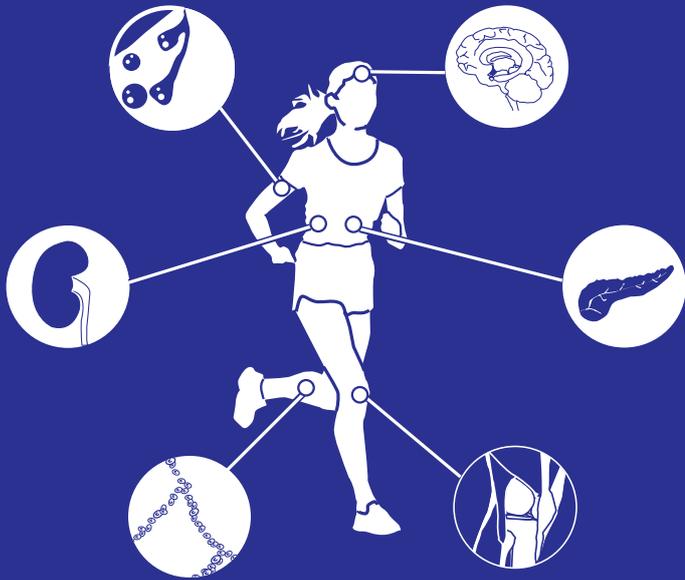
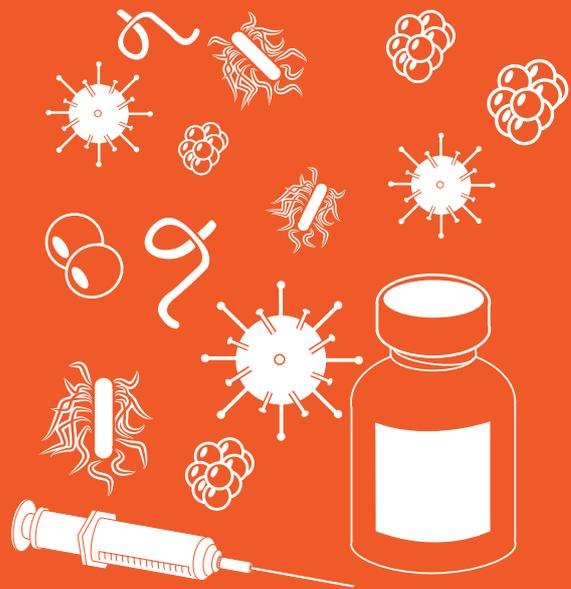


Year 12 General Human Biology Workbooks Unit 3 & Unit 4



Unit 3: Coordination

Unit 4: Infectious Disease



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Acknowledgements

The authors would like to acknowledge the work of the previous writers of the STAWA Human Biology resources, from which several activities have been adapted for this publication. We would also like to acknowledge Shenton College Science staff for providing us with the resources that they developed and use for teaching Human Biology. Some of the activities and diagrams from those resources have been used due to their quality and appropriate level of difficulty for this course. We would like to thank Lorraine McKenzie for editing the documents and making constructive suggestions.

STAWA Year 12 General Human Biology Unit 3 and 4 Workbook ISBN: 978-0-9925739-8-0

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Printed in Australia by: Daniels Printing Craftsmen - 10 Walters Drive, Osborne Park, WA 6017. Tel: (08) 9204 6800

Graphic Design by: Kattie Muir - Digital Crayon digitalcrayon@hotmail.com

Illustrations by: David Keigwin

CONTENTS

Structure and use of the general Human Biology resources	4
Glossary of key words used in the formulation of questions	5
CHAPTER 1 Skeletal System	7
CHAPTER 2 Muscular System	37
CHAPTER 3 Nervous System	62
CHAPTER 4 Endocrine System	79
CHAPTER 5 Disease	95
CHAPTER 6 Vaccines and Immunology	139
CHAPTER 7 Community and Global Health	163

Structure and use of general Human Biology resources

General information for teachers and students

This resource has been produced to support teachers and students in the absence of a textbook for this course. Each chapter corresponds to the topics outlined in the Science Understanding strand of the syllabus, with Science Inquiry and Science as a Human Endeavour incorporated where appropriate. The *Syllabus Dot Points* are included, and *Learning Intentions* and *Success Criteria* are provided so that teachers and students have a clear understanding of exactly what is expected to learn. Please note that these are suggestions from the writers only. Teachers and students are encouraged to formulate their own success criteria as part of the learning process.

Teachers should not use this book as their sole source of information and resources. This is a guide and provides some further resources to explore such as websites and educational films. Once again these are suggestions only. Practical activities are included in each chapter. These may include experiments, dissections, and interpretation of second-hand data. Safety issues have been highlighted where applicable. Teachers do not have to use all of the activities. These are suggestions but should be able to be completed even with somewhat limited resources. Students are encouraged to formulate their own tables for data collection and presentation, as well as practicing their graphing skills. There are several opportunities for students to draw labelled scientific diagrams.

Students should use this book as a source of essential information covering the syllabus dot points, but should seek other resources for greater depth of understanding. A glossary at the beginning of each chapter provides a list of key terms that students should define as they progress through the text. Students are encouraged to write their own notes using the '*Checkpoints*' as a guide. Some Checkpoint questions enable students to write answers in this book, but they are encouraged to write their own notes for revision. These have been included following each section of text information to enable students to consolidate their understanding of the key concepts and summarise the key points. *Chapter Review Questions* are found at the end of each chapter and should be answered by students in their notebooks as revision for each topic. There are '*Extras for Experts*' for students who want to check their depth of understanding of some concepts outlined in the chapter.

Glossary of key words used in the formulation of questions

Note – definitions in the glossary available from SCSA website syllabus documents are generic and applicable across all courses. Students should be aware of the meaning of the terms so as to be able to understand the questions asked in the book.

Word key	Definition
Account	Account for: state reasons for, report on. Give an account of: narrate a series of events or transactions
Advise	Recommend or inform
Analyse	Identify components and the relationship between them; draw out and relate implications
Apply	Use, utilise, employ in a particular situation
Assess	Make a judgement of value, quality, outcomes, results or size
Calculate	Ascertain/determine from given facts, figures or information
Choose (multiple-choice)	Decide or select the most suitable from a number of different options
Clarify	Make clear or plain
Classify	Arrange or include in classes/categories
Comment on	Make reference to and expand upon
Compare	Show how things are similar and different
Complete	Finish an outlined task
Consider	Reflect on and make a judgement/evaluation
Construct	Make; build; put together items or arguments
Contrast	Show how things are different or opposite
Correlate	Demonstrate a mutual or complementary relationship
Create	Make, invent something
Deduce	Draw conclusions
Define	State meaning and identify essential qualities
Demonstrate	Show by example
Describe	Provide characteristics and features
Determine	Decide, find out
Discuss	Identify issues and provide points for and/or against
Distinguish	Recognise or note/indicate as being distinct or different from; note differences between
Draw (diagrams etc.)	An instruction, as in <i>draw a circle</i>
Evaluate	To ascertain the value or amount of; appraise carefully
Examine	Inquire into

Word key	Definition
Explain	Relate cause and effect; make the relationships between things evident; provide why and/or how
Explore	Investigate, search for or evaluate
Extract	Choose relevant and/or appropriate details
Extrapolate	Infer from what is known
Identify	Recognise and name
Illustrate	Similar to 'explain' (see above), but requires the quoting of specific examples or statistics or possibly the drawing of maps, graphs, sketches, etc.
Interpret	Draw meaning from
Investigate	To plan, search or inquire into; examine in order to obtain the true facts
Justify	Support an argument or conclusion; give reasons for your statements or comments
Label (and annotate)	Identify by placing a name or word used to describe the object or thing
List	Provide a series of related words, names, numbers or items that are arranged in order, one after the other
Name	Provide a word or term used to identify an object, person, thing, place etc. (something that is known and distinguished from other people or things)
Outline	Sketch in general terms; indicate the main features of
Predict	Suggest what may happen based on available information
Propose	Put forward (for example, a point of view, idea, argument, suggestion) for consideration or action
Recall	Present remembered ideas, facts or experiences
Recount	Retell a series of events
Respond to...	Provide an answer; reply
Select	Choose somebody or something from among several
Show	Give information; illustrate
Sketch	A picture or diagram that is done quickly, roughly; a brief outline
State	Express the main points of an idea or topic, perhaps in the manner of 'describe' (see above)
Summarise	Express, concisely, the relevant details

CHAPTER 1

Skeletal System



Syllabus dot points

Science understanding:

- The support and movement of the body is facilitated by the structure and function of the bones and joints in the skeletal system.
- The location and structure of joints in the skeleton allow for a range of movement.
- The structure and development of long bones provide for strength, growth, and repair.

Science as a human endeavour:

- Skeletal damage caused by many sporting injuries are due to movements beyond the capabilities of the bones and joints, and treatment can be by basic first aid and medication, or radical surgery.

The Learning intentions and Success criteria are included as a guide to understanding expectations of students as outlined in the syllabus. Students could use them to review their understanding of the syllabus prior to assessments.

Learning intentions

1. Understand that bones and joints of the skeletal system have specific structures and functions that support movement of the body.
2. Identify the location and function of joints in the skeletal system and explain the type of movement they provide for the body.
3. Understand how long bones are formed to provide strength, for the skeletal system
4. Understand how a long bone can repair itself.

Success criteria

- Describe the functions of the skeletal system.
- Explain the structure of bone tissue.
- Identify and explain the main types of joint classification and give an example for each type.
- Explain giving an example the range of movement joints allow.
- Identify the structure of a synovial joint and explain the function for each structure.
- Explain, using examples, the types of body movement.
- Explain the process of stabilising a dislocated joint.
- Explain the process of managing a sprain
- Explain how a long bone is formed and grows.
- Explain how the structure of a long bone provides strength for the skeletal system.
- Explain the process of repair in a fracture of a long bone.

