's individual circumstances, these facilities may not be accessible (e.g. due to a lack of time or money, or due to the large number of people trying to access limited facilities). Similarly, a person living in inner-city Brisbane may not have access

to large open spaces required for certain sports. This lack of space may act as a barrier to these activities.

On the other hand, a person living in a remote or rural area of Queensland (without a town or regional city close by) will not have access to any of the facilities available in Brisbane, may not be able to consult with coaches or trainers, and may not have access to any sporting clubs or associations. All of these factors act as barriers to participation. Despite these barriers to some sports, life in this more natural environment may act as an enabler to a range of other recreational sports and physical activities that require large open spaces or access to natural environments; for example, rock-climbing, kayaking, hiking, cross-country running, and so on.

According to the World Health Organization (WHO), 'The way we build our cities, design the urban environment and provide access to the natural environment can be a great encouragement or a great barrier to physical activity and active living.' Furthermore, WHO state that a positive correlation exists between spending time in nature and physical, social and emotional health status.

5.5A Check your learning

Engage and understand

1 **Define** the term 'environment' and provide three examples of the built environment and three examples of the natural environment.

Analyse and apply

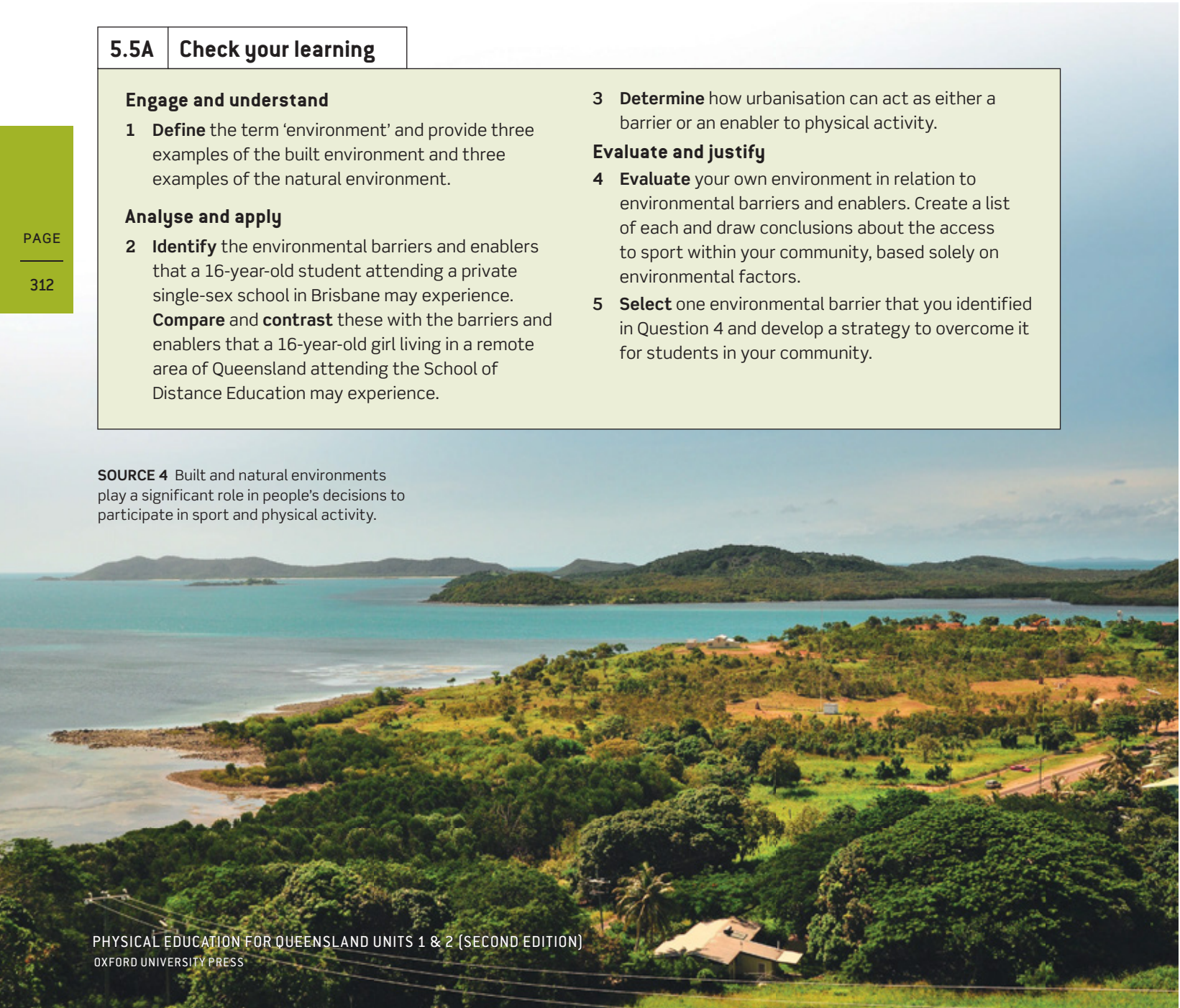
2 **Identify** the environmental barriers and enablers that a 16-year-old student attending a private single-sex school in Brisbane may experience. **Compare** and **contrast** these with the barriers and enablers that a 16-year-old girl living in a remote area of Queensland attending the School of Distance Education may experience.

3 **Determine** how urbanisation can act as either a barrier or an enabler to physical activity.

Evaluate and justify

4 **Evaluate** your own environment in relation to environmental barriers and enablers. Create a list of each and draw conclusions about the access to sport within your community, based solely on environmental factors.

5 **Select** one environmental barrier that you identified in Question 4 and develop a strategy to overcome it for students in your community.



SOURCE 4 Built and natural environments play a significant role in people's decisions to participate in sport and physical activity.

5.5B Green space

green space
a general term used to describe any area of grass, trees or other vegetation set aside for recreational purposes in environments that are otherwise urban (i.e. built)

Green space is a term used to describe any area of grass, trees or other vegetation set aside for recreational purposes in an otherwise built environment. In other words, green spaces are large areas in cities that are protected from development so that people can use them for a range of different sporting activities.

Although Australia has an abundance of natural environments, approximately 90% of all Australians live in cities (i.e. built environments). This directly influences people's ability to participate in certain activities over others. The availability of green space is an important environmental factor affecting participation in sport and physical activity for people who live in cities.

Green space as a barrier and enabler

Because certain sports rely on the availability of green spaces, local councils and state governments have a responsibility to ensure that these areas are set aside for public use in large towns and cities. They also need to ensure that these green spaces are evenly spread and well maintained in all areas of the city to make sure people in all suburbs have equitable access. Not having access to these areas is a direct barrier to participation in certain sports such as rugby, soccer and Australian football.

It is also the responsibility of workplaces and schools in built-up areas to find ways to compensate for a lack of green space with initiatives and incentives for physical activity. An example of one such incentive is the 10 000 Steps challenge. This initiative – organised by CQUniversity Australia since 2001 – is a free program that challenges employees to wear a pedometer and walk 10 000 steps each day. Initiatives like this can encourage people to increase their levels of physical activity by setting a daily goal and finding new ways to achieve it (such as taking the stairs rather than the lift, working at 'standing desk' stations rather than sitting, riding to work or walking the dog).

FOR THE RECORD!

New York's Central Park is one of the largest and most famous green spaces in the world.

A real estate appraisal conducted in 2018 estimated the land value of this 3.41 km^2 park at around US$600 billion, however many New Yorkers argue it is priceless!

One thing is clear, its removal would act as a serious barrier to sport and physical activity for people living in Manhattan.

5.5B Check your learning

Engage and understand

1 **Define** the term 'green space' and **explain** how it can act as a barrier and enabler to sport and physical activity for people living in urban areas.

2 Identify a green space in your local area and **evaluate** its effectiveness in terms of enabling citizens to access the benefits of physical activity.

Check your obook assess for the following additional resources and more:

» **Student book questions**
5.5 Check your learning

» **Student worksheet**
5.5 Environmental factors that influence equity and access worksheet

» **Weblink**
The importance of green space

5.6 Emerging megatrends in physical activity in Australia

That's a goal!

By the end of Section 5.6, you should be able to:

→ **identify** and **describe** a number of emerging megatrends in Australian relating to sport and physical activity

→ **explain** how these megatrends may act as barriers or enablers to engagement in physical activity (particularly in relation to personal, social, cultural and environmental factors)

Commonwealth Scientific and Industrial Research Organisation (CSIRO)
an independent scientific research agency funded by the Australian federal government and responsible for improving economic and social industry

megatrend
a large-scale social, economic, political, environmental or technological change that takes place over an extended period of time

Sport is an important part of Australia's national identity. While not everyone may actually participate in regular physical activity, many Australians are involved with sporting clubs, support friends and family members who are involved in sport, and enjoy watching competitive and recreational sport (either in person or in the media). In short, many Australians are passionate about sport!

As you have discovered in this chapter, the kinds of sports and physical activities that people engage in – and the ways in which they do so are not static. Instead, they are constantly changing over time. If governments, sporting organisations, community groups and other members of the sports industry are to make informed strategic decisions and plan well for the future, they need reliable information about the role that sport and physical activity plays in the lives of contemporary Australians.

Emerging Australian megatrends

In 2013, recognising the value and importance of this kind of data, Sport Australia authorised the **Commonwealth Scientific and Industrial Research Organisation (CSIRO)** to research and prepare a report for the on the social, economic and environmental changes likely to affect the Australian sports sector over the next 30 years.

SOURCE 1 In 2013, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) prepared a report for Sport Australia on the social, economic and environmental changes likely to affect the Australian sports sector over the next 30 years.

Based on the primary and secondary data collected, the CSIRO identified six potential changes likely to impact on Australian sport over the next three decades. Because of the large scale on which they are taking place, the CSIRO called these changes **megatrends**. Each of the megatrends identified relates to an important pattern of social, economic or environmental change. Each one also has significant implications for future investment and policy development at all levels of government.

Four of these megatrends are relevant to the topics covered in this chapter as they relate to equitable access to sport and physical activity. These include:

- **MEGATREND 1 – A perfect fit**
  Personalised sport for health and fitness

- **MEGATREND 2 – From extreme to mainstream**
  The rise of lifestyle sports
- **MEGATREND 3 – Everybody's game**
  Demographic, generational and cultural change
- **MEGATREND 4 – More than sport**
  The attainment of health and community objectives via physical activity

It is important to note that these megatrends are interconnected. This means that the forces shaping one may also be shaping others and the causes of one may be the consequences of another. We will now explore each megatrend separately in more detail.

SOURCE 2 Megatrends in Australia

MEGATREND 1 – A perfect fit

Personalised sport for health and fitness

This megatrend reflects the finding that Australians are increasingly opting to participate in physical activities that are 'a perfect fit' for their lives. These 'perfect fit' activities are most frequently non-organised, non-team and non-competitive sports and physical activities such as walking, running, cycling and fitness classes. The appeal of these activities is that they require lower levels of commitment from participants and that they are more flexibly scheduled. An interesting exception to this trend is outdoor soccer, which continues to be a popular leisure time activity in Australia.

In response to the growing popularity of individual physical activities, the Australian fitness industry has boomed over the past decade – more gyms have opened, particularly 24-hour access gyms; sales of fitness equipment, activity tracking technologies and athletic wear have risen; and demand for personal trainers has grown. These factors both reflect and fuel people's demand for personalised health and fitness options.

MEGATREND 2 – From extreme to mainstream

The rise of lifestyle sports

This megatrend describes the rise of lifestyle, adventure and alternative sports, as activities once considered 'extreme' enter the cultural mainstream, for example, skateboarding, kite surfing and rock climbing. New endurance sports events and communities like Tough Mudder, The Stampede and CrossFit are also gaining popularity.

The shift of these kinds of activities from extreme to mainstream is a product of the rise of alternative sports cultures since the 1960s and 1970s, as well as the growing popularity of these activities among younger generations of Australians. This shift has also been influenced and reinforced by factors like the emergence of the X Games, the expansion of digital media outlets seeking to attract young viewers (many of whom are more interested in lifestyle sports than traditional sports) and the inclusion of formerly alternative sports into mainstream competitions like the Olympic Games.

SOURCE 3 Lifestyle, adventure and alternative physical activities like 'Tough Mudder' are on the rise. The impact that this will have on traditionally popular sports remains to be seen.

MEGATREND 3 – Everybody's game

Demographic, generational and cultural change

This megatrend describes important changes in the demographics of the Australian population. As discussed earlier in this chapter, Australians are now living longer, with a growing number of the population 65 or older. The Australian population is also becoming more culturally diverse as immigration patterns change and a greater proportion of Australia's migrants come from Asian countries. This pattern contrasts with migration trends of the 1950s when a greater proportion of this country's migrants hailed from Europe.

These changes have an impact because people of different ages and cultures have different preferences and habits relating to physical activity. Getting an increasingly diverse Australian population interested in physical activity will therefore involve providing a more diverse range of physical activity options.

MEGATREND 4 – More than sport

The attainment of health and community objectives via physical activity

This megatrend reflects the increasing use of sport by governments and non-government agencies worldwide to achieve their policy objectives. For example, these organisations use sport and physical activity initiatives to try to improve mental and physical health outcomes, prevent crime, foster cooperation between countries, promote international peace and prosperity, and generate social and economic improvement in poor and marginalised communities.

STUDY TIP

Each one of the Skill Drills within this chapter has been designed to enhance your understanding of personal, social and cultural factors that act as barriers and enablers to participation in sport and physical activity.

Remember to reflect on these experiences when planning for your final assessment task.

How megatrends affect engagement in physical activity

Note that none of the megatrends identified by the CSIRO are inherently good or bad. Whether or not they act as barriers or enablers to a person's participation in sport and physical activity depends on the individual characteristics of each person and their situation. The relationships between the megatrends and the factors that affect people's access to sport and physical activity are complex and multi-directional.

Each of the megatrends is a response to changing personal, social, cultural and environmental factors in Australia. For example, personalised sport for health and fitness is a response to factors like changes in the demands on people's time, the goals they are motivated by and the increasing commodification of health and wellbeing.

However, each of the megatrends also 'feeds forward' to influence personal, social, cultural and environmental factors. That is to say, the megatrends will produce changed circumstances in the future regarding these four factors.

Overall, the CSIRO's report on the megatrends shaping Australian sport argues that the kinds of physical activity in which Australians participate is changing significantly. It also argues that the how and why Australians are participating in these physical activities is changing in quite profound ways. The key message regarding these changes is that a 'business as usual' approach will not ensure equitable access to meaningful and developmentally appropriate physical activity for all Australians. Rapid responses and adaptations are required.

In general, the causes and consequences of these megatrends represent a major challenge to the status quo (i.e. current state of things) of sport in Australia. They are also a challenge to those people and groups whose access to sport and physical activity is benefited by this status quo. As we have shown throughout this chapter, access to the many benefits associated with participating in sport and physical activity are far from equitable in contemporary Australia. To achieve equitable access for all, we must reflect on for whom the megatrends (and our collective responses to them) act as enablers and for whom they act as barriers.

STUDY TIP

Interviews are a valid method for collecting primary data. Interview members of your school community to determine the impact that these megatrends are having.

Wording your questions in an objective (factual) manner will allow for an easier comparison of responses. For instance, instead of asking an open question like 'How have the megatrends had an impact on your engagement with physical activity?', you could devise closed questions, like:

'Are technological devices or apps an integral part of your fitness routine?' 'If you answered yes, do you use these apps always/sometimes/rarely?' and so on.

5.6 Check your learning

Engage and understand

1 **Identify** four factors that reflect and fuel the personalised sport for health and fitness megatrend.