Key terms

Identify and fill in the definitions for the following key terms:

Key term	Definition
Abduction	
Adduction	
Ball and Socket Joint	
Bone Marrow	
Cartilage	
Circumduction	
Compact Bone	
Diaphysis	
Dislocation	
Epiphysis	
Extension	
Flexion	
Fracture	
Gliding Joint	
Hinge Joint	
Immovable	

Key term	Definition
Joint	
Ligament	
Medullary Cavity	
Moveable	
Periosteum	
Red Bone Marrow	
Saddle Joint	
Slightly Moveable	
Spongy Bone	
Sprain	
Synovial Joint	
Tendon	
Yellow Bone Marrow	

Skeletal system

The skeletal system is more than just a structure that enables the attachment of muscles. The skeletal system is a framework for support of the body's mass which consists of muscles that are attached to the bones. It also acts as a store for calcium, fats (lipids) and mineral salts. These stores are transferred through the circulatory system to areas of the body where they are needed. Blood cells are produced in the red bone marrow. The skeletal system also provides protection of vital organs. The cranium surrounds the soft tissue of the brain, the heart and lungs have ribs around them, and the spinal cord has vertebrae surrounding it while also allowing flexibility. Movement is an important function of the skeletal system. Working with muscles the body can perform precise movements like writing, and movements involving the whole body like running, through the movement at joints.

Checkpoint

Summarise the functions of the skeletal system in the table below:

	Summary of function
Framework of support	
Storage	
Production blood cells	
Protection	
Movement	

Structure of a long bone

Bones are made up of two types of bone tissue **compact bone** and **spongy bone**. The composition of bone consists of calcium salts and protein fibres called collagen. **Compact bone** makes up the dense outer layer of the bone that supports and protects the inner cavity and spongy ends of the long bone. Compact bone is thicker where there is stress on the bone. It is also very strong and provides the main weight-bearing support for the body.

Spongy bone is made up of thick branches creating an open network. This structure makes the bones lighter, reducing the weight of the skeleton making it easier to move. Spongy bone is not able to withstand stress therefore it is only found at the ends of the long bone where there is less stress on the bone structure. Spongy bone contains bone marrow.

There are two kinds of bone marrow red bone marrow and yellow bone marrow. **Red bone marrow** is where the red blood cells, white blood cells and platelets are created. Red bone marrow and blood vessels are found in spongy bone and compact bone, the blood vessels deliver nutrients to the bone cells.

The function of **yellow bone marrow** is to store fats that can later be used for energy. Yellow marrow also contains cells that produce cartilage.

Checkpoint

Complete the table below outlining the differences between compact and spongy bone.

	Structure	Function
Compact bone		
Spongy bone		

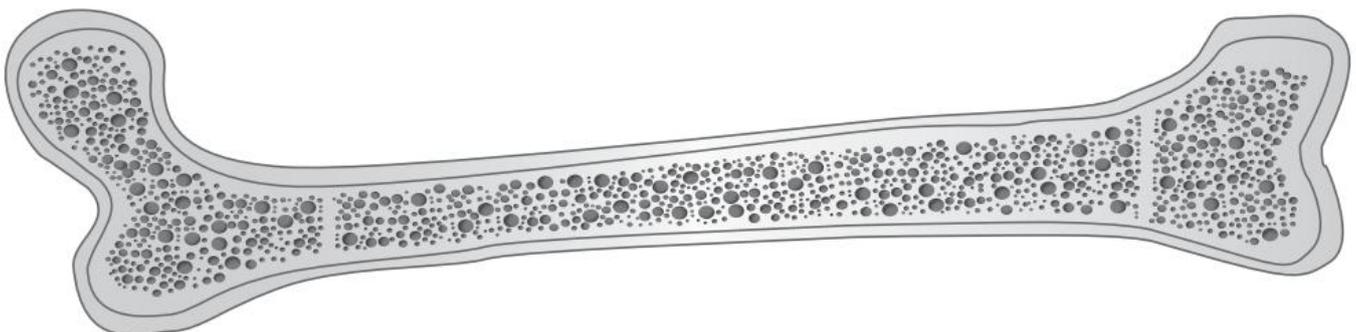
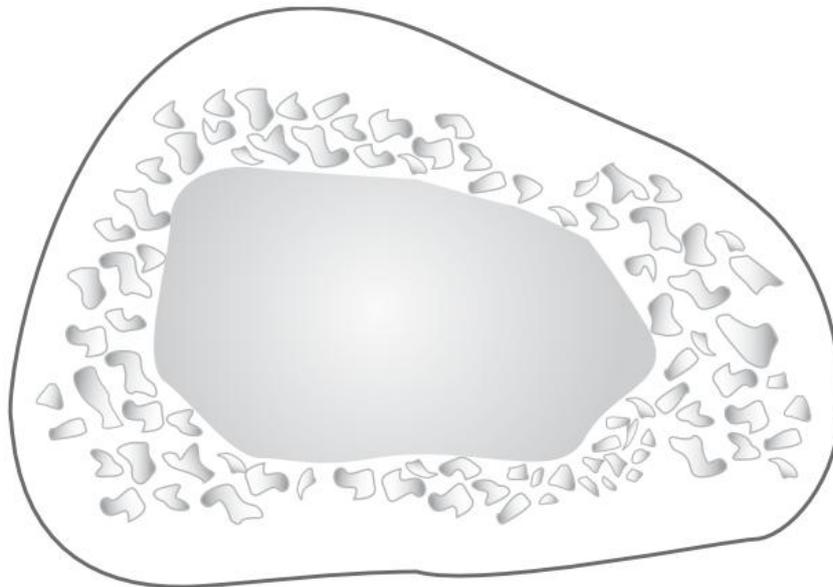
Identify where red marrow and yellow marrow can be found in a long bone.

Describe the functions of red marrow and yellow marrow.

Compare the strength of compact and spongy bone based on their structure.

On the top diagram below, colour the compact bone in green and the yellow marrow in yellow.

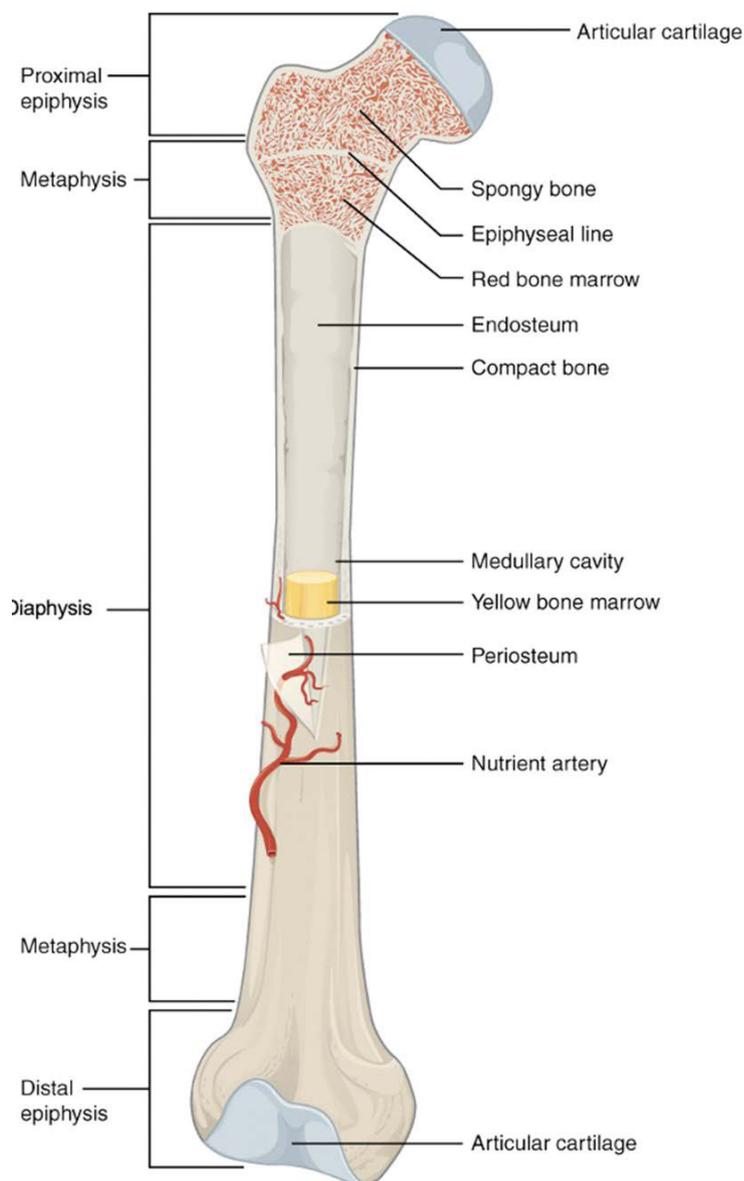
On the bottom diagram colour the compact bone in green, the spongy bone in red and yellow marrow in yellow.



A long bone is made up of an outer layer called the **periosteum**. This layer protects the bone and supports blood vessels entering the bone. The shape of the long bone consists of a long shaft and two ends. The two ends are called **epiphysis** and are filled with red bone marrow. Covering the epiphyses is articular cartilage. This provides a smooth, frictionless surface for bones to move at a joint. The long middle shaft is called the **diaphysis**. There is a hollow cavity in the diaphysis called the **medullary cavity**. In adults this is filled with yellow bone marrow.

Where the diaphysis and epiphysis meet is called the growth plate where growth of the bone takes place during childhood. Once adulthood has been achieved the growth plate (epiphyseal plate) fuses and becomes the epiphyseal line.

Bones have a large supply of blood vessels to ensure that the bone has a consistent supply of blood. This is necessary for the delivery of oxygen and nutrients from the circulatory system and the removal of wastes.



Checkpoint

Complete the table below, outlining the function of the components of a long bone.

Name of structure	Function
Diaphysis	
Epiphysis	
Metaphysis	
Medulla cavity	

Name of structure	Function
Periosteum	
Epiphyseal line	
Articular cartilage	
Red bone marrow	
Yellow bone marrow	

Explain why bones need a consistent blood supply.

Identify the function of spongy bone in a long bone.

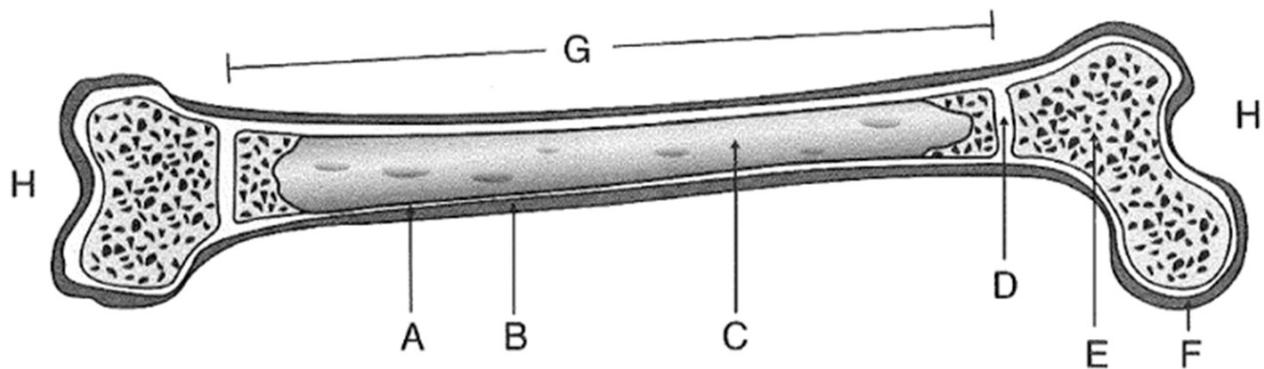
Identify the function of compact bone in a long bone.

Draw a long bone and label all the sections and parts.

Identify the position of articular cartilage in the bone and explain its function.

Label the parts of the long bone in the diagram below.

epiphysis, articular cartilage, diaphysis, spongy bone, compact bone, periosteum, medullary cavity, yellow marrow, red marrow



Properties of bones to provide strength and flexibility

The strength of bones is not only found in the material that bones is made up of, but also in the structure of the bone. A bone's structure is sturdy as it is made up of calcium salts, and protein fibres called collagen. The calcium in the bone makes it hard, brittle and inflexible. Collagen in the bone provides the opposite of the qualities of calcium in the bone. Collagen is flexible and tough, and it can tolerate twisting, bending and compression. This allows the bone to be both strong and partially flexible.

Joints

Joints are important as they support and protect the bones, they prevent the bones from rubbing together and stabilise where the bones meet. With the help of ligaments and tendons a joint becomes stable. Joints can get damaged in a dislocation where the bone moves out of the position it is being held in. This condition is painful and can damage the surrounding structures of the joint.

There are many different structures that make up a joint. They can also have different shapes depending on what they are being used for. Muscles around the joints are used to make the skeleton move.

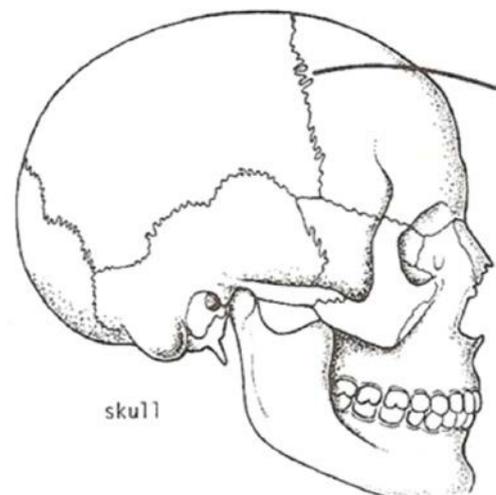
Types of joints

Joints can be classified into three broad categories. Joints can also be classified on the dominant type of connective tissue or by its range of movement.

Fibrous joint - immovable

Collagen connects two or more bones that are in close contact with each other. These joints are usually immovable. For example, the cranium has sections of bone and where they join is called sutures.

The image below shows the fibrous joints of the skull. These joints do not allow the bones to be pulled apart.



Cartilaginous joint - slightly movable

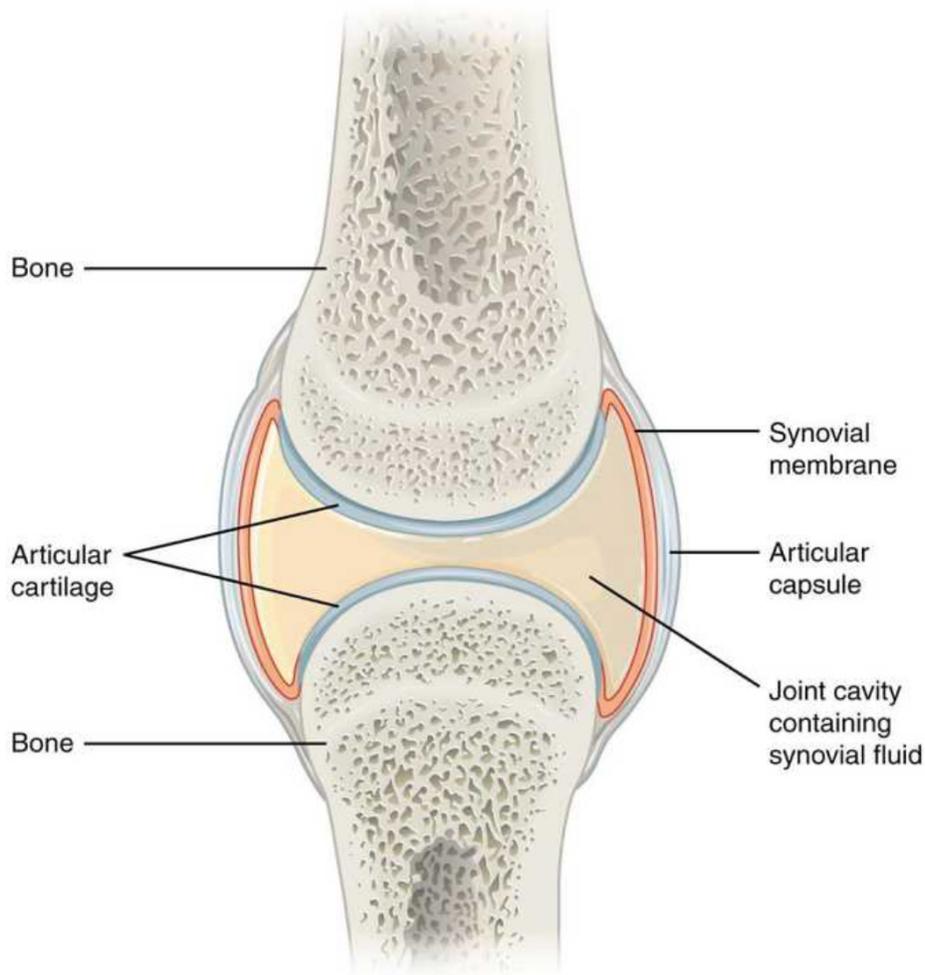
Cartilage joins two or more bones together allowing for slight limited movement. An example of this type of joint are the discs between the vertebrae and the symphysis pubis, the cartilage that joins the pelvic bones, shown in the diagram below. There must be some flexibility in these joints. For example, the vertebrae must enable the spine to move for bending and turning. In females, the pelvis must be flexible during childbirth.



Synovial joint - freely movable

The joint cavity is surrounded by fibrous connective tissue that attaches to each bone in the joint. The cavity produces synovial fluid secreted by the synovial membrane. Cartilage forms a covering around the end of each bone in the joint that acts as a protection for the bone.

The image below shows the structure of a synovial knee joint.



Checkpoint

Fill in the table below outlining the types of joints found in the body.

Classification	Description	Example
Fibrous joint		
Cartilaginous joint		
Synovial joint		

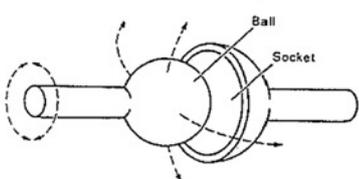
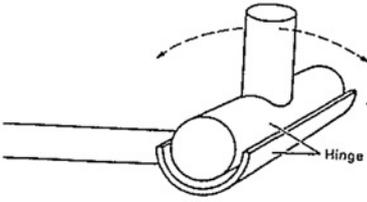
Types of synovial joints

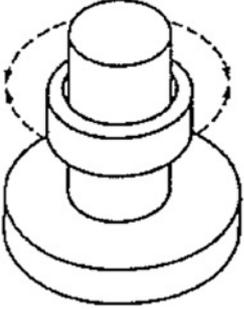
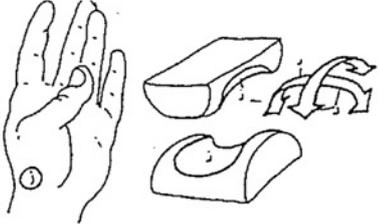
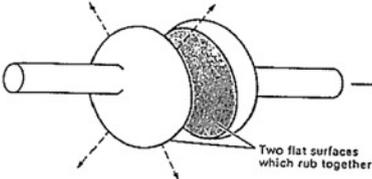
Synovial joints are further classified into six types of joints according to the movement they permit.

- **Ball and socket joint:** the round ball shaped end of a bone will fit into a cup shaped socket giving angular rotation. An example of this is found in the hip socket and shoulder joint.
- **Hinge joints:** Hinge joints allow angular motion in a single direction. An example of this is the knee joint.
- **Pivot joints:** A cylinder-shaped bone that is surrounded by a moon shaped bone. The cylinder-shaped bone can rotate backwards and forwards, allows rotary movement around a single point. An example of this is found in the vertebrae of the neck it allows the head to move from side to side.
- **Saddle joints:** They look like a saddle shape and a rider astride the saddle. Both bones fit together. An example of this type of joint is found in the thumb.
- **Gliding joints:** They are relatively flat surfaces that slide across each other. An example of this type of joint is found in the ankles and wrist.

Checkpoint

Fill in the table below, identifying the joints and explaining their movement.