2 The dimensions of learning about, through and in movement inform learning and teaching in Physical Education. **Identify** which of these dimensions is reflected in the attainment of health and community objectives via physical activity mega trend and explain how it does so.

3 'The types of physical activities that people engage in – and the way in which they do so – are not static; they change over time.' **Identify** the types of changes this statement may be referring to and sort them into what you perceive to be *enabling changes (enablers)* and *limiting changes (barriers)*.

Analyse and apply

4 **Determine** the relationship between the megatrends and the personal, social and environmental factors affecting physical activity and display your findings using a diagram. Include one example of each megatrend and factor to show the relationships.

Evaluate and justify

5 Locate demographic data on the generational and cultural make-up of your local community. Using these data as a reference point, **judge** the appropriateness of the physical activity services and facilities available in your community. Propose and **justify** two ways that these services and facilities could be better tailored to the needs and interests of your community.

Check your obook assess for the following additional resources and more:

- **Student book questions**
  5.6 Check your learning
- **Video weblink**
  CSIRO: The future of Australian sport
- **Weblink**
  CSIRO: The future of Australian sport report

CHAPTER 5 REVIEW

Sum it up!

5.1 **Equity** is a concept that relates to fairness and justice in the way all people are treated; equity means striving for fairness and justice by treating people differently (based on their individual needs and personal differences).

Access is the opportunity a person is given to participate. **Barriers** are factors that decrease access to sport and physical activity (e.g. poor health, high cost of equipment, lack of motivation). **Enablers** are factors that increase access to sport and physical activity (e.g. closeness to sporting facilities, encouragement from parents and teachers, having friends on the team)

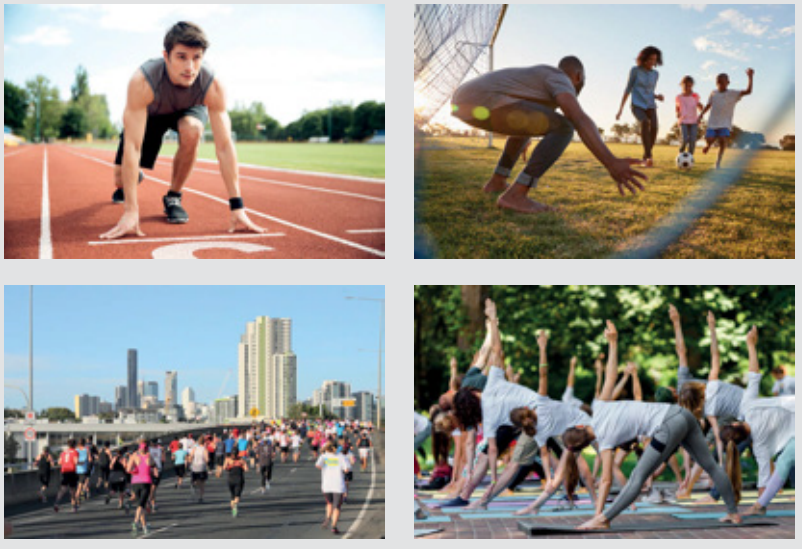
5.2 **Personal** factors are a range of influences at an individual level (e.g. a person's likes and dislikes, their personality type, their thoughts, feelings and past experiences) that act as both barriers and enables to **physical** activity. Personal factors that act as barriers and enablers include **motivation**, **confidence**, **personality traits**, **personal ability**, **genetic disposition**, **gender**, and **previous experiences of physical activity**.

5.3 **Social factors** are a range of influences at a social level (e.g. our relationships with our friends, family, community and broader society). Social factors that act as barriers and enablers include **agents of socialisation**, the **social construction of gender**, **diversity**, and physical **activity preferences**.

5.4 **Cultural factors** are a range of influences at a cultural level (e.g. influences nationally and internationally such as population changes, the role of institutions such as the government, the church and the mass media). Cultural factors that act as barriers and enablers include **demographic**, **generational and cultural change**, **government funding**, **mass media promotion and marketing of physical activity**, **and institutional rules**, **policies and procedures**.

5.5 **Environmental factors** are a range of influences at an environmental level (e.g. the natural and human-made spaces that exist in the world around us and our ability to access these). Environmental factors that act as barriers and enablers include **built** and **natural environments**, and **green space**.

5.6 Four **megatrends** are predicted to shape the future of physical activity in Australia over the coming decades. They include **personalised sport for health and fitness**, **the rise of lifestyle sports**, **demographic**, **generational and cultural change**, and the **attainment of health and community objectives** via physical activity.



SOURCE 1 A range of personal, social, cultural and environmental factors influence participation in sport.

Dig deeper!

Exam-style revision questions and tasks

SECTION A

→ Ten multiple-choice questions

QUESTION 1

Equity can be defined as

(A) treating people the same regardless of their individual needs and personal differences.

(B) treating people differently based on their individual needs and personal differences.

(C) the distribution of equal resources to all.

(D) the distribution of monetary resources only.

QUESTION 2

Giving every member on a softball team the same size and brand of glove is an example of

(A) social giving.

(B) equity.

(C) diversity.

(D) equality.

QUESTION 3

A person's genetic disposition is one example of _____ that can affect equity and access.

(A) environmental factors

(B) cultural factors

(C) social factors

(D) personal factors

QUESTION 4

Social factors that can act as barriers and enablers to participation in sport and physical activity include

(A) diversity, physical activity preferences, generational change, parents and siblings.

(B) diversity, physical activity preferences, parents and teachers.

(C) diversity, genetic disposition, parents and coaches.

(D) diversity, government funding, parents and friends.

QUESTION 5

The opening of a state-of-the-art sporting facility within walking distance of your house is an example of _____.

(A) an environmental enabler

(B) a personal enabler

(C) a social enabler

(D) a personal barrier

QUESTION 6

According to the CSIRO, one of the megatrends predicted to affect the future physical activity choices of Australians is

(A) the increasing cost of living.

(B) the prominence of social media.

(C) the rise of lifestyle sports.

(D) a reduction in government funding in personalised sport.

QUESTION 7

Which of the following *is* ***not*** considered an agent of socialisation?

(A) Peers

(B) Parents

(C) Facilities

(D) Coaches

QUESTION 8

Demographic change is a term used to describe

(A) changes in the size, age, composition and structure of a population.

(B) influences at a cultural level that can act as barriers or enablers to participation in sport.

(C) the changing levels of cultural diversity that take place within a population over time.

(D) changes in tastes, influences and preferences that take place within a population over time.

QUESTION 9

The belief that a person's abilities can be developed through hard work is an example of

(A) intrinsic belief.

(B) a growth mindset.

(C) fixed mindset.

(D) amotivation.

QUESTION 10

Agenda-setting theory argues that

(A) government policies influence the types of physical activities that receive the most funding.

(B) the rules of sporting organisations enable equitable participation.

(C) institutional rules and regulations improve access to opportunities.

(D) the choice of issues covered in the media affect public perception of reality.

SECTION B

→ Two short-response questions
→ One extended written response question

QUESTION 11 (150 words)

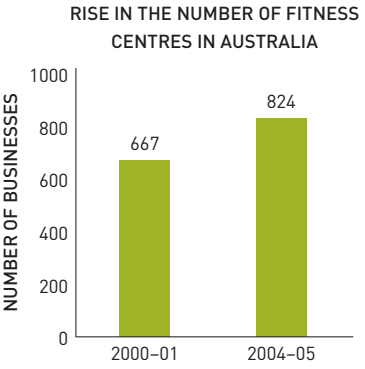
Compare and contrast a new migrant's ability to access the benefits of physical activity with the ability of someone who has lived in the same community their whole life. In your response provide specific examples to a number of different barriers and enablers to participations.

QUESTION 12 (150 words)

The graph to the right shows estimates of the numbers of gyms and fitness centres in Australia from 2004 to 2015. Describe the factors that are driving this change over time and identify the megatrend that best accounts for this.

QUESTION 13 (400 words)

Identify a sport or physical activity that you have never participated in and have no interest in. Reflect on why you feel this way about the sport or physical activity and describe three barriers to participation. Identify each barrier as either personal, social, cultural or environmental. Justify your position on each barrier.



Source: *IBISWorld Industry Report R9111, Gyms and Fitness Centres in Australia, January 2014*

Practice assessment task

Subject	Physical Education	**Instrument number**	
Technique	Investigation – report		
Unit	2 Sport psychology, equity and physical activity		
Topic	2 Equity – barriers and enablers		

Conditions			
Duration	5 hours in class		
Mode	Report	**Length**	1500–2000 words
Individual / Group	Individual	**Other**	→ The reference list, title page and table of contents are not included in the word count. → Schools implement authentication strategies that reflect QCAA guidelines for ensuring student authorship.

Context

In this unit, you have engaged in integrated learning experiences relating to equity, identifying a range of barriers and enablers that impact on physical activity. Equity strategies to optimise engagement in physical activity were developed, used as learning experiences, and analysed to determine their effectiveness on physical engagement and performance. Within various class groups, you have developed and participated in many games where personal, social and cultural factors were manipulated to increase equitable opportunities and optimise physical engagement in activities.

Task

Evaluate the use of equity strategies in optimising your engagement and performance in physical activity this term. Justify the implementation of one equity strategy to increase physical engagement and performance at your school.

To complete this task, you must present a response in a report format that includes the following assessable evidence:

Introduction

→ Briefly explain how barriers and enablers affect equity in physical activity.

→ Identify the school context to frame the investigation.

Discussion

→ Identify equity strategy #1 for optimising your participation.

→ Analyse and synthesise primary data and secondary data to justify the effectiveness of the equity strategy based on the influence of:

  → personal factors (activities that account for personal preference, attitudes, beliefs and values)

  → social factors (grouping and team selections, manipulation of rules and environment)

  → cultural factors (school context: marketing, promotion, policies, rules and community values).

→ Identify equity strategy #2 for optimising your engagement.

→ Analyse and synthesise primary data and secondary data to justify the effectiveness of the equity strategy based on the influence of:

  → personal factors (activities that account for personal preference, attitudes, beliefs and values)

  → social factors (grouping and team selections, manipulation of rules and environment)

  → cultural factors (school context: marketing, promotion, policies, rules and community values)

→ Devise, modify or maintain an equity strategy to increase engagement and performance in physical activity at your school.

  → Justify the selection of the equity strategy using evidence from primary data and secondary data.

Conclusion

→ Summarise the impact that equity strategies can have on engagement and performance in physical activity.

→ Identify which factors had the greatest influence on your decision.

Reference list

→ Acknowledge all sources cited in the investigation.

You can find a detailed instrument-specific marking guide (ISMG) for this task on your obook assess.

Check your obook assess for the following additional resources and more:

» **assess quiz**
Test your skills with this auto-correcting multiple-choice quiz for Chapter 5

» **Revision notes**
Make your own revision notes for assessment tasks with this handy template

» **Data analysis worksheet**
Chapter 5 review – Practice your data analysis skills with this worksheet

» **Practice assessment task ISMG**
Instrument-specific marking guide for the practice assessment task in Chapter 5

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CHAPTER 6

SKILL DRILLS

SKILL DRILLS

This chapter contains a range of practical activities – known as Skill Drills – designed to support and extend your understanding of theoretical components detailed in Units 1 & 2 of the QCAA Physical Education General Senior Syllabus 2019. The activities in this chapter are cross-referenced to the corresponding section in the book. There are two types of Skill Drills in this chapter:

RESEARCH	These Skill Drills have a **research focus**. They require students to learn and practise a variety of research techniques relevant to the content of the syllabus.
PERFORMANCE	These Skill Drills have a **performance focus**. They require students to participate in a variety of physical activities, collect and record data, and analyse it to develop and consolidate their understanding of theory covered in the syllabus.

>> from page 11

RESEARCH

SKILL DRILL **1.2A**

Planning, creating and presenting a Project – folio

In this Skill Drill you will practise:

- capturing and analysing video footage of a physical performance
- recording personal observations and reflections of a physical performance
- delivering an audio visual presentation
- communicating your findings to an audience.

Refer to your obook assess to complete this integrated research activity.

>> from page 13

RESEARCH

SKILL DRILL **1.2B**

Creating and presenting an Investigation – report

In this Skill Drill you will practise:

- using the internet to find relevant, credible and reliable sources
- comparing, selecting and using information from a range of sources
- collecting, recording and analysing relevant data
- structuring and presenting a written point of view
- referencing and crediting sources.

Refer to your obook assess to complete this integrated research activity.

>> from page 16

RESEARCH

SKILL DRILL **1.2C**

Strategies for improving your results on the Examination – combination response

In this Skill Drill you will practise:

- applying strategies for success under examination conditions
- responding to multiple-choice questions
- structuring short-response questions
- structuring extended written response questions.

Refer to your obook assess to complete this integrated research activity.

>> from page 23

RESEARCH

SKILL DRILL **1.3A**

Capturing and analysing video footage of physical performances

In this Skill Drill you will practise:

- capturing and analysing video footage of a specialised movement sequence or physical performance
- recording observations and using a range of tools to analyse a specialised movement sequence or physical performance

Refer to your obook assess to complete this integrated research activity.

>> from page 25

RESEARCH

SKILL DRILL
1.3B

Conducting a survey and presenting the results

In this Skill Drill you will practise:

- designing and structuring a print or online survey that is reliable and valid
- using a range of graphs and infographics to communicate the survey data you have collected.

Refer to your obook assess to complete this integrated research activity.

>> from page 26

RESEARCH

SKILL DRILL
1.3C

Using the internet to find relevant, credible and reliable sources

In this Skill Drill you will practise:

- identifying and locating relevant sources using ICT
- using the Internet to find relevant, credible and reliable sources
- evaluating the reliability of a range of different websites.

Refer to your obook assess to complete this integrated research activity.

>> from page 61

PERFORMANCE

SKILL DRILL 2.4

Assess the impact of rate limiters on performance

Aim

To assess the impact of rate limiters on your physical performance

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **implement** specialised movement sequences and movement strategies to gather primary data about the outcomes, implications and limitations of decisions
- **analyse** the influence of rate limiters on your performance in an authentic performance environment using primary data
- **develop** a motor learning strategy that considers rate limiters to optimise your performance.

Equipment

- Data Collection Instrument 1 (DCI 1), also available on your obook assess
- Pen
- Game Performance Assessment Instrument 1 (GPAI 1), also available on your obook assess

Method

STEP 1

Identify three specialised movement sequences that are commonly performed in your selected physical activity (e.g. returning a serve in volleyball or delivering a leg spin bowl in cricket). Record these in the left-hand column of DCI 1.

STEP 2

Take a moment to consider your physical characteristics and how they can work as rate limiters to your selected movement sequences. What impact do you think your height has on your ability to perform the sequence? What about your confidence?

DCI 1 identifies seven individual characteristics that can act as constraints for learning motor skills. A constraint can either:

- cause an adjustment to your skill development/technique
- restrict your performance of the skill (i.e. act as a rate limiter).

Determine the impact these characteristics have on your ability to perform your specialised movement sequences. Your assessment will be based on whether the individual characteristic:

- is a constraint causes an adjustment to your technique/skill development (+)
- is a constraint that restricts your performance (–)
- makes no difference to performing the skill (0).

Specialised movement sequence	Height	Power	Technique	Flexibility	Agility	Confidence	Tactical knowledge
1							
2							
3							

DCI 1

STEP 3

Participate in a game or performance of your selected physical activity for 20 minutes.

STEP 4

Analyse your performance of the three selected specialised movement sequences using the GPAI 1. Place a tick to indicate if your performance was excellent (controlled and accurate), good (has sufficient control), ok (more good than bad) or poor (requires considerable improvement).