Type of synovial joint	Diagram	Description	Types of movement	Examples
Ball-and-socket				
Hinge				

Type of synovial joint	Diagram	Description	Types of movement	Examples
Pivot				
Saddle				
Gliding				

Structure of a synovial joint

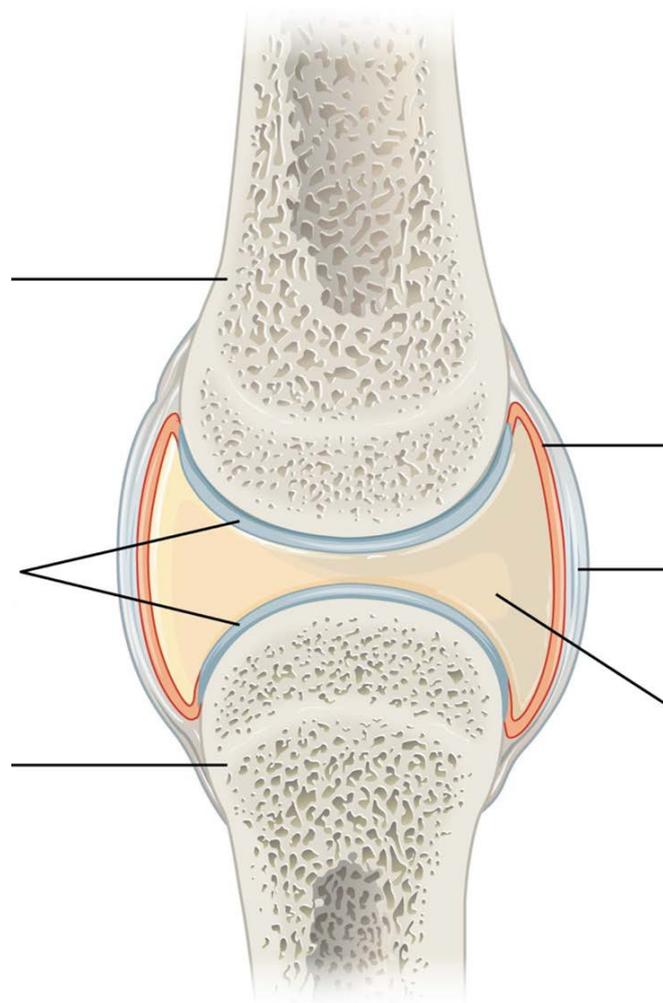
Synovial joints may contain different structures like:

- Cartilage forms a type of pad called a **meniscus**. This occurs in the knee only. The cartilage is fibrous yet smooth and slippery to enable the joint to have as little friction as possible. This meniscus is found between the two bones in the joint. Synovial fluid fills the joint cavity and acts as a lubricant to keep the joint moving easily.
- **Ligaments** support, strengthen and stabilise synovial joints by attaching joint to the surrounding bone to other bones. Ligaments are strong as they are made up of tough collagen fibres.
- **Tendons** provide a mechanical support for a synovial joint as it may limit certain movements. Tendons attach muscle and bone; they allow for movement as the muscle contracts and relaxes.

Checkpoint

Label the diagram of a synovial joint showing structures.

bone, joint capsule, synovial membrane, articular cartilage, synovial fluid, ligaments



Fill in the table below outlining the difference between cartilage, ligaments and tendons.

Structure of a synovial joint	Function
Cartilage	
Ligament	
Tendon	

Explain what would happen in a joint if the synovial fluid is removed.

Identify the differences between a ligament and a tendon.

Compare the structure and range of movement of a ball and socket joint with a hinge joint.

Identify the type of joint that would be found in the following:

Elbow _____

Wrist _____

Thumb _____

Knee _____

Joints and movement

Joints allow for a wide range of movement and with each movement the muscles around the joint will either contract or relax. The range of movement is restricted by ligaments and the shape of the bones.

An example of **flexion** is when an arm is bent, decreasing the angle between the lower arm bones (radius and ulna) and the upper arm bone (humerus). **Extension** is when the angle of the joint is increased by straightening the joint.

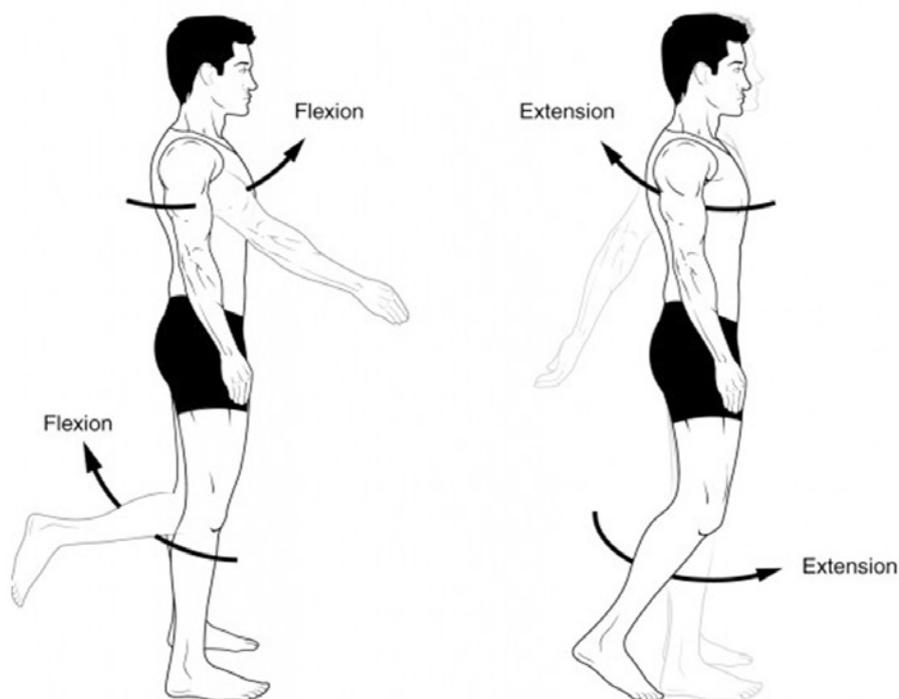
Abduction is moving the limb away from the centre line of the body. For example, moving the arm out sideways from the body. Think of abduction as 'taking away'.

Adduction is moving the limb back towards the centre line of the body. For example, moving an arm raised out sideways from the body back towards the body. Think of adduction as 'adding to'.

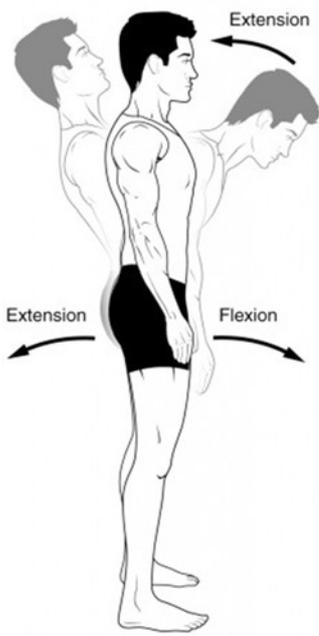
Rotation is the movement of a joint around its axis. For example, turning the head from side to side.

Circumduction is the movement in which the body stays relatively still while the moving part will circulate. For example, holding your arm still and circulating your hand. This movement is helpful when bowling a cricket ball.

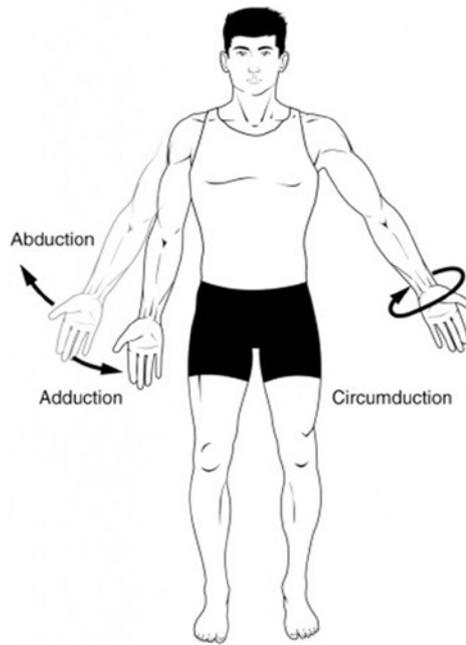
The following diagrams show the different types of body movement that utilises joints, ligaments, muscles, and tendons.



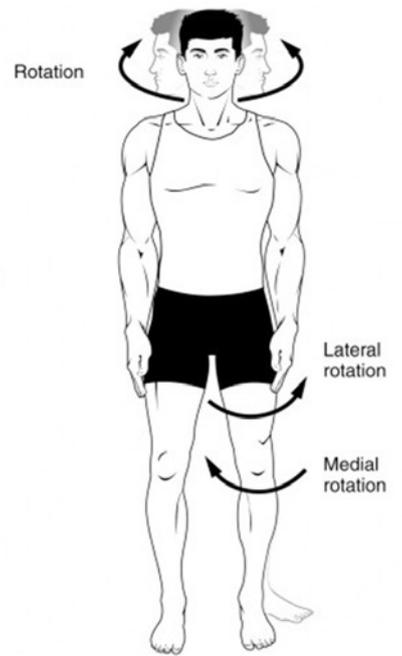
(a) and (b) Angular movements: flexion and extension at the shoulder and knees



(d) Angular movements: flexion and extension of the vertebral column



(e) Angular movements: abduction, adduction, and circumduction of the upper limb at the shoulder



(f) Rotation of the head, neck, and lower limb

Checkpoint

In the table below Identify the type of body movement giving an example.

Type of movement	Description	Example
Flexion		
Extension		
Abduction		
Adduction		
Rotation		
Circumduction		

Describe the movements at joints of a:

Cricketer batting

Runner

Football player kicking the ball

Sporting injuries and the skeleton

A dislocation is when a bone is knocked out of place in a joint. There is usually injury to the ligaments as they can tear, tendons that tear and muscles can overstretch. This can happen during sport or in an accident like a car accident or a fall. A dislocation causes trauma and pain to the joint. Dislocation symptoms include pain near the injury, discoloration, and swelling. Other symptoms include difficulty for the person to move normally, and the injured joint may look abnormal or deformed.

The treatment for a dislocation includes immobilising the joint by stopping any movement, this can be done by supporting the injured joint with a padded splint. Call an ambulance and keep the injured person as comfortable as possible.

Checkpoint

Describe what may cause a joint to dislocate.

Describe how you can tell if a joint may have been dislocated.

Explain what procedure a person would follow to stabilise a dislocated joint.

Identify structures within the joint that could be affected from the dislocation.

Managing a sprain

Ankles are a common site for a sprain as this is where three bones join and held by ligaments. The ligaments help to prevent the ankle from rotating too much and stabilise the joint. A sprain happens when the joint is rolled or twisted with enough force to put strain on the ligaments. The movement can stretch or even tear ligaments causing a sprain.

The symptoms for a sprain are swelling and bruising of the affected joint. The person may also have localised pain, numbness of the joint and surrounding area, and difficulty moving the joint depending on the level of damage that has occurred.

The treatment for a sprain is RICE – Rest, Ice, Compression and Elevation.

Checkpoint

Identify ways to reduce risk of a sprain.

Identify ways to prevent the stretching of tendons while exercising or playing a sport.

Identify the joints that are more likely to experience a sprain.

Explain the procedure to treat a sprain.

Human skeleton

There are 206 bones in the adult human body. Babies have over 270 bones but many fuse before adulthood. The largest bone in the body is the leg bone (femur) and the smallest bones are found in the middle ear called staples. Some bones are listed below with information about each bone.