Specialised movement sequence	Skill analysis (after performance)			
	Excellent	Good	Ok	Poor
1				
2				
3				

GPAI 1

Analysis and discussion tasks

1 Collecting primary data about your performance will give you insight into your strengths and weaknesses. This will allow you to make strategies to optimise your performance.

- **a** **Analyse** the data in GPAI 1 and **identify** which specialised movement sequence was (i) your strongest and (ii) your weakest.
- **b** **Explain** possible reasons for your strengths and weaknesses, making reference to the rate limiter assessment you conducted using DCI 1.

2 Rate limiters impact the learning potential of your specialised movement sequence. A consideration of how rate limiters have impacted your performance can help you to tailor a strategy to suit your personalised needs in your selected physical activity.

- **a** **Describe** how one rate limiter had a negative impact on your performance of one of the three selected specialised movement sequences.
- **b** **Devise** a strategy that you could implement in an authentic environment to overcome this rate limiter. For example, if height was a rate limiter for executing an effective spike in volleyball, you could (i) set the ball deep into the court instead of spiking it (ii) develop your digging skills to become the team libero (iii) hit a spike away from the net and use a topspin to hit with some pace and land inside the court.

SOURCE 1 Rate limiters impact the learning potential of your specialised movement sequence.

3 Any data you analyse (primary or secondary) will have various degrees of validity and reliability. Revisit the toolkit (page 21) to recap your understanding of validity and reliability.

- **a** **Evaluate** the reliability and validity of the data you collected in this Skill Drill.
- **b** **Propose** at least two recommendations to increase the reliability of this experiment.

>> from page 65

PERFORMANCE

SKILL DRILL 2.5

Investigate the impact of types of practice on performance

Aim

To investigate the impact of types of practice on personal performance

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **develop** a motor learning strategy that considers the type of practice suitable to the requirements of your physical activity
- **evaluate** the effectiveness of the motor learning and movement strategies to achieve a determined outcome, including meeting your individual learning requirements using primary data.

Equipment

- 20+ AFL footballs or similar
- a set of markers (or goal uprights)
- Tape measure
- Data Collection Instrument 2 (DCI 2), also available on your obook assess
- Pen

Method

STEP 1

Your teacher will divide the class into three groups (A, B and C).

In your group, work in pairs. Position yourself 30 metres from your partner with a set of markers placed halfway between you and three metres apart, simulating a pair of goal uprights.

STEP 2

Take turns punt kicking the ball back and forth between you using your non-dominant foot. Aim to kick the ball through markers.

Each time the ball goes through the markers, you score a point.

STEP 3

Record your results in the Condition 1: pre-practice column on the DCI 2.

You should only fill out the row indicating your personal result and the result of the group you are in.

Hint: To workout the average, divide the total group score by the number of people in your group.

	Condition 1: Pre-practice	Condition 2: Post-practice	Difference post-practice (e.g. + 2, – 5)
My personal result	/20 =	/20 =	
Group A average	/20 =	/20 =	
Group B average	/20 =	/20 =	
Group C average	/20 =	/20 =	
Class average	/20 =	/20 =	

DCI 2

STEP 4

Each group now practises punt kicking with their non-dominant leg, using three different types of practices.

Group A uses massed practice, repetitively kicking through the markers in unchanging conditions, for 10 minutes.

Group B uses distributed practice, kicking through the markers for two minutes followed by hand ball passes for two minutes, and repeat for 10 minutes total.

Group C practice in a modified game situation (e.g. three on three on a reduced field) for 10 minutes.

STEP 5

Re-assess your punt kick performance by lining up for 20 kicks. Make sure that the conditions are as close as possible to what they were during step 1.

Record your personal results and the average result of your group in the Condition 2: post-practice column of DCI 2. Analyse the difference between rounds and record it in the final column of DCI 2.

Compare the results of your group with the class. Record the class average in DCI 2.

Analysis and discussion tasks

1 In order to find meaningful information from the primary data you have collected, it is important to **consider** the relevant motor learning concepts that underpinned this task. **Describe** the task's characteristic (e.g. was it discrete or continuous? open or closed? fine or gross?).

2 Analysing class result will allow you to identify links between stages of learning and types of practice.

- **a** Prior to this Skill Drill, at what stage of learning – cognitive, associative, autonomous – would you place your class in the skill of non-dominant foot punt kicking. **Justify** your answer with reference to the characteristics of each stage of learning.
- **b** **Consider** your personal results. Did you experience an improvement in your performance following your practice session? If so, did you increase your goal count?
- **c** **Compare** your results with the group you were in. Are your results consistent with the group average, or is there a significant difference? Refer to specific data from the table to enhance your response. Explain any factors that could have contributed to a difference in results between yourself and your group.
- **d** **Reflect on** the overall results of the class, and **determine** which group saw the greatest improvement in performance during the post-practice kicking. What type of practice did that group participate in?
- **e** Based solely on the data you have collected in this Skill Drill, make a recommendation for the best type of practice for someone in the same stage of learning as your class.

3 Draw links between your conclusions about types of practice and your performance in your selected physical activity. Use these links to devise a personalised motor learning strategy.

- **a** Write down one specialised movement sequence from your current physical activity. *Hint*: Select a specialised movement where your current stage of learning is similar to the stage you were at in the Skill Drill.
- **b** **Devise** a personalised motor learning strategy to refine your performance of the specialised movement sequence. Your motor learning strategy should detail the best type of practice for this type of skill and for someone at your stage of learning. **Justify** your response using the theories of practice and stages of learning, combined with your analysis of the primary data collected in this Skill Drill.

  How would you modify your strategy to reflect a dynamic systems approach to refining your specialised movement sequence?

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PERFORMANCE

SKILL DRILL 2.6

Evaluate the impact of different types of feedback on performance

Aim

To evaluate the effectiveness of extrinsic feedback on improving performance

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **analyse** the influence of different types of feedback on performance using primary data
- **compare** the effectiveness of knowledge of results (KR) feedback and knowledge of performance (KP) feedback.

Equipment

- Blindfolds
- Tennis balls
- Four bullseye targets with different scoring sections
  Hint: Use tape or chalk to draw circles straight onto a wall or use a large sheet of butcher's paper.
- Game Performance Assessment Instrument 2 (GPAI 2), also available on your obook assess
- Notebook
- Calculator
- Pen

Method

STEP 1

In pairs, take turns being blindfolded and throwing a tennis ball at a target from five metres. Each student gets ten throws.

This is the control condition, so no feedback will be given. Your partner records your score in the Condition 1 column of GPAI 2 but does not reveal it to you.

STEP 2

Come together as a class to determine your class average and record the results in your the Condition 1: class average column of GPAI 2.

STEP 3

Your teacher will separate the pairs into three groups – Group A, Group B and Group C. Your conditions will change depending on which group you are in. Repeat the exercise with the following differences between the groups:

SOURCE 2 Feedback is given to help improve a personal skills and confidence.

Group A is blindfolded and given knowledge of results (KR) feedback. This means that partner can tell them the score they receive for each throw but are not permitted to reveal anything else.

Group B is blindfolded and given knowledge of performance (KP) feedback. This means that partners can provide feedback on the direction of their throw (e.g. higher, lower, left or right) but are not permitted to reveal their score.

Group C is blindfolded and given both knowledge of results and knowledge of performance (score and direction).

Record results in the Condition 2: personal space column of GPAI 2.

STEP 4

Come together as a group to determine your group average and record the results in your the Condition 2: group average column of GPAI 2.

Ball	Condition 1: Control score	Condition 1: Class average	Condition 2: Group _____	Condition 2: Group average
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
TOTAL:				

GPAI 2

Analysis and discussion tasks

1 Graphs can help to create a visual representation of your data which can allow you to detect any trends.
   - **a** Create a line graph that shows your group's combined average across performance over the course of the exercise.
     Hint: one axis of your graph should indicate points and the other axis should show the different balls.
   - **b** Consider your graph. Can you spot any trends? Did accuracy improve over time?

2 Analysing the average of your entire class, rather than just your group, will help you increase the validity of your data.
   - **a** Using the data that you collected from the two other groups in the class, plot and label an additional two lines on your line graph.
   - **b** **Consider** each line in relation to the different conditions. What do you notice about the shape of the lines? Does any shape on the graph indicate improvement?

3 Detecting a trend in a graph is a good first step to start drawing conclusions about the concept that you are investigating. In order to evaluate the impact of different types of feedback on performance, consider the following:
   - **a** Which group had the greatest rate of improvement?
   - **b** Would you predict this result based on your understanding of KR and KP feedback? If not, what could account for the difference you discovered?
   - **c** **Justify** the use of KR and KP feedback in improving your own performance using primary data (from this Skill Drill) and secondary data (from the textbook) to support your response. This is known as synthesising primary and secondary data.

4 **Identify** the type of feedback you find most useful for your selected physical activity. **Justify** your answer using the primary data you collected in this Skill Drill.

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PERFORMANCE

SKILL DRILL 2.7

Investigate how body and movement concepts can be used to assess and improve performance

Aim

To investigate the impact of body movement concepts on performance

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **implement** specialised movement sequences and movement strategies to gather primary data about the quality of movement for a selected skill
- **analyse** the outcome of your strategy
- **identify** the limitations of the data you have collected
- **evaluate** the effectiveness of rating your skill against various movement concepts.

Equipment

- Equipment specific to your selected physical activity
- Pen
- Game Performance Assessment Instrument 3 (GPAI 3), also available on your obook assess

Method

STEP 1

Select three specialised movement sequences from your selected physical activity for which you would like to assess your skill level (e.g. serving in tennis or passing the ball in touch football). Record them in the left hand column of GPAI 3 (i.e. Skill 1, Skill 2 and Skill 3).

STEP 2

Perform your three specialised movement sequences in a **closed** environment. Your teacher will specify whether the skill should be performed for a set time or a set number of repetitions (e.g. serve for two minutes or perform 20 consecutive passes with a partner).

STEP 3

After each skill performance, assess your success using the criteria on GPAI 3.

SOURCE 3 A specialised movement sequence is a combination of foundational movement skills (and movement elements) that enable the body to move in response to a stimulus. A serve is an example of a specialised movement sequence.

Body and movement concepts																
	Quality of movement (accuracy, continuity and outcome of movement, effect, efficiency, effort, flow, force development, sequence, time and speed)				Body awareness (balance, flight, stability, transfer of weight and weight bearing)				Space awareness (direction, levels and planes of movement, pathways of movement, using general space and using personal space)				Relationships (interaction with opponents, interaction with other players, interaction with implements and objects)			
	Excellent	Good	Okay	Poor	Excellent	Good	Okay	Poor	Excellent	Good	Okay	Poor	Excellent	Good	Okay	Poor
Skill 1: _____																
Skill 2: _____																
Skill 3: _____																

GPAI 3

Analysis and discussion tasks

1 In Physical Education you will often be asked to grade and evaluate your performance using different criteria, like the ones in GPAI 3.

- **a** **Consider** the overall effectiveness of GPAI 3 as a tool to assess your skill levels for your three selected skills. Did the four body and movement concepts help you determine your skill level?
- **b** Quality of movement refers to how the body moves. Which sub-criteria was most relevant to your quality of movement evaluation? Explain.
- **c** Body awareness refers to what movements the body can perform. Which sub-criteria was most relevant to your body awareness evaluation? Explain.
- **d** Space awareness refers to awareness of where the body can move. Which sub-criteria was most relevant to your space awareness evaluation? Explain.
- **e** Relationships refers to connections with objects. Which sub-criteria was most relevant to your relationships evaluation? Explain.

2 Reflecting on the primary data collected in this Skill Drill, and specifically, the sub-criteria you identified as most relevant to your specialised movement sequences, you can now **analyse** your performance.

- **a** Referring to the four body and movement concepts, **explain** which of the three specialised movement sequences was:
  - **i** your strongest
  - **ii** your weakest.

3 Evaluating your performance can provide you with data to inform the development of movement strategies. These strategies can act as possible solutions to any movement problems that you experienced in your performance.

- **a** Making explicit reference to GPAI 3, **devise** a personal movement strategy to optimise your performance of one specialised movement sequence in your selected physical activity.
- **b** Justify your strategy using the primary data that you collected in this Skill Drill and at least two secondary sources.

>> from page 101

PERFORMANCE

SKILL DRILL 3.3

Evaluate the impact of joint movement on optimal physical performance

Aim

To identify the anatomical structures and correct movements involved in a bicep curl to determine the impact of incorrect joint actions on physical performance

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **implement** specialised movement sequences and movement strategies to gather primary data about the influence of functional anatomy and biomechanics concepts on personal performance in authentic performance environments
- **analyse** how functional anatomy and biomechanics concepts can influence personal performance in authentic performance environments using primary data.

Equipment

- 3–5 kg hand weights (enough to share for one between a small group)
- Pen
- Data Collection Instrument 3 (DCI 3), also available on your obook assess

Method

STEP 1

Form small groups (approximately 3–4 students).

STEP 2

Have one group member perform a minimum of ten bicep curls, as per the instructions for Position A below. Sit on a bench (or the edge of a seat), with upright posture (sit still and do not sway). Hold hand weight in non-dominant hand, down by your side. Lock your elbow in against your torso. Slowly perform a bicep curl, bending the elbow to raise the weight up towards the shoulder before lowering it back down (with control) so that the arm is straight. At the same time have other group members ask questions A to E and record the answers in column 1 of DCI 3. Discuss the degree of awareness that you have for the muscle groups mentioned A to G of DCI 3.

STEP 3

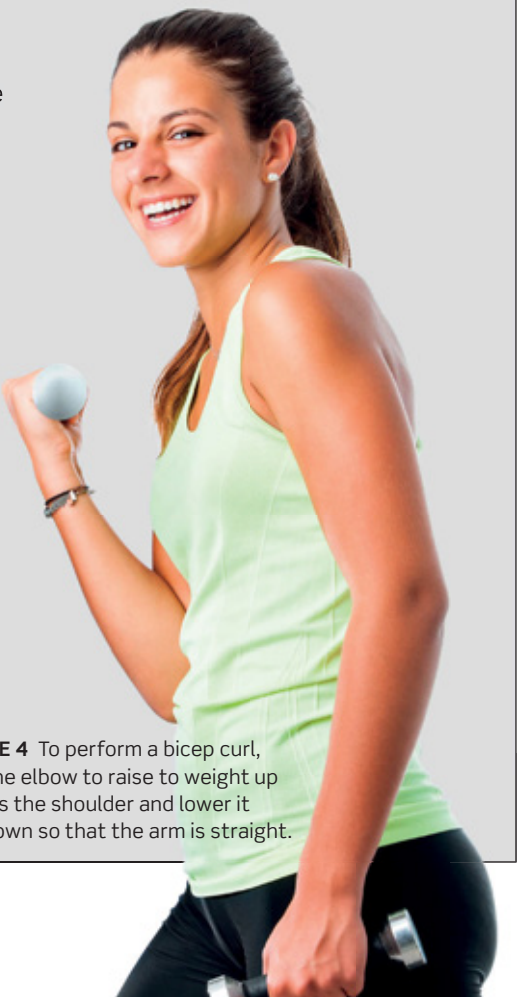
Repeat step 2, this time performing the bicep curl in as per the instructions for Position B below. Repeat all elements of position A; however, rather than pinning your elbow against your torso, position your elbow approx. 20cm away from torso (i.e. abduct your elbow). Record the answers to questions A to E in column 2 of DCI 3.