Head

The head consists of eight **cranial bones**, they provide structure for the face and protect the brain. The head also has the jaw attached and is made up of the maxilla at the top and the mandible making up the lower jaw.

Upper body – shoulder girdle

Clavicle, also called a collar bone, attaches to the sternum (breast plate). The clavicle has an s-shape.

Scapula, also called the shoulder blade, has a triangular shape. A complex structure of muscles, ligaments and tendons hold the scapular in place.

Upper limbs

Humerus is in the upper arm. The **radius** and **ulna** run parallel and make up the lower arm.

Carpal and **metacarpals** are in the wrist and hand, the **phalanges** make up the fingers.

Pelvic girdle

The pelvis or hip bone is a large bone as it attaches to the lower part of the body and has the sacrum at the back. The hip bone is different in males and females as in females this section becomes part of the birth canal.

Lower limbs

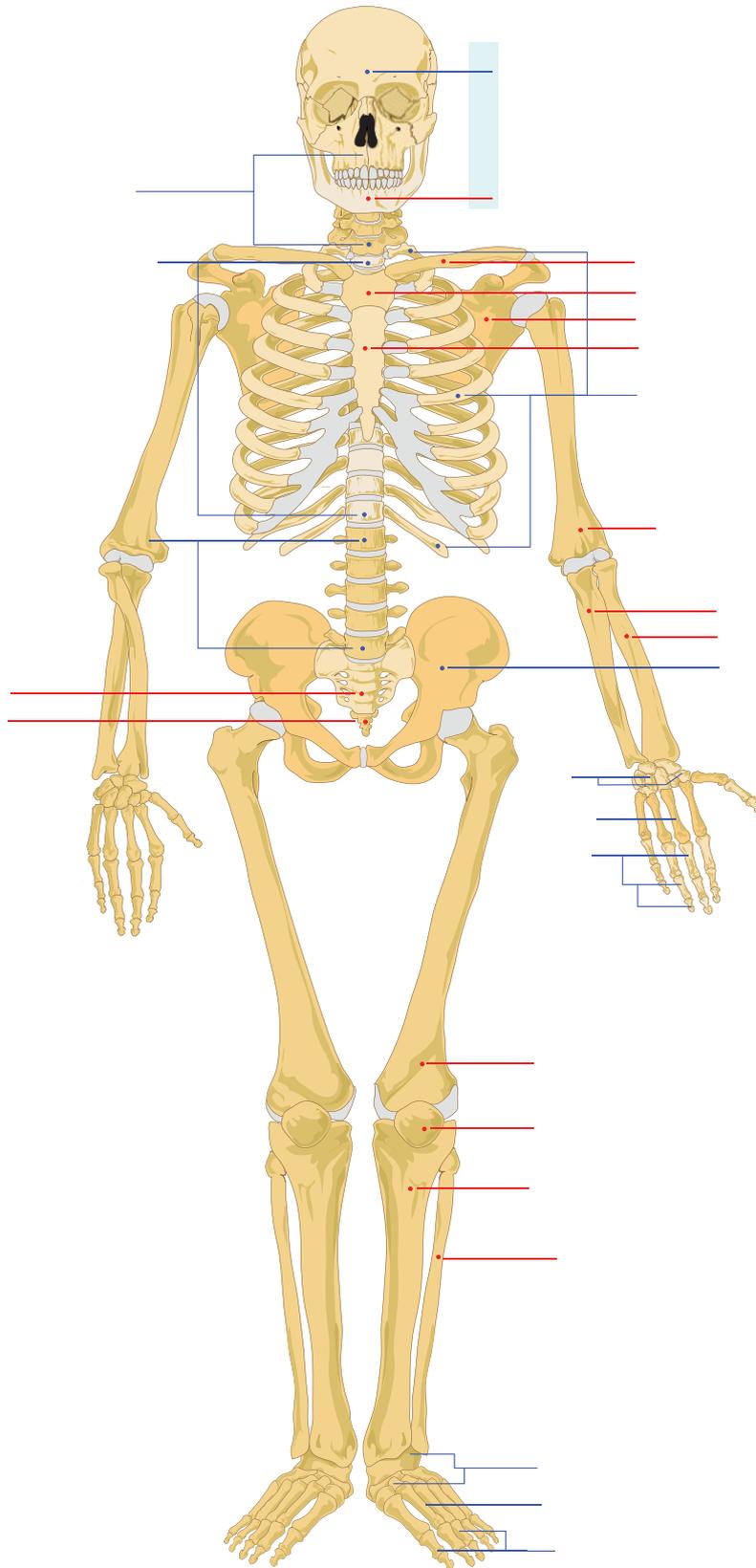
Femur is the upper leg bone that fits into the hip socket, it is the heaviest and largest bone in the body.

Patella is also called the kneecap it covers the knee joint.

The **tibia** (shin bone) and **fibula** run parallel to make up the lower leg

Tarsal and **metatarsals** make up the ankle and foot bones, **phalanges** make up the toes.

Label the diagram below showing the different bones in the body. Identify the axial and appendicular skeleton.



Checkpoint

Identify how many vertebrae make up the spinal column?

Identify the internal organs the sternum protects.

Identify the bone that is held in front of the knee joint and explain its function.

Explain how the vertebrae allow for movement.

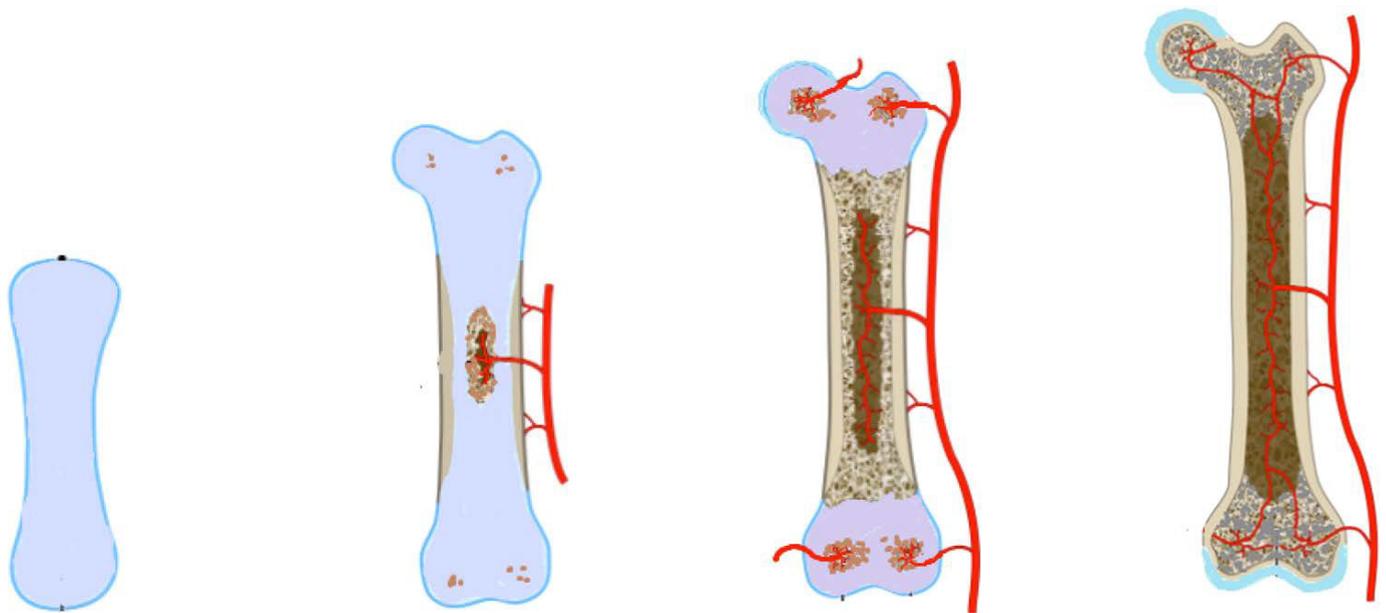
Identify the bone the top of the femur attaches to and identify the type of joint.

Ossification

Ossification is the process of bone tissue formation and hardening into bone tissue.

At 6 weeks an embryo has started to form limbs made of hyaline cartilage. These will grow and expand as the embryo develops. The process of bone growth is to replace the cartilage and remodel it to the structure of bone tissue.

The image below shows the stages of bone growth.



Stages of bone growth

Cells form cartilage that starts the skeleton of the new bone.

A blood supply penetrates the cartilage and start delivering nutrients and oxygen to the newly forming bone.

Bone cells are called osteocytes. These cells maintain the bone.

Bone is laid down by bone-forming cells called osteoblasts (osteo = bone; blast = making cells) over time until the entire structure is made of bone.

Bone-shaping cells called osteoclasts (osteo=bone; clasts= breaking) continue to refine the shape of the bone.

When an infant is born the only cartilage that remains is at the joint surfaces and between the diaphysis and epiphysis as a growth plate (epiphyseal plate) used to longitudinal growth.

Checkpoint

Create a poster for an antenatal clinic showing the stages of bone growth of a foetus. You must include:

- An introduction explaining the importance of bone development as a foetus.
- Stages of growth of bones.
- Labelled diagrams.

Bone growth needs vitamin D, C and A in addition to calcium, phosphorus, and magnesium. The hormones required to maintain homeostasis are parathyroid hormone and calcitonin. This will maintain proper bone growth and maintenance.

Create an information sheet outlining how a person can keep their bones healthy. Points to include:

- Diet, vitamins, and minerals.
- Physical activity.
- Medications
- Gender
- Body mass
- Ethnicity
- Hormone levels

Fracture repair process

Even though bone is strong, it can crack, fracture, or even break due to sudden stress on the bone or direct force to the bone. The symptoms of a fracture are swelling, discolouration, abnormal sensation, and numbness.

A fractured bone can repair itself if there is an adequate blood supply to the damaged area of the bone. The bone is highly vascular meaning it has a lot of blood vessels and capillaries, this can lead to a loss of blood due to a bone fracture. A loss of blood supply to the damaged bone can result in the death of the bone tissue. Nerves can be affected in the injury too resulting in a change in sensation.

The time taken to heal a fracture depends on many factors like age of the person or nutrition. Mitosis occurs very slowly in bone making healing time slow. This is why it is important for bones to be stabilized in a cast during healing.

Checkpoint

Describe the function of collagen in bone tissue.

Explain why bones need a good supply of blood vessels for repair.