STEP 4

Rotate through the group so that each member completes steps 2 and 3.

STEP 5

Complete questions F to I, identifying the joint actions involved in your performance of the two different bicep curls.



SOURCE 4 To perform a bicep curl, bend the elbow to raise to weight up towards the shoulder and lower it back down so that the arm is straight.

	Position A:		Position B:	
A Do you have an awareness of muscles being engaged in the hand?	☐ Yes ☐ No		☐ Yes ☐ No	
B Do you have an awareness of muscles being engaged throughout the lower arm?	☐ Yes ☐ No		☐ Yes ☐ No	
C Do you have an awareness of muscles being engaged throughout the upper arm?	☐ Yes ☐ No		☐ Yes ☐ No	
D Do you have an awareness of muscles being engaged throughout the shoulder region?	☐ Yes ☐ No		☐ Yes ☐ No	
E Do you have an awareness of muscles being engaged throughout the back including trapezius and latissimus dorsi (lats)?	☐ Yes ☐ No		☐ Yes ☐ No	
F What are the joint actions occurring at the fingers?	☐ Flexion ☐ Extension ☐ Abduction	☐ Adduction ☐ None	☐ Flexion ☐ Extension ☐ Abduction	☐ Adduction ☐ None
G What are the joint actions occurring at the wrist?	☐ Flexion ☐ Extension ☐ Abduction	☐ Adduction ☐ None	☐ Flexion ☐ Extension ☐ Abduction	☐ Adduction ☐ None
H What are the joint actions occurring at the elbow?	☐ Flexion ☐ Extension ☐ Abduction	☐ Adduction ☐ None	☐ Flexion ☐ Extension ☐ Abduction	☐ Adduction ☐ None
I What are the joint actions occurring at the shoulder?	☐ Flexion ☐ Extension ☐ Abduction	☐ Adduction ☐ None	☐ Flexion ☐ Extension ☐ Abduction	☐ Adduction ☐ None

DCI 3

Analysis and discussion tasks

1 **Reflect on** your performance and data to determine which bicep curl technique felt the most efficient and effective.

2 **Analyse** secondary data about the joints and muscles involved in a bicep curl by doing some further research. Gather data from two secondary sources. A good place to start is the Livestrong website. A link is provided on your obook assess.

   a **Explain** where the secondary data correlates (relates or connects) with your findings and where there is a discrepancy (a mismatch) between the secondary data and your findings.

   b Considering your findings, draw a conclusion about which position (A or B from the task above) most closely resembles the optimal technique for a bicep curl.

3 Select one sub-routine within a key movement sequence in the physical activity you are currently studying (e.g. the arm action during the flight phase of a volleyball spike).

   a Research the joint actions and muscle contractions necessary for optimal performance of this sub-routine. For example: 1. Flex elbow; contract biceps 2. Adduct shoulder; contract deltoid 3. Circumduct shoulder; contract rotator cuff muscles 4. Adduct and rotate shoulder; contract rotator cuff 5. Extend elbow; rotate rotator cuff.

   b Based on the primary and secondary data collected during this Skill Drill, predict the various ways incorrect joint actions would negatively affect the performance of this sub-routine.

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PERFORMANCE

SKILL DRILL 3.7

Evaluate the impact of summation of forces on force production

Aim

To evaluate the impact of summation of forces on force production

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **implement** specialised movement sequences and movement strategies to gather primary and secondary data about the influence of functional anatomy and biomechanics concepts on personal performance in authentic performance environments
- **analyse** how functional anatomy and biomechanics concepts can influence personal performance in authentic performance environments using primary and secondary data
- **devise** your own biomechanical strategies to optimise performance in your selected physical activity
- **evaluate** the effectiveness of biomechanical strategies to achieve a determined outcome using primary and secondary data
- **determine** whether or not you will maintain or modify the biomechanical strategies
- **justify** the development of biomechanical strategies using evidence from primary and secondary data.

Equipment

- Netball
- Measuring tape
- Data Collection Instrument 4 (DCI 4)

Method

STEP 1

Form groups of three (one thrower and two measurers).

STEP 2

The thrower in the group throws a netball multiple times under the conditions listed below.

- **a** Sitting with back against a wall, legs straight out in front, using only your throwing arm (ensure your back stays against the wall throughout the throw)
- **b** Sitting with your buttocks on a line, legs straight out in front, using only your torso and arms
- **c** Standing with feet shoulder-width apart, toes to a line
- **d** Standing side-on with feet shoulder-width apart, front foot to a line
- **e** No restrictions (may run or take a 'crow hop') but must release ball before a line

STEP 3

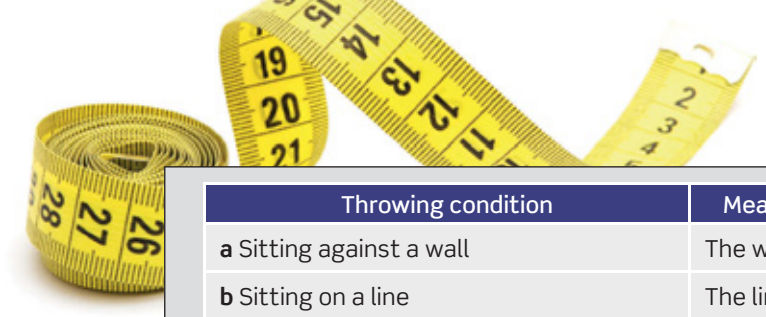
The measurers measure the distance the ball travels from the point it is thrown to the first contact it makes with the ground and then record it in the 'Distance' column of DCI 4.

STEP 4

Repeat steps 2 and 3 until all members of the group have had a turn at throwing.

STEP 5

Record your results in DCI 4.



Throwing condition	Measure from	Distance (m)	Muscle groups activated
a Sitting against a wall	The wall		
b Sitting on a line	The line		
c Standing with feet apart, toes to a line	The line		
d Standing side-on to a line	The line		
e No restrictions (can move)	The line		

DCI 4

Analysis and discussion tasks

1 Before considering the data from your experiment, it is useful to apply some prior knowledge to help start the process of understanding your findings.

- **a** What do you notice about the number of muscles that are activated as you move through the conditions?

2 Gathering primary data can allow you to identify patterns, trends and relationships in your physical performance. **Identify** patterns, trends and relationships in the primary data that you gathered in DCI 4.

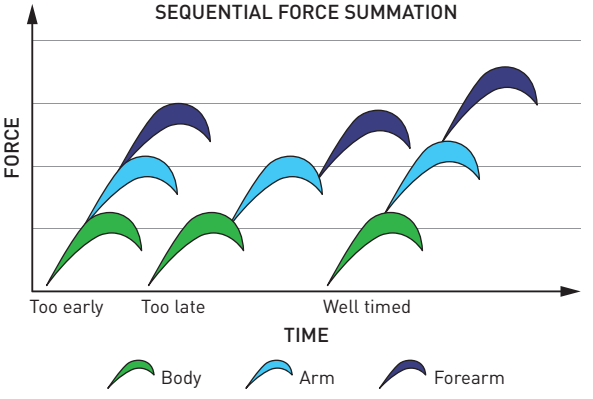
- **a** Which of the throwing conditions (a–e) produced the most force?
- **b** Convert your results to a line graph with distance (cm) on the y-axis and Conditions a–e listed along the x-axis.
- **c** What pattern do you notice when looking at the distance thrown and the conditions in this experiment?
- **d** **Explain** the relationship between muscle activation and distance achieved when throwing a ball. Use the format: 'As muscle activation _____, the distance the ball can be thrown _____'.

3 Investigating secondary sources of data on force summation will allow you to consider additional information that can support you to form valid conclusions about the impact of increased muscle activation on producing force. Analyse the secondary data in Source 5.

- **a** **Identify** the role of sequencing and timing of muscle activation in effective force summation.
- **b** How did the conditions set up from a to e in this experiment replicate the ideal sequencing for force summation? Was there a way to control for timing in each condition?

4 Once an initial analysis of data has been conducted, it is important to use the information to develop strategies to optimise performance.

- **a** **Consider** your selected physical activity and select a specialised movement sequence that requires considerable force production (if any).
- **b** List the phases within the specialised movement sequence that combine to produce optimal force summation.
- **c** **Explain** how the timing and sequencing of the sub-routines within each phase contributed to optimal force production.
- **d** **Consider** a movement sequence in your selected physical activity that favours accuracy over force. **Compare** the phases within this movement sequence to the ones you listed in part b.
- **e** Based on your understanding of force summation, make recommendations to either maintain or modify your performance of the specialised movement sequence you identified in part a. **Justify** your recommendations using primary data collected in this Skill Drill and at least one other piece of secondary data.



SOURCE 5 Force Summation is maximised when body parts generate and produce force sequentially.

>> from page 152

PERFORMANCE

SKILL DRILL 3.11

Evaluate the impact of base of support on quality of movement

Aim

To investigate the impact of base of support and centre of gravity on performance

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **implement** specialised movement sequences and movement strategies to gather primary data about the influence of functional anatomy and biomechanics concepts on personal performance in authentic performance environments
- **analyse** how functional anatomy and biomechanics concepts can influence personal performance in authentic performance environments using primary data
- **evaluate** the effectiveness of biomechanical strategies to achieve a determined outcome using primary data
- **justify** the development of biomechanical strategies using evidence from primary data.

Equipment

- Game Performance Assessment Instument 4 (GPAI 4), also available on your obook assess
- Copy of the Student book
- Equipment relevant to one physical activity from either the invasion, net and court, or striking and fielding categories
- Pen

Method

STEP 1

Select one of the following specialised movement sequences as the focus of your Skill Drill:

a shooting/scoring **b** throwing **c** striking an object.

STEP 2

Perform your selected specialised movement sequence (eg. serving a ball in tennis) in Position A (see the balance and stability variations below).

STEP 3

Assess the quality of your specialised movement sequence by describing whether the accuracy, flow and force development of your skill is: worse than usual; the same as usual; better than usual. Record your result in the position A row of GPAI 4.

STEP 4

Repeat steps 2 and 3 for positions B to E.

Position A	Position B	Position C	Position D	Position E
In this position, perform this skill as you usually would	In this position, perform this skill bend your knees to about 150 degrees	In this position, perform this skill bend your knees to about 90 degrees	In this position, perform the skill with your feet close together	In this position, perform the skill with your feet greater than shoulder width apart

Selected skill: _____									
	Accuracy Describe how close to the target you were able to throw or hit the ball			**Flow of movement** Describe how easily you were able to throw or hit the ball			**Force development** Describe the force you were able to apply		
Balance & stability variations	Worse than usual	Same as usual	Better than usual	Worse than usual	Same as usual	Better than usual	Worse than usual	Same as usual	Better than usual
Position A									
Position B									
Position C									
Position D									
Position E									

GPAI 4

Analysis and discussion tasks

1 Through analysing the primary data that you have gathered in this Skill Drill you can draw conclusions about the impact of balance and stability of your chosen specialised movement sequence.

- **a** Which positions provided the most stability? Which provided the least?
- **b** In which position was movement easiest? In which position was movement hardest?
- **c** **Compare** and **contrast** your performance (accuracy, fluency, etc.) across the five positions.
- **d** Based on these results alone, form a conclusion about the role of stability in this specialised movement sequence.

2 It is important to reflect on the reliability and validity of the data you collected in this Skill Drill to ensure that your final conclusions are strong.

- **a** **Describe** the factors that increase and those that decrease this data's reliability.
- **b** **Describe** the factors that increase and those that decrease this data's validity.
- **c** Form conclusions about the overall reliability and validity of your data. **Justify** your answer.

3 Following the primary data analysis, a deeper inquiry can be made using secondary sources. This enables the information to be used in a meaningful way to make decisions about movement strategies. Synthesise the primary data you have gathered in this Skill Drill with secondary data sources to answer the following questions.

- **a** **Explain** how the different conditions of stability affect your ability to transfer weight effectively.
- **b** **Distinguish** which quality of movement criteria (accuracy, flow of movement, force development) had the greatest variation due to changes in stability.
- **c** **Consider** your usual position. How would you describe the relationship between your stability and your movability in this position?
- **d** **Consider** three other specialised movement sequences from your selected physical activity. **Analyse** how balance and stability is optimised in these movement sequences. You may need to conduct additional research to answer this question.
- **e** Make suggestions to modify any of the sub-routines within your own performances of these movement sequences. **Justify** your recommendations based on the primary data you collected, as well as at least two other secondary data sources.

>> from page 161

PERFORMANCE

SKILL DRILL 3.12

Compare the effectiveness of levers in the production of speed in sport

Aim

To determine how levers can be used to gain an advantage in sport

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **implement** specialised movement sequences and movement strategies to gather primary data about the influence of functional anatomy and biomechanics concepts on personal performance in authentic performance environments
- **analyse** how functional anatomy and biomechanics concepts can influence personal performance in authentic performance environments using primary data
- **evaluate** the effectiveness of biomechanical strategies to achieve a determined outcome using primary data
- **determine** whether or not you will maintain or modify the biomechanical and movement strategies
- **justify** the development of biomechanical strategies using evidence from primary and secondary data.

Equipment

- Baseball tees (as many as possible to maximise efficiency)
- Baseball/softball bats
- Class set of softballs, baseballs or tennis balls
- 20+ markers
- Measuring tape
- Game Performance Assessment Instrument 5 (GPAI 5), also available on your obook assess
- Pen

Method

STEP 1

Run a tape measure from the tee into the field, marking every five metres with a marker.

STEP 2

Form groups of five (one batter, one catcher and three recorders).

STEP 3

Each group takes their positions on the field. In each group, the three recorders take position out in the 'field' with markers, maintaining a safe distance from the hitting zone. The catchers also take position out in the field, ready to throw roll balls back to the batting area.

STEP 4

The batter in the group hits three balls off the tee, beginning each hit from the same 'ready position' – feet shoulder width apart, knees bent, bat drawn high over dominant shoulder and elbows high.

It is important that the ball is struck consistently with the same degree of force and in the same spot in each of the following conditions:

Condition a Hold the bat with hands gripped in a neutral position in the middle of the handle

Condition b Hold the bat with hands close to the hitting end of the bat in a position known as 'choking' the bat

Condition c Hold the bat with hands at the very end of the bat

STEP 5

The three recorders mark the final resting position of each ball with a marker.

STEP 6

The batter completes GPAI 5.

STEP 7

Rotate through the group so that each student gets a turn at batting, and so everyone can fill populate GPAI 5 with their personal results.

			Level of control experienced during swing and contact		
Batting Condition	**Length of lever i.e. short, medium or long**	**Approximate distance travelled (to the nearest metre)**	High i.e. result could be replicated consistently	Moderate i.e. result could be replicated most times	Low i.e. not confident about the degree to which the result would be replicated
Condition A					
Condition B					
Condition C					

GPAI 5

Analysis and discussion tasks

1 Identifying relationships or patterns in your data will help you form conclusions about your physical performance.
   - **a** **Summarise** of your results.
   - **b** **Identify** any relationships or patterns between the length of lever and distance travelled by the ball.

2 Primary data is most useful when it is gathered under controlled and stable conditions. This improves its validity and reliability.
   - **a** **Evaluate** the stability of the conditions across your three batting performances. What impact did control have on the reliability of the data that you collected in this experiment?
   - **b** How could you increase the control of this experiment? **Consider** the role of variables in your response.

3 Analysing secondary data can help you reach stronger conclusions about the data that you collect in your experiment.
   - **a** **Determine** the relationship between lever length and force production by researching two secondary sources.