Explain the process of helping a person with a fractured bone.

Activity: Bones of the skeleton

The skeletal system is made up of bones, cartilage, and ligaments. It is responsible for support, protection, blood cell production, mineral storage and helps in body movement. There are 206 bones in the adult human and approximately 100 joints. Some bones are very small, such as the ones that transmit sound vibration through the ear. Many of the larger bones are known by either their common names or their scientific names. Often these can be the same. The names of bones help identify areas of the body and are used to name other features found nearby.

Activity purpose

- Identify and locate the major bones of the body.

Materials

- Access to a life size skeleton
- Textbook with labelled diagrams of the skeleton
- X-rays of various bones, fractures and other injuries if possible
- Sticky labels
- Large felt pen
- Unlabelled diagram of skeleton

Procedure

- In the table below, list all the names of bones you know (before looking in the textbook). If you know where the bones are in the body, fill in the right-hand column.

Bones I know	Where I think the bones are in the body

Bones I know	Where I think the bones are in the body

2. Write the names of the bones you have listed in the table onto separate sticky labels.
3. Place the sticky labels on what you think are the correct bones on the skeleton.
4. Discuss your placement of the labels with your group to get consensus. If there is no agreement on some, use two different sticky labels each with the person's name.
5. Check with the textbook to see how well you went.

Questions

How many bones did the people in your group know? _____

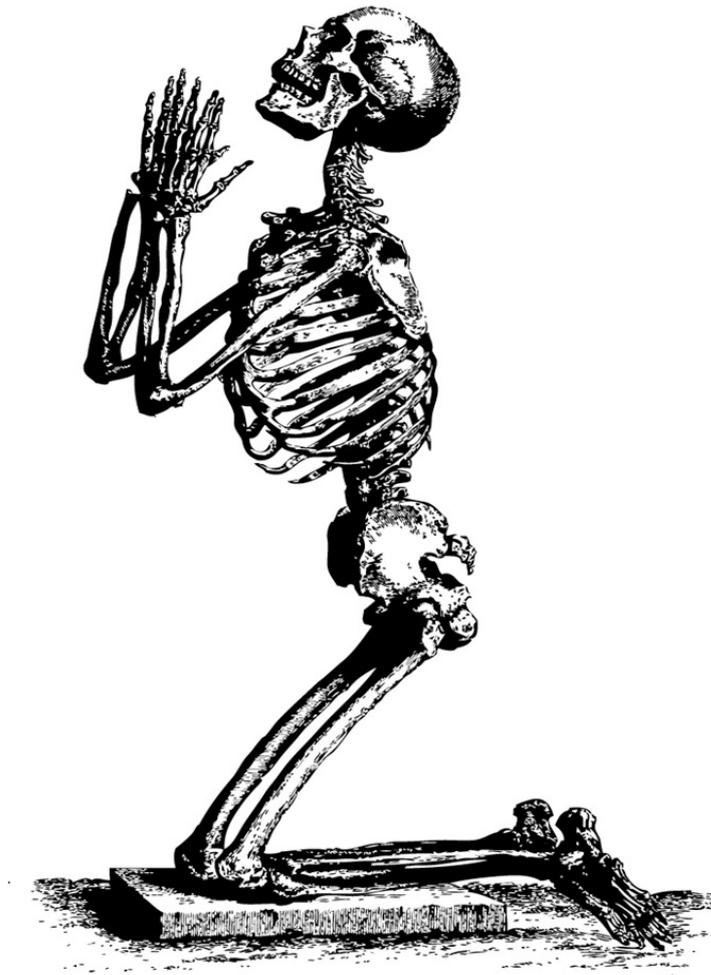
How many bones did you know the scientific term for? _____

Give three examples where the scientific name of the bone is the same as the common name.

How well did your group locate the bones? Put a mark on the line to indicate your ability.

Absolutely fabulous (all correct) ----- Absolutely awful (all wrong)

Label the diagram of a skeleton provided.



Research tasks

Your teacher will assign each research task to groups of 3 or 4 students. Students will then communicate their findings. This could take the form of a poster or PowerPoint presentation.

Research the diseases osteoarthritis and osteoporosis

- Identify a cause.
- Describe the symptoms.
- Determine if there is an age, gender, or ethnicity determinant for developing these diseases.
- Describe the type of treatments.

Observe some X-rays provided by your teacher.

Discuss with your group the identity of the bones pictured in the X-ray and any injuries that you can observe.

Chapter review

- State three functions of the skeletal system.
- Describe the difference between spongy bone and compact bone..
- Draw and label a typical long bone.
- List the three main types of joints.
- Describe the movements of the different types of synovial joints.
- Describe the structure of a synovial joint.
- Define flexion and extension.
- Describe the different parts of the vertebral column (spine).
- Describe the procedure for treating a sprain.

CHAPTER 2

Muscular System



Syllabus dot points

Science understanding:

- Locomotion and balance are facilitated by the structure and actions of the skeletal muscles.
- Skeletal muscles work in groups around joints to bring about the desired action, while maintaining stability of the joint and providing strength to the action.
- The structure of muscles allows for small movements at cellular level to combine to produce large, strong movements used in walking, balance and arm movements.

Science as human endeavour:

- Dysfunctions of the nervous and/or the muscular systems can be debilitating to affected individuals, and ongoing research needs to occur to discover causes and/or improved treatment.
- Increased understanding of the central nervous system and muscle coordination have led to innovations in the treatment of injuries.

The Learning intentions and Success criteria are included as a guide to understanding expectations of students as outlined in the syllabus. Students could use them to review their understanding of the syllabus prior to assessments.

Learning intentions

1. Understand how the macroscopic and microscopic structure of skeletal muscles allow for muscular contraction.
2. Understand that skeletal muscles work with other muscles in various ways to bring about desired actions at joints.
3. Understand how the muscles of the foot, knee, hips, and arms work together during walking and maintaining balance and posture.

Success criteria

- Describe the macroscopic structure of skeletal muscles.
- Describe the microscopic structure of skeletal muscles.
- Outline the movements of the myofilaments that cause muscle contraction.
- Give examples of antagonist pairs of muscles and describe how they work together to allow movement.
- Describe the action of muscles of the feet, knee, hips, and arms when walking.
- Define muscle tone as it relates to balance and posture.

Key terms

Identify and fill in the definitions for the following key terms:

Key term	Definition
Agonist	
Antagonist	
Antagonistic pairs	
Belly	
Fixator	
Insertion	
Muscle fibre	
Muscle tone	
Origin	
Skeletal muscles	
Synergist	
Tendons	

The muscular system

There are three types of muscle in the body, voluntary skeletal, smooth involuntary and cardiac muscle. There are over 650 voluntary muscles in the human body, making up 35-45% of your body weight. Muscles are made of long and thin, but strong fibres and attach to bones by tough collagen cords called **tendons**. Muscles allow the bones of the skeleton to move at the joints and move the bones by contracting (shortening). Muscle can also stretch and are elastic (can return to their original length).

These three features of muscles – contractability, extensibility, and elasticity – allow muscles to work together to move the body. Muscles can only pull on bones – they cannot push bones to create movement. For example, the triceps is the muscle in your upper arm that allows you to straighten your arm. If the triceps was injured, the biceps cannot push the forearm to straighten the elbow.

Checkpoint

Name the structure that attaches muscles to bone.

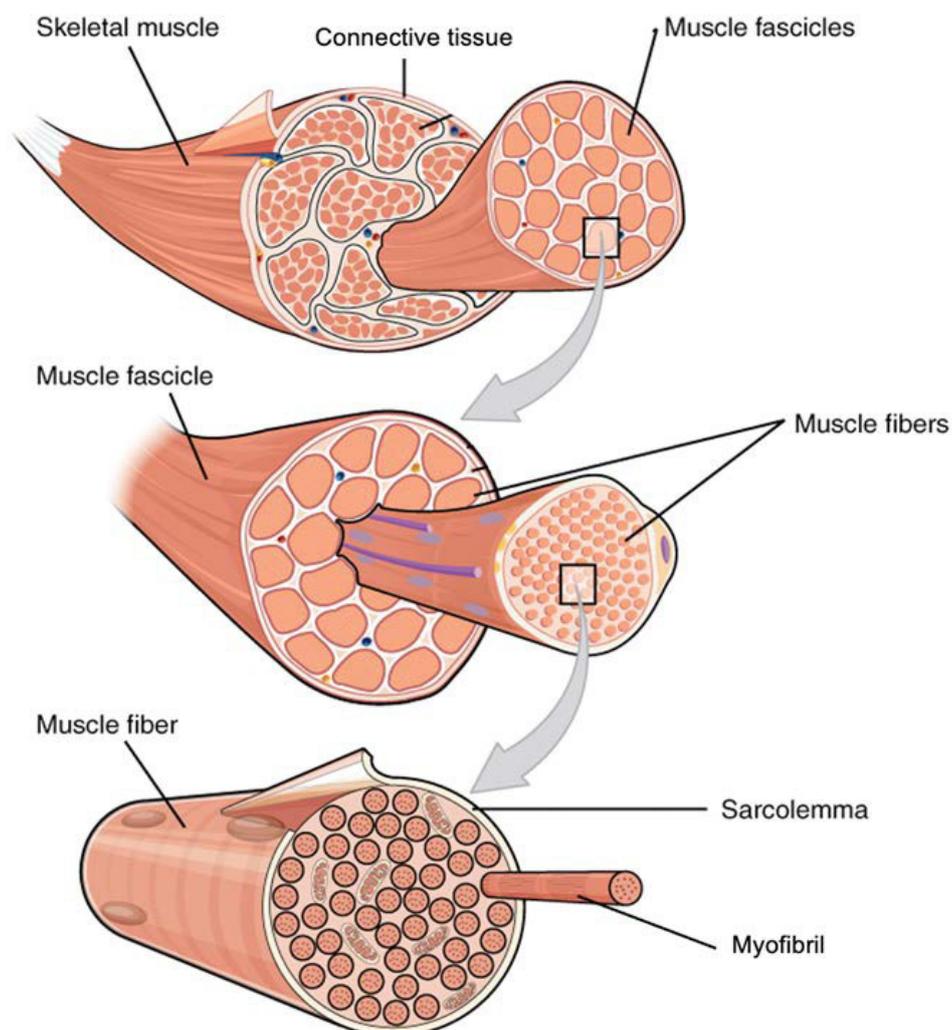
List the three properties of muscles.

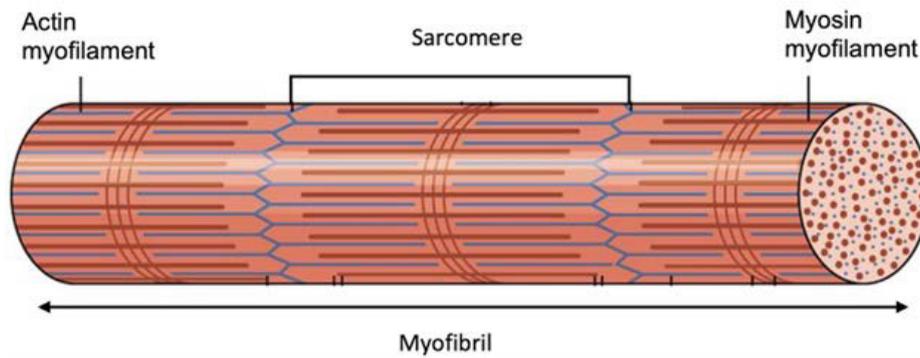
Structure of skeletal muscles

Skeletal muscles are muscles that are attached to the bones of the skeleton and allow for voluntary actions, such as walking, texting, talking or bending an arm.

Skeletal muscles are arranged in bundles called fascicles, and each fascicle is surrounded by connective tissue. The connective tissue is smooth to allow bundles to slide over each other easily. Within each fascicle are long and thin **muscle fibres** (also called muscle cells). Muscle fibres are different to other cells in that they have many mitochondria, more than one nucleus, and have specialised structures called myofibrils. Myofibrils are made up of myofilaments called actin and myosin.

The diagram below shows the structure of skeletal muscle.





Myofibrils are made up of myofilaments called actin (thin filament) and myosin (thick filament). Myofilaments are arranged in contractile units called sarcomeres that allow actin to slide over myosin when given the signal to contract. This small sliding action at the cellular level is magnified across the myofibrils of the muscle fibre, which leads to the contraction of the whole muscle.

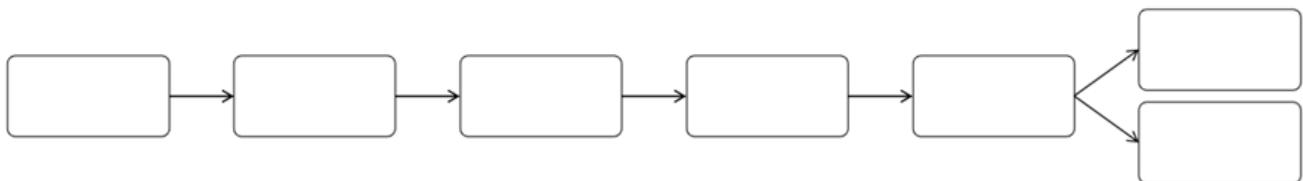
Checkpoint

Circle the following scenarios that would be controlled by voluntary skeletal muscles:

- Running
- Beating your heart
- Picking up a pencil
- Pupil dilation
- Peristalsis of the small intestine
- Doing a sit-up

Complete the flowchart of the structure of a skeletal muscle using the following words:

myofilaments, fascicles, belly, myosin, muscle fibre, actin, myofibril



In the space below, draw a relaxed sarcomere and a contracted sarcomere underneath. Label the actin and myosin.

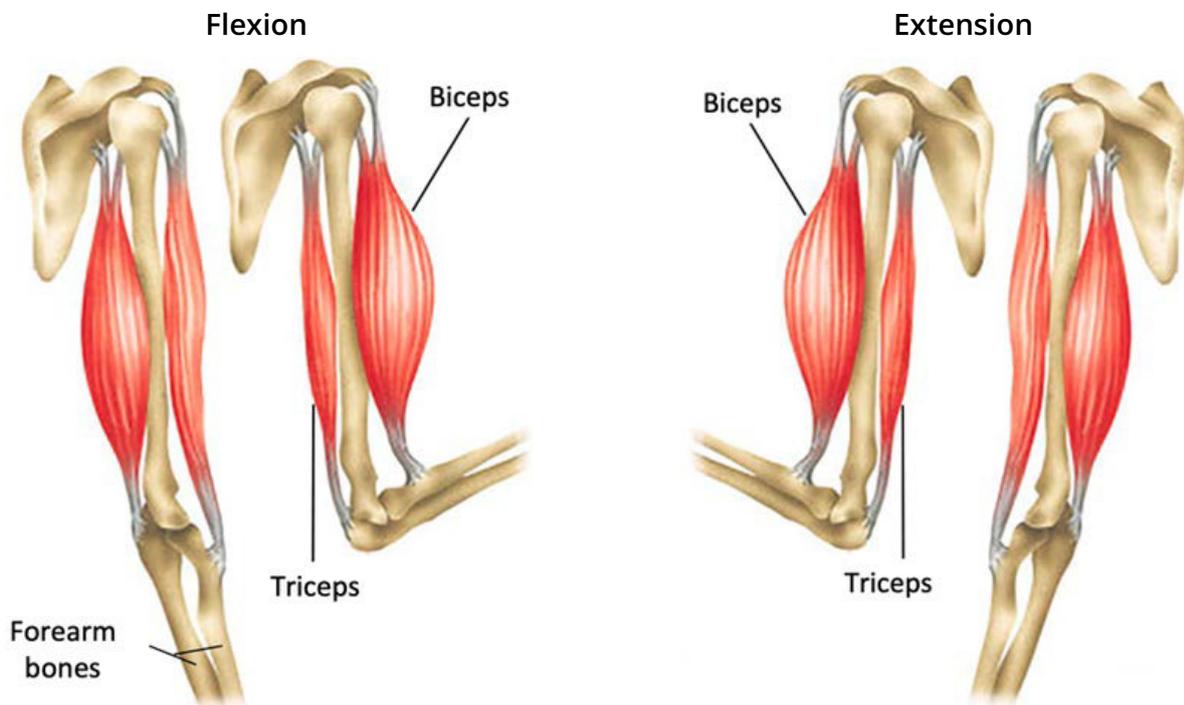
Refer to your diagram above to explain how these movements at the cellular level can result in the entire muscle contracting.

Muscles working together

There are at least two muscles attached to every moving bone that work as a team. When we bend the arm at the elbow, the biceps muscle bulges and shortens (contracts) to pull the forearm bones up. At the same time, the triceps muscle relaxes and stretches (extends).

When your arm is straightened, the forearm bones are pulled down by the triceps contracting as the biceps muscle relaxes.

On the diagram below, label the humerus, radius and ulna.



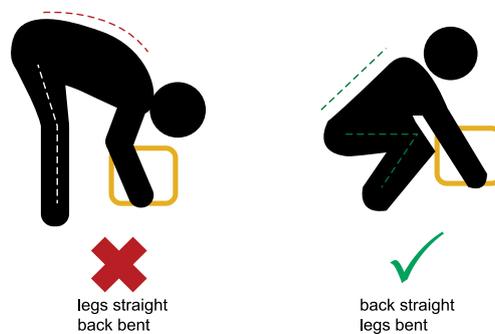
A pair of muscles that work opposite from each other i.e. as one contracts the other relaxes, to produce movement around a joint are called **antagonistic pairs**, or antagonistic muscles. The muscle that contracts to perform the desired action is called the **agonist**. The muscle that relaxes when the agonist contracts is called the **antagonist**.

Perform a biceps curl by lifting something with reasonable weight (e.g. a chair or a textbook). Place your other hand on your triceps as you do this. It should feel relaxed and you might even be able to move it around. Now place your hand on the middle of your biceps. It should feel hard and bulge out. This middle portion of the muscle is called the **belly**. Follow the muscle up towards the shoulder. You should feel it flatten and taper at the end. This is where the tendon attaches to scapula in the shoulder. Since your scapula does not move during a biceps curl it is called the **origin** – the attachment site

that is stationary during muscular contraction. Follow the belly of the biceps towards your elbow and forearm bones. Once again, you should feel the tendons attaching to the radius as the forearm moves. The attachment site of the moveable bone in a contraction is called the **insertion**.

Perform the biceps curl again. Place your hand on your forearm muscles. Are they also contracting? Muscles that contract to assist the agonist are called **synergists**. In this case, these forearm muscles are helping the biceps – the agonist – to lift the object. You might be able to feel another synergistic muscle underneath your biceps.

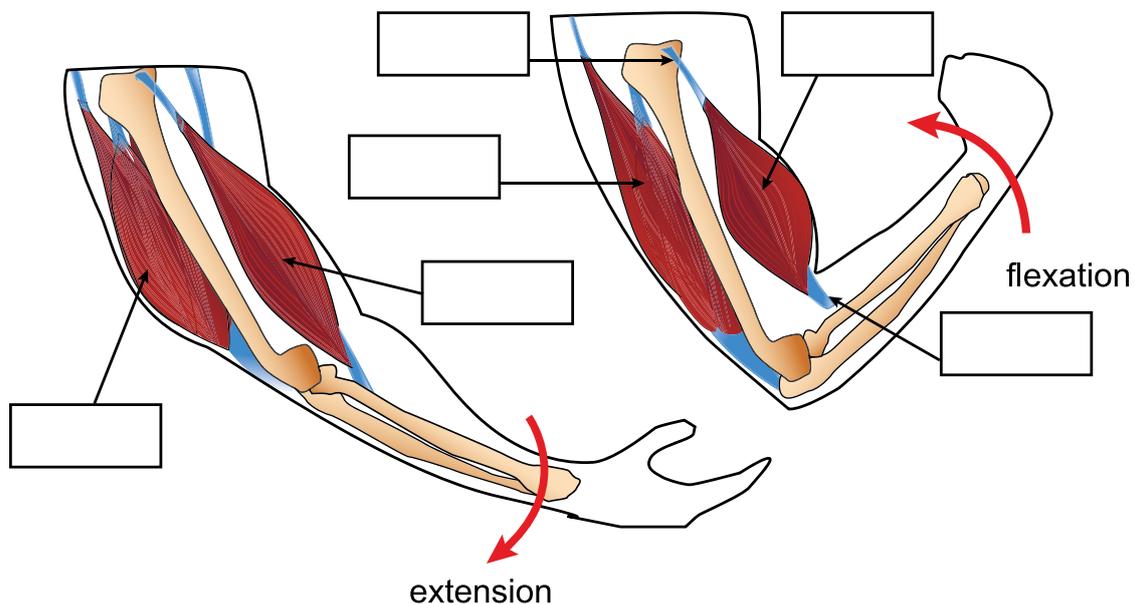
Fixators are muscles that stabilise one joint during the movement at another joint. In the same example, as you bend your elbow to lift the object, there are fixators attaching to your shoulder blade and down your back. They contract opposite to the agonist to hold your shoulder in place and keep your back straight. This is why people will often injure their back if a load is too heavy or they did not use proper lifting techniques, as shown in the image below.