     Hint: Start by reading about speed multipliers and force multipliers in Section 3.12 on pages 159–160.
   - **b** **Evaluate** the degree to which your primary data aligns with the secondary data you gathered. **Justify** your response with specific examples from primary and secondary data.

SOURCE 6 In sport, a lever can increase the efficiency of movement, influence the speed of an object and help athletes produce force.

4 The use of levers is not just about force production. Good performers need to find a balance between using levers to generate force and maintaining control of their skill execution.
   - **a** **Analyse** the image and explain how this hockey player is using their hands to change the lever length for optimal force production.
   - **b** What modification would the hockey player make to the lever length to optimise her control of the ball?
   - **c** **Identify** a specialised movement sequence from your chosen physical activity that involves the use of levers. Using primary and secondary data, devise a strategy for your use of the lever in optimising force production *or* optimising control. *Hint*: levers can include the limbs of our body or external implements.

>> from page 209

PERFORMANCE

SKILL DRILL 4.4

Evaluate the impact of arousal on performance

Aim

To evaluate the impact of different arousal levels on personal or team performance

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **implement** specialised movement sequences and movement strategies to gather primary data about impact of arousal levels on performance
- **evaluate** the impact of different arousal levels on your performance
- **evaluate** the reliability and validity of your collected data
- **justify** your findings and use them to devise a practical strategy to optimise your performance.

Equipment

- Sporting equipment specific to your selected physical activity
- A portable music player (e.g. a smart phone or digital audio device) and headphones
- A calming/meditative piece of music (selected by the teacher and downloaded to the music player in advance)
- A high-energy/upbeat piece of music (selected by the student and downloaded to the music player in advance)
- Game Performance Assessment Instrument 6 (GPAI 6), also available on your obook assess
- Notebook
- Pen

Method

STEP 1

Select a sport or physical activity. This should be the same physical activity that you have chosen to study this term.

STEP 2

Complete a standard teacher-led warm up, followed by a whole class tactical discussion for a total of 10 minutes.

STEP 3

Play or perform your physical activity for 10 minutes and assess your performance by completing Condition A of the GPAI 6. Rate your performance by placing ticks in the appropriate boxes.

If you need to refresh your memory of the different body and movement concepts, you can revisit Section 2.7 (pages 69–75).

STEP 4

Divide the class into two groups:

Group A listens to a piece of calming/meditative music while lying still on the ground for 10 minutes

Group B listens to a piece of high-energy/upbeat music while performing an active warm up (e.g. star jumps, active stretching) for 10 minutes.

STEP 5

Play or perform the same physical activity as you completed the first time, for another 10 minutes.

STEP 6

Again, assess your performance using GPAI 6. Group A completes Condition B and the high arousal music group completes Condition C.

	Condition A Standard arousal			Condition B Low arousal			Condition C High arousal		
Body and movement concept	Worse than usual	Same as usual	Better than usual	Worse than usual	Same as usual	Better than usual	Worse than usual	Same as usual	Better than usual
Body awareness (e.g. balance, transfer of body weight)									
Spatial awareness (e.g. use of space, direction of movement)									
Quality of movement (e.g. speed, accuracy, force and flow of movement)									
Relationships (e.g. positioning on court/field, relationship to opponent, communication)									

GPAI 6

Analysis and discussion tasks

1 **Analyse** the primary data gathered in this Skill Drill to by completing the following tasks.
   - **a** Which group did you participate in? How did your arousal level differ between your two performances?
   - **b** **Describe** the relationship between your arousal level and overall performance referring specifically to the data in GPAI 6.
   - **c** **Compare** your results with the results of three members of the class who participated in the opposite arousal condition to yours.
   - **d** Based on your data and the data collected by others in your class, what preliminary conclusions can you draw about the impact of arousal levels on psychological state and performance?

2 **Assess** the reliability and validity of your data by completing the following tasks.
   - **a** **Consider** the reliability of the data you have gathered. If you repeated this activity on a different day, how likely is it that you would get the same results? **Explain** your answer.
   - **b** How could the reliability of this experiment be improved?
   - **c** **Consider** the validity of the data you have gathered. Did you get the results that you were expecting? If the actual results were different to the expected results, how might you explain this?
   - **d** What measures could be put in place to increase the validity and reliability of this experiment? **Consider** variables such as measurement techniques and sample size.

3 Based on the data you have gathered, **draw conclusions** about the optimal level of arousal for your performance in the physical activity you are currently studying. Use secondary sources to justify your conclusions.

4 **Synthesise** your knowledge of arousal from Section 4.4 with the data you have gathered in this activity (relating to your personal optimal arousal level) in order to devise a practical strategy to help you optimise arousal in your future performances. Record your strategy in a written response of 250 words.

>> from page 217

PERFORMANCE

SKILL DRILL 4.6

Assess the impact of team cohesion on performance

Aim

To evaluate the impact of team cohesion on your implementation of movement strategies

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **implement** specialised movement sequences and movement strategies to gather primary data about the impact of team cohesion levels on the outcome of an attack strategy in your selected physical activity
- **analyse** the relationship between team cohesion and performance using primary data
- **devise** strategies to improve team cohesion.

Equipment

- Equipment specific to one selected physical activity from either the invasion, net and court, or striking and fielding category
- Pen
- Game Performance Assessment Instrument 7 (GPAI 7)

Method

STEP 1

Select a sport from the invasion, net and court or striking and fielding categories.

Form a team with players who are familiar to you and with whom you have played before.

In one minute, decide as a group on **one** clear attacking strategy that you will implement during your game. At the end of the minute, you are no longer permitted to speak.

STEP 2

Begin play and implement your attacking strategy without using any verbal or non-verbal cues.

After 10 minutes of play, stop and – as a team – fill out the Performance 1 row of GPAI 7.

STEP 3

In one minute, again decide as a group on one **new** attacking strategy. At the end of the minute, take to the court field and implement the strategy. This time, you are permitted to communicate without restrictions. After 10 minutes of play, stop and fill out the Performance 2 row of GPAI 7 as a team.

STEP 4

Form a new team of players who are less familiar to you. Repeat steps 1 to 3 of this Skill Drill and complete the Performance 3 and Performance 4 rows of GPAI 7.

	Chosen attack strategy	Outcome of strategy (e.g. Was it successful? How many goals or points were scored? What was the outcome of the game?)	Evaluation of overall team cohesion (e.g. Did each team member understand their role? Did the team function effectively?)
Performance 1 Familiar team with no communication			
Performance 2 Familiar team with communication			
Performance 3 Unfamiliar team – with no communication			
Performance 4 Unfamiliar team – with communication			

GPAI 7

Analysis and discussion tasks

1 **Analyse** the primary data you gathered during this Skill Drill by completing the following tasks.
   - a **Evaluate** the effectiveness of the attack strategy across the four performances. **Discuss** what factors contributed to the success or failure of this strategy.
   - b **Compare** and **contrast** the level of team cohesion across the four performances. **Discuss** what factors contributed to the success or failure of your team cohesion.

2 **Analyse** the data you have gathered and **Identify** the most significant factor affecting the level of team cohesion (i.e. familiarity with team members; ability to communicate with team members; a combination of these factors).

3 **Assess** the reliability and validity of your data (i.e. would the results be the same if you repeated this activity tomorrow? Is the activity measuring what it is supposed to measure? Did your results match what could be expected, given the conditions of each performance? How could you ensure your conclusions regarding team dynamics are more accurate and convincing?) **Justify** your answer.

4 Based on the data you have gathered, **draw conclusions** about the importance of team cohesion on effective implementation of attacking strategies in invasion sports.

5 **Devise** a Strategy to improve team cohesion. **Justify** your response using secondary sources.

SOURCE 7 Team cohesion can enable a group of skilled individuals to succeed as a unified team.

>> from page 227

PERFORMANCE

SKILL DRILL 4.9

Assess the impact of mental rehearsal on performance

Aim

To assess the impact of mental rehearsal on performance

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **implement** specialised movement sequences and movement strategies to gather primary data about the impact of mental rehearsal on performance
- **apply** the sport psychology technique of mental rehearsal
- **analyse** the relationship between mental rehearsal and personal performance using primary data.

Equipment

- Sporting equipment specific to your selected physical activity
- Pen
- Game Performance Assessment Instrument 8 (GPAI 8), also available on your obook assess

Method

STEP 1

Participate in a game of your selected physical activity for 10 mins. If your physical activity is a performance, target or aesthetic activity, either complete the entire event or complete a crucial aspect of the event e.g. a transition in triathlon.

STEP 2

Rate your performance according to the body and movement concepts in GPAI 8. Indicate the standard of your performance for each concept in Column A (i.e. Worse than usual, Same as usual or Better than usual)

STEP 3

Find a quiet space where you can close your eyes and spend 10 minutes using the PETTLEP model (refer to Section 4.9 of your Student book, page 225) to revisit the game from

Step 1, mentally rehearsing a more optimal performance. Ensure your rehearsal considers the optimisation of the four body and movement concepts over the full 10 minutes. (i.e. you will spend 10 minutes playing the whole game in your mind).

STEP 4

Repeat Step 1 and record your results in column B, following the same method outlined in Step 2.

My selected physical activity is: _____						
	Column A Control sample (i.e. before mental rehearsal)			Column B Performance sample (i.e. after mental rehearsal)		
Body and movement concepts	Worse than usual	Same as usual	Better than usual	Worse than usual	Same as usual	Better than usual
Quality of movement						
Space awareness						
Body awareness						
Relationships						

GPAI 8

Analysis and discussion tasks

1 **Analyse** the primary data you gathered during this Skill Drill by completing the following tasks.
   - **a** **Discuss** whether your performances were better before or after mental rehearsal. **Justify** your response by referring explicitly to your GPAI 8.

2 Based on your knowledge of mental rehearsal, which round of performances (i.e. the one before or after mental rehearsal) should have produced the best average result? **Explain** why.
   - **a** **Identify** whether your results support your answer for Question 2. If not, **suggest** some possible reasons why.

3 **Assess** the reliability and validity of your data (i.e. would the results be the same if you repeated this activity tomorrow? Is the activity measuring what it is supposed to measure?). **Justify** your answer.

4 This Skill Drill allowed you to determine the outcomes, implications and limitations of using mental rehearsal to improve your performance in an authentic environment.
   - **a** Use primary and secondary data to **determine** whether regular mental rehearsal would be a worthwhile strategy for improving your performance in your selected physical activity.
   - **b** **Consider** the mental rehearsal strategy that you used in this Skill Drill. Would you modify it at all if you were to use it again? How would you optimise your implementation of this strategy for future performance enhancement? **Justify** your answer using primary and secondary data.

SOURCE 8 Mental rehearsal is a technique used to improve performance, reduce anxiety, and increase confidence and concentration.

>> from page 245

PERFORMANCE

SKILL DRILL 4.15

Determine the impact of pre-task routines on performance

Aim

To determine the impact of a pre-task routine on performance

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **implement** specialised movement sequences and movement strategies to gather primary data about the relationship between pre-task routines and your performance outcomes
- **analyse** the meaning, relationships, patterns and trends of implementing pre-task routines in performance using primary data
- **justify** the maintenance or modification of a pre-task routine strategy.

Equipment

- Equipment specific to your selected physical activity
- Game Performance Assessment Instrument 9 (GPAI 9), also available on your obook assess
- Data Collection Instrument 5 (DCI 5), also available on your obook assess

Method

STEP 1

Select a **closed** skill from your selected physical activity (e.g. a serve in tennis).

STEP 2

Participate in an authentic game or performance environment for a minimum of 10 minutes.

Then, use the Condition A column of GPAI 9 to rate your confidence, anxiety and concentration levels when performing the closed skill.

Rate your overall performance of the closed skill.

My Selected physical activity is: _____

My closed skill is: _____

	Column A – without pre-task routine			Column B – with pre-task routine		
Psychological concept	Worse than usual	Same as usual	Better than usual	Worse than usual	Same as usual	Better than usual
Confidence						
Anxiety						
Concentration						
Overall performance						
Reflection						

GPAI 9

STEP 3

Now create a pre-task routine for the same closed skill by combining up to four elements (i.e. separate parts of the overall routine), as outlined in DCI 5. Use the details column to describe each element in your routine in as much detail as possible.

Elements	Details
1 Breathing • Choose how many breaths you will take, as well as the rate and depth of these breaths.	
2 Trigger words • Choose a word or short phrase to focus your attention.	
3 Physical action • Create a ritualistic action to perform just prior to the task.	
4 Temporal consistency • Decide the length of preparation time (e.g. countdown prior to execution of skill). • Decide how long the complete pre-task routine will last.	

DCI 5

STEP 4

Perform your pre-task routine for 10 minutes. Complete the routine in its entirety each time, performing each element in a set order.

STEP 5

Participate in an authentic game or performance environment for 20 minutes. During the game or performance, complete your pre-task routine every time you perform the closed skill.

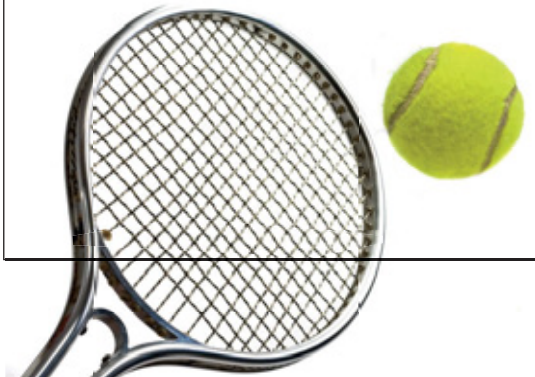
STEP 6

Then use Condition 2 of GPAI 9 to record the impact of your pre-task routine on your confidence, anxiety and concentration levels and overall performance of the skill.

Analysis and discussion tasks

1 **Analyse** the primary data you gathered during this Skill Drill by completing the following tasks.
   - **a** Referring to your completed GPAI 9, **describe** how your pre-task routine impacted your confidence, anxiety and concentration levels during the authentic game or performance.
   - **b** Can you identify a relationship between confidence, anxiety, concentration and pre-task routines?

2 **Assess** the reliability and validity of your data (i.e. Would the results be the same if you repeated this activity tomorrow? Is the activity measuring what it is supposed to measure? Did your results match what could be expected, given the conditions of each performance? What could you do to make your conclusions about the effectiveness of the pre-task routine more accurate?). **Justify** your answer.



3 Refer to Source 1 in Section 4.15. This graph shows the impact of pre-task routines on performance under pressure. Do your results support the findings of Mesagno and Mullane-Grant's experiment?

4 **Identify** any differences between your results and the expected impact of the pre-task routine. Was the result what you thought it would be? If not, why do you think that is the case?

5 **Predict** what changes you may observe in your confidence, anxiety and concentration levels (and your overall performance) if you apply a pre-task routine to all closed skills in your physical activity over the coming weeks or months.

6 **Discuss** the benefits of using pre-task routine for closed skills. Are pre-task routines always necessary? How can they be used most effectively to optimise the performance of closed skills? **Justify** your response using primary and secondary data.

>> from page 261

PERFORMANCE

SKILL DRILL **5.1**

Implement an equity strategy in your PE class

Aim

To implement an equity strategy and consider its outcomes, implications and limitations

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks

That's a goal!

In this Skill Drill you will:

- implement an equity strategy to gather primary data about the outcomes, implications and limitations of decisions
- make decisions to maintain or modify the equity strategy to optimise engagement in a physical activity
- **justify** maintenance or modification of the equity strategy using evidence from primary and secondary data.

Equipment

- Game Performance Assessment Instrument 10 (GPAI 10), also available on your obook assess
- Pen
- Bibs

Method

STEP 1

Your class will divide into two teams and play a short game of touch football.

Before play begins, all students who feel that they are experienced (i.e. competent) in touch football Should identify themselves and wear a bib.

Students who feel inexperienced (i.e. unfamiliar or unsure) about playing touch football should identify themselves and not wear a bib.

STEP 2

Form two even teams, spreading the experienced and inexperienced players across both of these teams. Now play for 10 minutes.

STEP 3

Complete the 'Condition 1' column on GPAI 10. In each row, rank your performance on a scale of 1–4 (one being very low and four being high). As you complete this column, discuss the equity of the game with your team (i.e. did each team member have equal possession of the ball in the rucking and transition phase? Did each team member have equal possession of the ball in the attacking zone?) Note your observations in the 'General comments' section on GPAI 10.

STEP 4

Now play for another 10 minutes, implementing the following equity strategy:

All inexperienced players are immune from being touched when they are within 10 metres of the try line (i.e. in the attacking zone).

STEP 4

Complete Column 2 of GPAI 10. As you complete this column, discuss the equity of the game with your team. Note your observations in the General Comments section of GPAI 10.

	Condition 1								Condition 2							
	Experienced				Inexperienced				Experienced				Inexperienced			
Participation (time on the field)	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Ball possession in the rucking and transition phase	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

	Condition 1								Condition 2							
	Experienced				Inexperienced				Experienced				Inexperienced			
Ball possession in the attacking zone (within 10 m of try line)	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Overall Performance (success when handling the ball)	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
General comments																

GPAI 10

Analysis and discussion tasks

1 **Analyse** the differences for your class between the regular and modified game (i.e when the equity strategy was in play).
   - **a** Was there a difference in ball possession? **Explain** your answer making explicit reference to GPAI 10 and the discussions with your team during the games.
   - **b** Was there a difference in performance? **Explain** your answer using examples from the games.

2 **Reflect on** the equity strategy to draw conclusions about whether it was truly equitable. **Explore** the outcomes, implications and limitations of the equity strategy. In forming your conclusion, **consider** the following definitions:
   - equity: striving for fairness and justice by recognising people's individual needs and personal differences
   - equality: the same rights, resources, conditions and opportunities available to all
   - social inclusion: access to the resources, opportunities and capabilities to learn, work, engage and have a voice.

3 The aim of this Skill Drill is to achieve equity through modifying just one rule; however achieving equity is very complex. Suggest modifications to the exercise in a 250 word response, using secondary sources to substantiate your claims.

SOURCE 9 In this Skill Drill, players of varying experience reflect on an equity strategy which is implemented halfway though the game.

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PERFORMANCE

SKILL DRILL **5.3B**

Investigate the impact of the social construction of gender

Aim

To assess the impact of uniforms on participation and performance in physical activity

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks as homework

That's a goal!

By the end of this Skill Drill you should be able to:

- **identify** relationships between personal, social and cultural factors in the social construction of gender
- gather and **analyse** primary and secondary data about the impact of uniforms on participation and performance in physical activity
- **devise** strategies to optimise engagement in physical activity, based on primary and secondary data.

Equipment

- Equipment specific to your chosen physical activity
- Regulation school PE uniform
- Game Performance Assessment Instrument 11 (GPAI 11), available on your obook assess
- Pen

Method

STEP 1

Select one of the following physical activities: touch football, tennis or volleyball. Research the regulation uniform requirements for males and females at the professional level in your chosen sport.

STEP 2

Conduct a warm up and participate in your chosen physical activity for 10 minutes in your regular school PE uniform.

STEP 3

At the end of the 10 minutes, complete the 'Performance' column of GPAI 11, rating your overall performance and your feelings of confidence, anxiety and concentration. You should also include a brief reflection of your experience.

STEP 4

Imagine how your confidence, anxiety and concertation would be impacted if you were performing in the regulation uniform for professional female athletes. Discuss these feelings with your fellow students, and record your findings in the 'Discussion' column of GPAI 11. Include a brief reflection of your experience.

SOURCE 10 Official uniforms of men and woman competing at the Olympic level in beach volleyball.

	Performance				Discussion			
	Very low	Low	Moderate	High	Very low	Low	Moderate	High
Confidence								
Anxiety								
Concentration								

Overall performance	Poor	OK	Good	Excellent	Poor	OK	Good	Excellent
Reflection								

GPAI 11

Analysis and discussion tasks

1 As a class, discuss the findings from this experiment.
   - **a** Are there any trends in the data that you can identify? **Discuss** what these trends are, and why they may have occurred.
   - **b** **Synthesise** your findings to determine whether there is a relationship between type of uniform and overall performance.

2 Uniforms can act as barriers to participation and performance in sport. As a class, explore the personal, social and cultural factors that inform the uniform regulations that require women to wear tight fitting and/or revealing clothes.
   - **a** **Compare** the two images of Olympic beach volleyball players (Source 8). Can you **generate** any reasons as to why the women are wearing tight fitting and revealing uniforms, while the men are wearing baggy singlets and shorts?
   - **b** Do you think that either uniform impacts on the athlete's performance? **Justify** your answer.
   - **c** Do you think it is fair that the female volleyball players are dressed in more revealing uniforms than the male volleyball players, despite the fact that they are playing the same sport? In your discussion, refer to the levels of confidence, anxiety and concentration that you recorded in GPAI 11.

3 **Investigate** how the social construction of gender impacts the rules and playing attire in sports. Record your findings, citing two secondary data sources.

4 **Devise** an equity strategy to help break down this barrier and increase engagement in sports. **Justify** your response using primary and secondary data.

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PERFORMANCE

SKILL DRILL 5.3C

Analyse the role of social factors on access

Aim

To devise equity strategies that overcome the social factors that act as barriers to physical activity

Time

1 lesson (70 minutes) with additional time to complete analysis and discussion tasks

That's a goal!

By the end of this Skill Drill you should be able to:

- gather primary data about the influence of equity on engagement in physical activity
- **devise** an equity strategy to influence personal, social or cultural factors in a physical activity context
- **justify** the development of an equity strategy using evidence from primary and secondary data.

Equipment

- Whistle
- Stopwatch
- Cones (for boundary and mid-court line)
- Dodgeball rules (available in obook assess)
- Game Performance Assessment Instrument 12 (GPAI 12), available on your obook assess

Method

Form two teams. In this two-part experiment, you will be playing dodgeball with two major modifications to the playing conditions:

- Team A will be notified of one major rule change (Note to teacher: ideas for this rule change can be found in obook assess).
- Team B will be unaware of this rule change and will not be allowed to talk during play.

STEP 1

In your teams, commence a 10-minute warm up and practice period. Team A is advised about the rule change by the teacher, and can discuss their team strategy during the warm up.

Meanwhile, Team B completes a standard warm up at a distance from Team A, far enough away that they cannot hear Team A's strategy.

STEP 2

Play one full game of dodgeball under the playing conditions outlined above.

STEP 3

Stop and complete the Condition 1 column of GPAI 12. Reflect on your levels of autonomy, relatedness and competence, which are all indicators of motivation for participation in physical activity. Provide a score for your overall performance and add a reflection of your experience.

STEP 4

Repeat steps 1 and 2; however, this time, your teacher will provide a different rule change.

This time, Team A is unaware of the rule change and is not permitted to speak during play, while Team B knows the rule change and has no constraints.

STEP 5

Stop and complete the Condition 2 column of GPAI 12.

Your team: _____								
	Condition 1 (major rule change no. 1)				Condition 2 (major rule change no. 2)			
	Poor	Ok	Good	Excellent	Poor	Ok	Good	Excellent
Your level of autonomy								
Your level of relatedness								
Your level of competence								
Overall performance	Poor (Score 1)	Okay (Score 2)	Good (Score 3)	Excellent (Score 4)	Poor (Score 1)	Okay Score 2)	Good (Score 3)	Excellent (Score 4)
Reflection								

GPAI 12

Analysis and discussion tasks

1 **a** **Determine** the average overall performance rating for your team, per game. To work this out, divide the total team score by the number of people in the team (e.g. if there are ten team members and their overall performance scores in game 1 totalled 23, the average overall performance score for that game is [23 ÷ 10 =] 2.3).

b Use a bar graph to present:

- your individual overall performance scores from games 1 and 2
- your team's overall performance scores from games 1 and 2.

2 Use your graph to identify the impact of the equity constraint on motivation and performance.

a **Compare** and **contrast** the primary data from game 1 to game 2 for your individual performance and your team's performance.

b **Identify** any relationships between your levels of competence, relatedness and autonomy, and your overall performance.

c Suggest possible reasons for differences (if any) between your individual results and your team's average result in this Skill Drill, referring to individual, social, cultural or environmental factors.

3 **Synthesise** primary and secondary data to answer the following questions.

a **Discuss** how the experience of some of your class members today might mirror the experience of culturally and linguistically diverse (CALD) members of society trying to access organised sport or physical activity.

b What conclusions can be drawn about the relationship between language as a barrier and motivation for sports participation of CALD citizens?

4 **Devise** an equity strategy to overcome the way that language acts as a significant barrier to motivation and engagement in physical activity.

Justify your decision using at least two secondary sources.

a If your equity strategy was to be implemented in your school setting, predict how effectively it would increase levels of motivation and engagement for CALD students. Consider personal, social, cultural and environmental factors in your response.

GLOSSARY

A

acceleration
a measure of how quickly or slowly the velocity of an object changes over time

access
the opportunity a person is given to make use of something or take part in something; in a sporting context, access refers to the ways in which different institutions (e.g. schools, sporting clubs, organisations and governments) make sure that all people have the same opportunities to participate in sports and activities of their choice

adaptability
a characteristic of motor skills; adaptability refers to the ability of an individual to perform a particular motor skill in response to what is required in a given situation

affirmations
positive statements that are directly related to an athlete's qualities, abilities or goals

agents of socialisation
the people in our lives from whom we learn the types of behaviours that are expected of us in society (e.g. parents and guardians, siblings, friends, teachers and coaches)

agonist
a muscle that provides the main force to cause a particular movement

amotivation
the total absence of motivation

anatomy
a field of science that investigates the bodily structures of humans, animals and other living organisms often by dissecting and examining the muscles, bone and internal organs of the organisms being studied

angle of release
the angle at which an object is launched into the air relative to the ground

angular motion
any movement that happens along a circular line around an axis (i.e. central point)

antagonist
a muscle whose action opposes (or reverses) that of the agonist muscle

anxiety
psychological and physical symptoms brought on by a sense of apprehension about something

appendicular skeleton
part of the skeleton consisting of the pectoral (shoulder) girdle and the upper extremities, the bones of the pelvic (hip) girdle and the lower extremities. The appendicular skeleton is so named because it supports the body's appendages (i.e. arms and legs)

arousal
a feeling of mental and physical alertness or excitement

associative stage
the second stage of Fitts and Posner's stages of learning model; during this stage, the learner has grasped the fundamentals and mechanics of the skill and their performance becomes more consistent with fewer errors

attention
a technical term used by sports psychologists to refer to the specific ability of an athlete to attend and respond to appropriate internal (e.g. thoughts or feelings) and external (e.g. the starter's gun or an opponent) stimuli during training and competition

Australian Bureau of Statistics (ABS)
an independent statistical agency of the government of Australia that provides key statistics on a wide range of economic, population and social issues (including information on sport and physical activity trends)

autonomous stage
the third stage of Fitts and Posner's stages of learning model; during this stage, the learner can perform the skill consistently and fluently in different environments without conscious effort

autonomy
a person's need to control their own life and make their own decisions

axial skeleton
the part of the skeleton consisting of the skull, vertebral column, ribs, sternum and coccyx. The axial skeleton is so named because it forms the long axis of the body

B

backspin
when an object (i.e. projectile) rotates backwards, causing it to fall slowly towards the end of its flight

balance
a term used to describe the ability of a person or thing to control their state of equilibrium (i.e. distribute their weight evenly in order to remain upright and not fall over)

barriers
factors that decrease access to resources; barriers discourage or prevent a person from participating in a sport or physical activity (e.g. poor health, high cost of equipment, lack of motivation)

base of support
the area beneath a person or thing that is in contact with a supporting surface

Bernoulli's principle
a scientific theory that explains that any increase in the velocity of a fluid (e.g. air or water) is accompanied by simultaneous decrease in pressure; these differences in fluid velocity and pressure explain the movement of many objects (including how planes fly) as well as how lift force is generated

biomechanics
a field of science that studies the body systems responsible for movement (i.e. the musculoskeletal system) using concepts from a specialised branch of mathematics known as mechanics

blocked practice
when learners repeat an isolated skill for a period of time or number of repetitions

body and movement concepts
a group of four concepts used to develop and improve specialised movement sequences and strategies in different sports and physical activities. The concepts are: body awareness, space awareness, quality of movement and relationships (e.g. to objects and other people)

body awareness
a body and movement concept; body awareness relates to the sense (or consciousness) we have of our own body when performing a skill

breathing techniques
any form of breathing exercise in which an athlete consciously regulates their breathing to stimulate a desired response

built environments
spaces that humans have built to provide the setting for daily life (e.g. houses, office buildings) and physical activity (e.g. gyms, stadiums, playing fields, courts, etc.)

C

cardiac muscle
a type of muscle that is found in the walls of the heart; it is a striated (i.e. striped), involuntary muscle (i.e. one that we have no control over)

cartilage
firm, flexible connective tissue found in many parts of the body, particularly on the articulating surfaces of joints

cartilaginous joints
where the bones have no joint cavity and are held together by cartilage

central nervous system
part of the larger body system known as the nervous system, the central nervous system consists only of the brain and spinal cord (i.e. the central part of the system). It does not include the network of nerves that run throughout our bodies (referred to as the peripheral nervous system)

centre of gravity
the central point of an object, around which all of its weight is evenly distributed and balanced

choke
(in sport) a term used to describe the failure of an athlete or team to perform to their full potential (e.g. freezing under pressure or making unnecessary errors due to nerves)

closed motor skills
skills that are performed in stable and predictable environments and where the person performing the task is in control of the timing of the movement sequence and doesn't need to consider other variables (e.g. serving a ball in tennis)

cognitive anxiety
anxiety felt as an emotional response

cognitive stage
the first stage of Fitts and Posner stages of learning model; during this stage, the learner is trying to understand the skill and figuring out exactly what needs to be done in order to perform it

cognitive systems approach
a theoretical framework used to help explain the processes involved in motor learning; according to this approach, the brain acts as the central command centre for the body. It creates action plans for movements based on information it receives from the body's senses and instructs the muscles to perform these actions in a linear order (i.e. step-by-step)

cognitive verbs
task words that will provide information on what students are expected to provide in an answer to a question

(in sport) cohesion
the ability to identify closely with the group's goals and to experience success obtaining those goals

commodification
the process of turning something into an object of commercial value

Commonwealth Scientific and Industrial Research Organisation (CSIRO)
an independent scientific research agency funded by the Australian federal government and responsible for improving economic and social industry

compact bone
a solid mass of bony tissue that has a smooth appearance; this forms the solid outer shell of most bones

competence
a person's need to learn and master skills that challenge their abilities

concentration
an everyday term used to describe how a person focuses their mental energy

concentric isotonic contraction
a process in which the muscle shortens to pull on bones and bring them closer together

confidence
the belief that an individual can have faith in (or rely on) themselves, someone or something

conservation of momentum
a biomechanical principle (i.e. law) that states that momentum cannot be lost. Instead, whenever two objects collide, their combined momentum will be the same after the collision as it was before

consistency
a characteristic of motor skills; consistency refers to the ability of an individual to perform a particular motor skill reliably and dependably over time

constant practice
when a skill is practised under the same (i.e. constant) conditions

constraint
any internal or external variable that has an impact on an athlete's performance

contact force
a type of force that acts on objects that come into direct contact with each other (e.g. friction force, drag force)

continuous motor skills
skills that do not have a clearly defined start and finish point and are made up of discrete motor skills linked together continuously (e.g. running)

cultural change
a term used to describe the changing levels of cultural diversity that take place within a population over time

cultural factors
a range of influences at a cultural level that can act as barriers or enablers to participation in sport and physical activities (e.g. influences nationally and internationally such as population changes, the role of institutions such as the government, the church and the mass media)

curvilinear motion
any movement that happens along a curved line

D

demographic change
a general term used to describe changes in the size, age, composition and structure of a population

discrete motor skills
skills that have a clearly defined start and finish point (e.g. throwing a ball)

displacement
a measure of the distance travelled and direction between a starting point and an end point 'as the crow flies'

distance
a measure of the length of space between two points

distributed practice
when a skill is practised with periods of rest that are equal to (or longer than) the periods spent training

diversity
a term used to describe difference; when used to describe people in a society, diversity means empowering people by respecting and appreciating the characteristics that make them different (e.g. age, sex, race, ethnicity, religious beliefs, gender, sexual orientation, socioeconomic status, physical and mental ability, geographical location)

drag force
a type of contact force that is generated by a fluid (e.g. air or water) opposing the movement of an object

drills
activities set up to allow for practising skills; they can target the development of one or multiple skills in various environments and can vary from simple to complex in nature

dynamic
a term used to describe a process or system that is constantly changing

dynamic balance
a term used to describe the ability of a person or thing to maintain balance while moving (i.e. a gymnast performing a jump on a balance beam)

dynamic systems approach
a theoretical framework used to help explain the processes involved in motor learning; according to this approach, the intelligence that coordinates and controls body movements is the result of complex interactions between the individual, the environment and the task

E

eccentric isotonic contraction
a process in which the muscle lengthens to release the bones and move them further apart

ectomorph
a term used to describe a body type that is leaner, longer and narrower with a low tendency to build muscle and store body fat

elastic force
a type of contact force that is generated by the resistance of an object to change shape

enablers
factors that increase access to resources; enablers encourage or support a person to participate in a sport or physical activity (e.g. closeness to sporting facilities, encouragement from parents and teachers, having friends on the team)

endomorph
a term used to describe a body type that is stockier, wider and shorter with a high tendency to build muscle and store body fat

environmental constraint
any changeable aspect of the environment that an athlete needs to overcome or adapt to (e.g. weather)

environmental cues
the relevant information from the environment

environmental factors
a range of influences at an environmental level that can act as barriers or enablers to participation in sport and physical activities (e.g. our ability to access the natural and human-made spaces that exist in the world around us)

equality
a concept that relates to being equal in terms of status, rights or opportunities; equality means striving for fairness and justice by treating people the same (regardless of their personal differences)

equity
a concept that relates to fairness and justice in the way all people are treated; equity means striving for fairness and justice by treating people differently (based on their individual needs and personal differences)

external force
a type of force that is generated outside the body or through an interaction with the body and the external environment (e.g. gravity, resistance from the air or water, contact with other objects or people)

external stimuli
information or cues that come from outside the body (e.g. changes in the environment such as sounds, sights, smells, etc.)

extrinsic (augmented) feedback
information from external sources that is received at the completion of a movement

extrinsic motivation
a type of motivation driven by external factors (i.e. factors that come from outside a person) such as money and fame

F

feedback
information about a person's skills or performance; can include intrinsic and extrinsic feedback

fibrous joints
where the bones have no joint cavity and are connected via fibrous connective tissue

fight or flight response
an innate (i.e. instinctive) physiological response to a threat of danger or harm that prepares the body to defend or flee

fine motor skills
skills that require precise movements and use smaller muscle groups (e.g. writing with a pen)

first-class lever
a type of lever in which the pivot point (i.e. fulcrum) is positioned between the effort (i.e. force) and the load (i.e. resistance)

fixed mindset
a mental state in which the individual believes that their abilities (e.g. intelligence and talent) are set (i.e. fixed), without any room for change or development

flat bones
bones that are often wide and flat to offer protection to internal organs or area for muscles to attach

force
a push or pull that happens when two objects interact; an interaction that (when unopposed) causes (or has the potential to cause) a change in the motion of an object

force multipliers
levers that make it easier to move a heavy object with less force by increasing the distance over which the force is acting

force production
a general term used to describe the ability of the body to produce internal force (i.e. movement) in order to overcome one or more external forces (e.g. gravitational force, drag force, friction force etc.)

friction force
a type of contact force that is generated by the surface of an object rubbing against the surface of another object

frontal plane
one of the three planes of movement; movements in this plane are side to side. A star jump (or jumping jack) is an example of movement along this plane

functional anatomy
a specialised branch of anatomy that studies how muscles and bones in the human body produce and affect movement

G

gender
the combined product of a person's biological characteristics (i.e. their sex) together with their social and cultural roles and identities that are formed in response to their environment (e.g. through interactions with family, friends, teachers and coaches, religious institutions, the media and so on)

general motion
any movement that combines linear motion and angular motion

generational change
a term used to describe the changing tastes, influences and preferences that take place within a population over time

genetic disposition
a term used to describe the physical and psychological characteristics that every person inherits from their biological parents (and the degree to which those characteristics make them think or act in particular ways)

goal setting
a technique used to identify a desired achievement and establish measures to track progress towards achieving it

Government funding
any financial assistance (i.e. money) from the government received by non-government institutions in the form of local, state, or federal grants, loans, property or other assistance

gravitational force
a non-contact force that attracts a body or object towards the centre of the Earth (or towards any other body that has mass)

green space
a general term used to describe any area of grass, trees or other vegetation set aside for recreational purposes in environments that are otherwise urban (i.e. built)

gross motor skills
skills that do not require a great deal of precision and use larger muscle groups or the whole body (e.g. running)

ground reaction force
a type of contact force exerted by the ground on a body or object that is in contact with it

group goals
the vision or aims of a team for their time together (i.e. the season)

group norms
the rules and expectations set out for all members of the team to follow

group roles
the formal and informal positions that each individual on the team is assigned or adopts

growth mindset
a belief that one's own abilities can be developed through hard work

H

height of release
the height at which an object is launched relative to the ground (or the landing point)

hierarchical
a term used to describe a process in which higher control centres (i.e. the brain) pass commands down to lower control centres (i.e. the muscles and nerves) in order to control movements

horizontal (or transverse) plane
one of the three planes of movement; movements in this plane are rotational. A golf swing is an example of movement along this plane

I

implements
equipment (e.g. bats, balls and other sporting apparatus such as a balance beam) that an athlete carries or uses when participating in a physical activity

improvement
a characteristic of motor skills; improvement refers to the ability of an individual to get better at performing a motor skill over time

impulse
a term used to describe the change in momentum that occurs over time when force is applied to an object

in the zone
(in sport) a term used to describe a state of focused concentration that allows an athlete or team to perform at the peak of their physical and mental ability

individual constraint
any individual characteristic that an athlete needs to overcome or adapt to (e.g. height, weight, skill level)

inertia
the tendency of an object at rest to remain at rest or of an object in motion to stay in motion (in a straight line) unless acted on by an external force

inertial force
a type of contact force that is generated by a resistance to change in the velocity of an object

information processing model
a theory that suggests humans receive, process and store information from their environment via the central nervous system (i.e. the brain and spinal cord)

input
information received by the brain from the body's senses (such as sight, touch, taste, smell and hearing) according to the information processing model

institution
a general term used to describe any organisation (e.g. school, sporting club, company, government or other formalised group) founded for an educational, professional, religious or social purpose

Instrument-specific marking guide (ISMG)
a tool for marking that describes the characteristics evident in student responses and aligns with the identified objectives for the assessment

internal force
a type of force that is generated inside the body (e.g. muscles inside the body contracting and relaxing to pull on tendons and joints to generate movement)

internal stimuli
information or cues that come from inside the body (e.g. thoughts, feelings, urges)

intrinsic feedback
the internal or sensory information that a player receives during and after a movement

intrinsic motivation
a type of motivation driven by internal factors (i.e. factors that come from inside a person) such as fun and personal satisfaction

irregular bones
bones that are unusually-shaped and designed to fit into different positions and perform different functions

irrelevant cues
extraneous (i.e. unnecessary) information that can distract an athlete

isometric contraction
a process in which the muscle fibres produce tension (i.e. force), but they neither shorten nor lengthen and there is no movement across the joint (i.e. the joint does not move)

isotonic contraction
a process in which the muscle fibres produce tension (i.e. force), as they shorten or lengthen and there is a range of movement across the joint (i.e. the joint moves)

J

joint reaction force
a type of contact force that is generated by two bones acting on each other across a joint

joints
the points at which bones meet and articulate with each other

K

knowledge of performance (KP) feedback
feedback that is concerned with the execution or process of the movement, as opposed to the outcome

knowledge of results (KR) feedback
feedback based on the outcome (i.e. result) of the performance

L

lever
a simple machine consisting of a solid bar supported by a pivot point (i.e. fulcrum) designed to help move a load (i.e. resistance) on one end by applying effort (i.e. force) on the other end

leverage
the advantage gained from using a lever

lift force
any force that acts to push an object or body upwards

ligament
a short band of tough, flexible fibrous connective tissue which connects two bones or cartilages or holds together a joint

line of gravity
the direction in which gravity is acting on a person or thing

linear
a term used to describe a process in which commands are carried out one after the other in sequential order

linear motion
any movement that happens along a straight line

long bones
bones that have a long shaft and a curved ends to absorb and distribute force

M

Magnus force
a type of force that explains why objects that are spinning as they travel through the air curve away from the trajectory (i.e. pathway) they would ordinarily follow if they were not spinning

mass
a measure of how much matter (i.e. particles and atoms) there are in a body or object

mass media
mass communication to a wide audience through a diverse collection of media technologies

massed practice
when a skill is practiced in a continuous and constant manner (and rest periods are either very short and non-existent)

mechanics
a branch of applied mathematics that deals with motion (and the forces that produce motion)

meditation
the practice of focusing attention on a single point of reference to create calmness and clarity

megatrend
a large-scale social, economic, political, environmental or technological change that takes place over an extended period of time

mental rehearsal
a technique used by athletes to develop skills, reduce anxiety, increase confidence and concentration, and ultimately improve performance

mesomorph
a term used to describe a body type that is muscular

midline
an imaginary line that runs vertically down the middle of the body (or through the middle of a body part) used as a reference to describe the angle and direction of joint movements

mindset
an established set of attitudes that determine how a person may interpret a situation and respond to it

momentum
a term used to describe the tendency of a moving object to continue moving (in a straight line); the mass (e.g. in kilograms) of an object multiplied by its velocity (e.g. metres per second)

motion
the action or process of moving or being moved; more specifically, the change in position of an object over time

motivation
a desire, need or want that causes a person to behave in a particular way

motor learning
a field of science that investigates human movement with the goal of understanding how humans acquire and retain the motor skills required to perform specialised movements (i.e. through practice, experience and/or feedback)

motor program
a movement plan (i.e. a plan of action) that contains all the commands from the brain to the muscles that are needed to perform a motor skill

motor reflex
an involuntary movement that is not consciously controlled and isn't designed to achieve a particular purpose or goal

motor skill
a voluntary movement that involves the use of specific muscles with the aim of achieving a defined purpose or goal; motor skills can be learnt and improved with practice

multimodal presentation
a presentation comprised of more than one media or component

movement strategies
a tactic or plan that assists a player or team to achieve an outcome or goal (e.g. moving into an opponent's space to intercept a pass or hit the ball away so they cannot score)

muscular system
a body system consisting of muscles and tendons which enables movement through connection to the skeleton; helps maintain temperature in the body

musculoskeletal system
a body system that is a combination of both the muscular system and the skeletal system; the musculoskeletal system provides support, stability, structure and movement in the body through the bones and muscles

N

natural environments
a term used to describe any environment that has not been significantly altered by humans

negative self-talk
saying negative comments to yourself

nervous system
a body system made up of organs, cells and fibres (including the brain, spinal cord and nerves) that collects information (stimuli) from different parts of the body and processes that information before transmitting impulses to activate responses in the muscles

Newton's first law of motion
a fundamental law of the physical world; this law states that an object will remain at rest or maintain a constant velocity unless an external force acts on it; also referred to as the law of inertia

Newton's second law of motion
a fundamental law of the physical world; this law states that the force required to accelerate an object at a given rate is proportional to the product of that acceleration and the mass of the body; also referred to as the law of acceleration

Newton's third law of motion
a fundamental law of the physical world; this law states that whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first object; also referred to as the law of action and reaction

non-contact force
a type of force that act on objects without coming into contact with them (e.g. gravitational force)

non-linear
a term used to describe a process in which commands are not carried out step-by-step in sequential order

non-self-determined motivation
a type of motivation that is not controlled by the individual

norm
a standard or pattern of behaviour that is typical or expected

O

open motor skills
skills that are performed in unstable, unpredictable or changing environments and require the person performing the skill to react to many different variables (e.g. passing the ball or shooting for goal in a netball game)

optimum angle of release
the angle at which both vertical and horizontal forces are equally applied to the projectile (in order to maximise the distance it will travel); the optimal angle of release required to maximise distance is generally considered to be around 45°, but varies depending on different situations and sports

outcome goal
a type of goal that focuses on winning and losing

output
a physical response or action executed by the body according to the information processing model

over-arousal
a state of arousal generally considered too high for optimum performance

P

parallel processing
the act of processing multiple pieces of information at the same time

part practice
when a skill is practised in its separate parts

pathways of movement
a term used to describe the pattern of direction the body is moving in (e.g. straight, curved, zigzag, angular or twisted)

performance goal
a type of goal that focuses on enhancing specific aspects of performance, often using statistics

performance segmenting
the process of breaking up a performance into more manageable periods in one's mind

persistence
a characteristic of motor skills; persistence refers to the ability of an individual to retain (i.e. keep) and perform a motor skill over time

personal ability
a term used to describe the combination of inherited qualities and learnt skills a person uses to complete a task or achieve a goal

personal factors
a range of influences at an individual level that can act as barriers or enablers to participation in sport and physical activities (e.g. age, personality traits, personal ability, gender, past experiences)

personality traits
psychological qualities and characteristics that determine our patterns of thinking, feeling and behaving

PETTLEP model
a framework to help athletes get the most out of mental rehearsal and visualisation by making it as close as possible to the real situation

phase
a distinct, observable period within the execution of a motor program or specialised movement sequence (e.g. a tennis serve or volleyball spike could be organised into preparation, action and follow-through phases or, similarly, into pre-impact, impact and post-impact phases)

physical activity preferences
the types of sports and physical activities that we choose to participate in (i.e. the sports we have a natural preference for over other sports)

planes of movement
an approach used to describe the different movements of the body; there are three planes (i.e. imaginary flat surfaces) that run through the body and along which the body moves: the sagittal plane (describes forwards and backwards movements), the frontal plane (describes side to side movements) and the horizontal plane (describes rotational movements)

positive cue words
single words or short statements to help refocus attention and combat negative thoughts or emotions

positive emotions
emotions that create an uplifting effect

positive self-talk
saying encouraging and motivating messages to yourself

pre-competition routine
a sequence of actions and/or thoughts that athlete follows just prior to performance or competition

pre-task routines
actions performed by athletes immediately prior to performing a task (e.g. a serve, free kick or pitch) within a performance

primary data
any data that you collect yourself that relates directly to your performance (e.g. video footage or photographs of your performance, sketches, personal performance statistics, etc.)

problem-solving drill
a type of task that requires learners to solve common problems (e.g. reading environmental cues) and respond to those problems in the most suitable way

process goal
a type of goal that focuses on improving technique

progressive muscle relaxation (PMR)
a stress-relief technique that involves the systematic tensing and relaxing of particular muscle groups in the body

projectile
any object (i.e. sporting implement or human body) that is launched, hurled or thrown into the air

projectile motion
a term used to describe the movement of any object that has been launched, hurled or thrown into the air

Q

qualitative analysis
a type of analysis that focuses on data that can be recorded in words (e.g. describing and analysing aspects of performance such as personal journals or diaries describing 'quality' of movement, personal observations, feelings and thoughts)

quality of movement
a body and movement concept; quality of movement relates to the characteristics (i.e. qualities) of a movement (e.g. speed, effort, force, accuracy, level of effort, etc.)

quantitative analysis
a type of analysis that focuses on data that can be recorded in numbers (e.g. measuring and analysing aspects of performance such as heart rate, stride length, distance covered, time spent in the air)

R

random practice
when several different sets of skills are practised in an order that is constantly changing

rate limiters
factors that have an effect on the development of motor skills in an individual and may restrict performance; rate limiters can be related to the individual, the environment or the task

reciprocal inhibition
a process during which the muscle (or muscles) on one side of a joint relax in order to accommodate the muscle (or muscles) on the other side of that joint that are contracting

relatedness
a person's need to feel a sense of belonging by interacting with others and feeling part of a group or community

relationships
a body and movement concept; relationships relates to the objects (i.e. the people and equipment) that an athlete interacts with during the performance of the skill

relaxation and energiser techniques
a range of different techniques aimed at optimising athletes' arousal levels

relevant cues
essential (i.e. important) information that an athlete needs to focus on

response execution
the third stage of the information processing model; the stage when the learner produces a response or action by implementing a developed motor program response selection
the second stage of the information processing model; the stage when the learner makes a decision by comparing information in stored memory

resultant force
the sum of lift force and drag force added together

S

sagittal plane
one of the three planes of movement; movements in this plane are forwards and backwards. A forward lunge is an example of movement along this plane

secondary data
any data that you do not collect yourself, but may still relate directly to your performance (e.g. video footage or photographs of elite athletes taken by other people, sketches or visual analysis performed by other people, performance data for other athletes, etc.)

second-class lever
a type of lever in which the load (i.e. resistance) is positioned between the effort (i.e. force) and the pivot point (i.e. fulcrum)

selective attention
the ability to process and react to certain stimuli selectively (when several stimuli accur simultaneously)

self-belief
an athlete's trust in their ability to succeed, regardless of their previous achievements and competencies

self-confidence
an athlete's conviction that they have the skills and abilities to succeed

self-determined motivation
a type of motivation that is controlled by the individual

self-determination theory (SDT)
a theoretical framework used to analyse human behaviour and explain what motivates people

self-efficacy
an athlete's belief in their ability to perform a particular task

self-organisation
a term used to describe a process in which many different systems and organs in the body interact with each other in order to achieve a task and establish a movement pattern that is stable

self-talk
words and thoughts directed towards yourself

serial motor skills
skills that are made up of a group (series) of different, discrete skills linked together to create a more complex movement sequence (e.g. a floor routine in gymnastics)
serial practice
when a set of skills is performed in a set sequence

serial processing
the act of processing one piece of information at a time

sesamoid bones
bones that are small and develop in tendons where pressure develops

sex
the biological and physical characteristics of males and females (i.e. their genitalia and genetic differences); either of the two main categories, male and female, into which humans and most other living things are divided on the basis of their reproductive functions

short bones
bones that are often cube shaped for strength

sidespin
when an object (i.e. projectile) rotates sideways, causing it to curve left or right during flight

skeletal muscle
a type of muscle that is usually attached to bones and is responsible for moving the skeleton; it is a striated (i.e. striped), voluntary muscle (i.e. one that we have control over)

skeletal system
a body system consisting of bones which gives the body its structure and supports and protects internal organs; provides attachment for muscles

skeleton
the internal framework of the body, which in adults is made up of around 206 bones

SMARTER principle
an acronym that athletes can use to remember all the elements required for effective goal setting (i.e. SMARTER goals are Specific, Measurable, Achievable, Relevant, Time-bound, Elevated, Recognised and rewarded)

smooth muscle
a type of muscle that is found in the walls of our internal structures (such as the stomach, blood vessels and intestines); it is non-striated (i.e. not striped), involuntary muscle (i.e. one that we have no control over)

social cohesion
the degree to which team members like each other and interact together

social construction of gender
the idea that society and culture create gender roles and that these roles (and the behaviours associated with them) are prescribed as ideal or appropriate for individuals of a particular sex

social factors
a range of influences at a social level that can act as barriers or enablers to participation in sport and physical activities (e.g. influences at the community level such as the opinions of friends, parents, teachers and coaches, social expectations, gender roles, levels of diversity in the community)

social support
the ability for team members to trust each other and actively seek each other out for assistance and support

socialisation
the process of learning to behave in a way that is acceptable to other people in the society in which we live

somatic anxiety
anxiety felt as a physical response

somatotype
a term used to help describe and classify human body shape and physique type

space awareness
a body and movement concept; space awareness relates to the relationship between the body and its surroundings (i.e. the space around it)

specialised movement sequence
a combination of fundamental movement skills (and movement elements) that enable the body to move in response to a stimulus

specificity practice
when skills are practised in an environment that is as close to match conditions as possible

speed
a measure of the distance an object travels over time (e.g. 30 kilometres per hour)

speed multipliers
levers that can increase the speed of, or distance travelled by, an object by changing a strong force that operates over a shorter distance into a weak force that operates over a longer distance

speed of release
the speed at which an object is travelling at the moment it is launched into the air

spongy bone
a lightweight mass filled with marrow, nerves and blood vessels; this forms the soft spongy centre of most bones

sponsorship
the act of providing money (i.e. to an athlete, club or sport) in exchange for the opportunity to promote or advertise the brand, product or service of a company (i.e. the sponsor)

Sport Australia
(formerly known as Australian Sports Commission (ASC)) a government agency in Australia responsible for providing strategic leadership and allocating funding for sporting activities at a national level

sport psychology
a field of science that investigates how an athlete's mental processes (e.g. their thoughts and emotions) influence their participation and performance in sport and physical activity; the discipline of sport psychology aims to assist athletes to achieve optimum mental health and to improve performance

sports marketing
the action or business of promoting and selling sports-related products or services (including market research, sponsorship and advertising)

stabiliser
a muscle that supports movement by promoting the same movement as the agonist or by reducing unnecessary movement (or undesired action)

stability
a characteristic of motor skills; stability refers to the ability of an individual to control the influence of internal and external factors on their performance of a motor skill

stage model of learning
a theory developed by Fitts and Posner in 1967 that explains the process of learning a motor skill in three stages – cognitive, associative and autonomous

state anxiety
situation-based anxiety

static balance
a term used to describe the ability of a person or thing to maintain balance when stationary (e.g. a gymnast holding position on a balance beam)

stereotype
a widely held but fixed and oversimplified image or idea of a particular type of person or thing

stimulus identification
the first stage of the information processing model; the stage when the learner recognises and identifies the input

sub-routine
a simple motor skill that – when combined with a number of other simple motor skills and sequenced in a specific order – is part of a motor program

summation of forces
a term used to describe the sequential combination of forces produced by different parts of the human body acting together to maximise force production

sutural bones (also known as Wormian bones)
small bones that are located between the joints of cranial bones in the skull

synovial joints
where the bones have a joint cavity and are held together by ligaments and separated by synovial fluid in the joint cavity

T

task cohesion
the ability to identify closely with the group's goals and to experience success in achieving those goals

task constraint
any aspect of a task that an athlete needs to overcome or adapt to (e.g. rule of a game)

team cohesion
the extent to which individual members of a team can work together and function as a single unified (i.e. united) whole

team dynamics
the relationships between all of the different members of a group (who are working together to achieve a common goal)

tendon
a flexible but inelastic cord of strong fibrous collagen tissue attaching a muscle to a bone

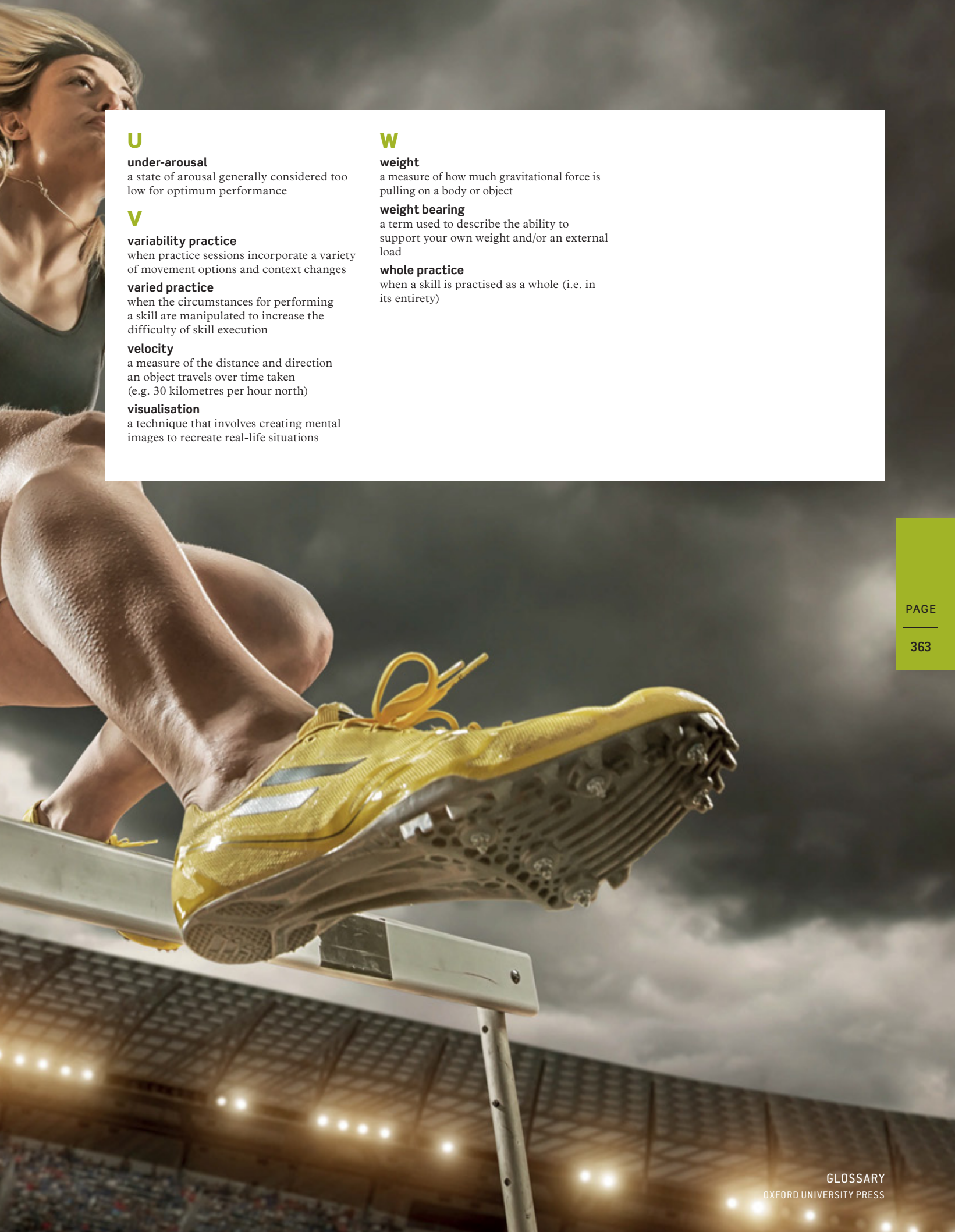
third-class lever
a type of lever in which the effort (i.e. force) is positioned between the load (i.e. resistance) and the pivot point (i.e. fulcrum)

topspin
when an object (i.e. projectile) rotates forwards on its horizontal axis, causing it to drop sharply during flight

trait anxiety
personality-based anxiety

trajectory
the line along which a projectile travels

trigger words
words or short statements used to focus attention on a specific task during or before the completion of a skill



U

under-arousal
a state of arousal generally considered too low for optimum performance

V

variability practice
when practice sessions incorporate a variety of movement options and context changes

varied practice
when the circumstances for performing a skill are manipulated to increase the difficulty of skill execution

velocity
a measure of the distance and direction an object travels over time taken (e.g. 30 kilometres per hour north)

visualisation
a technique that involves creating mental images to recreate real-life situations

W

weight
a measure of how much gravitational force is pulling on a body or object

weight bearing
a term used to describe the ability to support your own weight and/or an external load

whole practice
when a skill is practised as a whole (i.e. in its entirety)

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ACKNOWLEDGEMENTS

The authors and publisher would like to thank the following teachers for their considered reviews and advice during the development of this Student book:

• **Kirran Follers** – Head of Health and Physical Education, Brisbane State High School

• **Stephen Fogarty** – Director of Health of Physical Education, Brisbane Girls Grammar School.

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Chapter 5: AP/Reuters for the article 'Caster Semenya:IAAF rules to limit testosterone levels for female runners', 26 April 2018 on p. 308; AAP Image/DAVID CROSLING, 5.3:15; Alamy, 5.2:6; Alamy/Allan Devlin, 5.6:3; Alamy/Allstar Picture Library, 5.3:14; Alamy/carol moir, 5.1:2 left; Alamy/Steve Skjold 5.3:6; AP/Reuters, p. 308; Getty Images/AFP, 5.2:14; Getty Images/Duane Prokop, 5.3:11; Getty Images/Jaimi Chisholm, 5.2:8 left; Getty Images/Jono Searle, 5.2:15; Getty Images/Mark Nolan, 5.2:12; Getty Images/Matt King, 5.1:3; Getty Images/Peppo, opening image; Getty Images/Quinn Rooney, 5.2:8 right; Getty Images/Robert Laberge, 5.3:9 right; Getty Images/Seam M Haffey, 5.3:9 left; Getty Images/Elsa, 5.2:10; Getty Images/FRANCOIS-XAVIER MARIT/AFP, 5.4:9; Getty/Michael Dodge, 5.3:12; Glennie Aquatic Centre/Cassandra Daniells, 5.4:8; Lachlan Whelan, 5.3:13; Play by the Rules, playbytherules.net.au, 5.3:3; Shutterstock, 5.1:2 right, 5.1:4 (cultural, environmental, personal & social), 5.2:11, 5.2:13, 5.2:19, 5.2:2, 5.2:3, 5.2:4, 5.2:7, 5.3:16, 5.3:17, 5.3:2, 5.3:7, 5.3:8, 5.4:11, 5.4:13 5.4:14, 5.4:15, 5.4:17 5.4:2, 5.4:4, 5.4:5, 5.5:2, 5.5:3, 5.6:1, 5.6:2 (map only), pp. 255, 259 (phone), 318, 334; The Glennie School, for the article on p. 298.

Chapter 6: Getty Images/Peepo, opening image; Getty images/Robert Laberge, p. 352 right; Getty Images/Seam M. Haffey, p. 352 left; all other photographs by Shutterstock.

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OXFORD
UNIVERSITY PRESS
AUSTRALIA & NEW ZEALAND

ISBN 978-0-19-031319-7

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