Checkpoint

The diagram below depicts biceps extension and flexion. Write the following labels into the correct boxes:

relaxing triceps, biceps origin, contracting biceps, relaxing biceps, biceps insertion, contracting triceps



Define the term 'antagonist pairs' and give one example of antagonist pairs in the body.

Outline the similarities and differences between agonists and synergists.

Extend one arm palm down. Place your other hand on the back of your forearm near your elbow. Make a fist with the extended arm. The agonist is in the inner forearm. Did you feel the muscles at the back of the forearm contract instead of relax?

What is the term given to muscles that contract opposite to the agonist?

Suggest a reason for these muscles contracting when making a fist.

Activity: Muscles working together

Activity purpose

- To produce a working model of an antagonistic pair of muscles to demonstrate how these muscle work together to produce movement at a hinge joint.

Science inquiry skills

- Design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics, including animal ethics.
- Interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments.
- Select, use and/or construct appropriate representations, to communicate conceptual understanding, solve problems and make predictions.

Safety

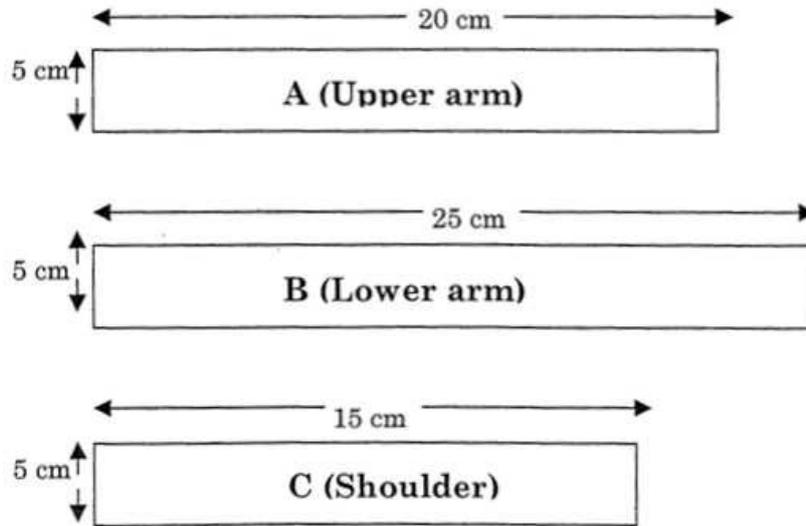
Care is to be taken when handling scissors and box cutters.

Materials

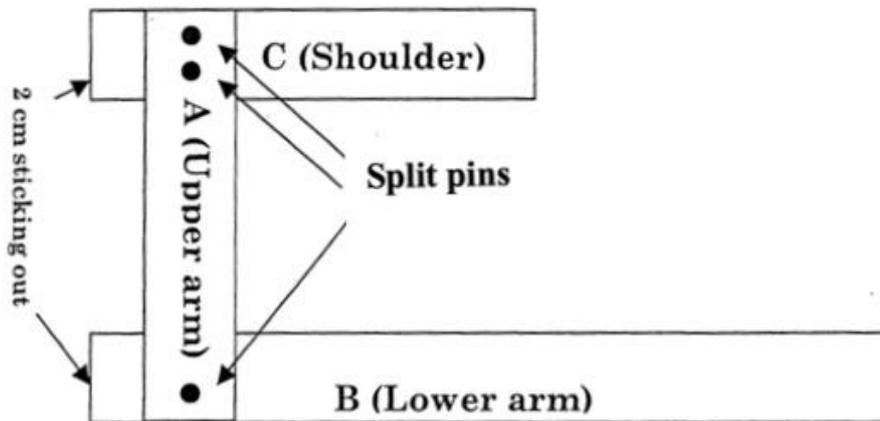
- 1 x scissors or box cutter
- 1 x ruler
- 1 x cardboard at least 25 cm by 15 cm
- 2 x pieces of string 40 cm long
- 3 x split pins
- Optional: craft materials for decorating (e.g. drawing muscle striations, or more cardboard to make a hand)

Procedure

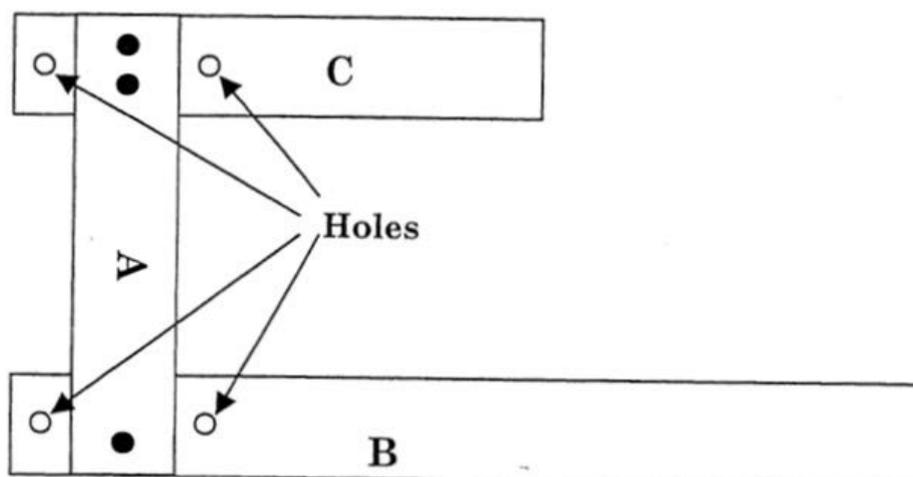
1. Use the scissors or box cutter to cut three strips of cardboard according to the dimensions below.



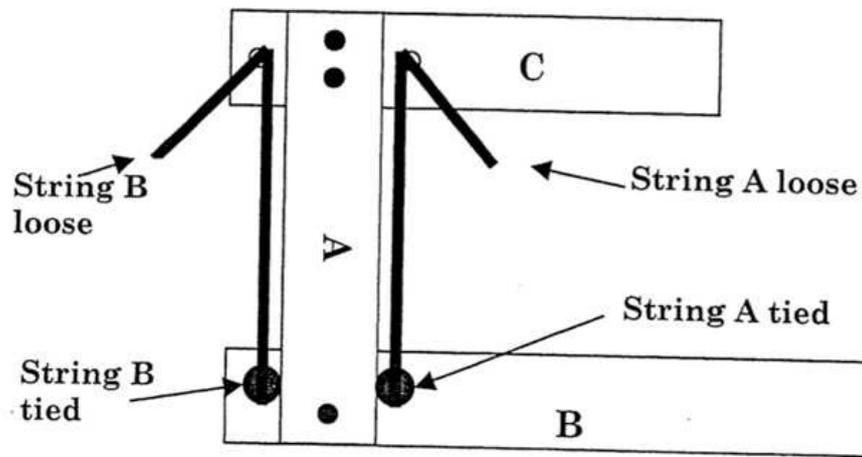
2. Place strip A on strips B and C. Leave 2 cm of strips B and C sticking out. Insert the split pins as shown below.



3. Use the scissors or box cutter to make holes in strips C and B as shown below



4. Tie each string to one of the two holes in strip B. Feed the other end of the string through the corresponding hole in strip C. Leave this end of the string loose.



Questions

Pull on the front thread to bend your model arm. Be careful not to pull the thread out of the back hole.

Draw a diagram to show what happened to the length of the front and back thread.

Pull on the back thread to straighten your model arm. Be careful not to pull the thread out of the front hole.

Draw a diagram to show what happened to the length of the front and back thread.

Pull the back thread of your model arm as far as you can without the thread coming out the front hole.

Describe what happened.

Compare and contrast your model with the human arm.

Comparison of a model arm with the human arm.

	Model	Human arm
The part that shortens to bend (flex) at the joint.		
The part that shortens to straighten (extend) at the joint.		
Range of movement		

Muscle tone, posture and balance

Muscle tone is the passive and partial contraction of skeletal muscles. It helps to keep the body upright against gravity. Muscle tone is controlled by the brain and is passive in that, once you are standing, you do not have to think about which muscles to contract to remain standing. It is also partial as the muscle fibres are partially contracted just enough to stabilise a joint without causing movement. For example, when standing, the quadriceps are contracted just enough to straighten your hip, rather than fully contracted to lift the leg. Furthermore, both sets of antagonist muscles partially contract to maintain posture and balance. For example, quadriceps, gluteal muscles, and hamstrings that normally oppose each other will contract to keep the hip and torso straight when standing. There are many other examples of antagonistic pairs working together to maintain an erect posture from the feet all the way up to the neck.

Checkpoint

Identify and describe two characteristics of muscle tone.

1. _____
2. _____

Sketch other muscle groups involved in standing up straight on the diagram below.



Locomotion

Locomotion is the movement from one place to another. Humans have bipedal locomotion – we walk on two feet. Antagonist muscles work together at the heels and ankles, knees, and hips to achieve this seamless motion.

To take a step forward, the gastrocnemius contracts to lift the heel off the ground. The hamstring then contracts to bend the knee. Hip flexors contract to lift the leg and drive it forward. The quadriceps contracts to extend the knee so that the heel strikes the ground. The cycle is mirrored on the other leg.

Although the lower limbs do most of the work when walking, the arms swing back and forth. The arm opposite the leading leg naturally swings forward. That is, the right arm swings forward when the left leg is also extended forward. Even though the arms swing passively, there are some benefits to their motion.

The arm swing:

- Balances rotational momentum – the arm swing levels the shoulders to keep the person walking straight.
- Counterbalances the leading leg, increasing stability when walking.
- Decreases energy use, making walking more energy efficient.

Checkpoint

In this section, only the agonist muscles were listed when describing the leg movement during locomotion. Research the corresponding antagonists, then draw lines to connect these sentence fragments.

Agonist	Antagonist	Resulting motion
Gastrocnemius contracts...	as the quadriceps relaxes...	to straighten the leg as the heel hits the ground.
Hamstring contracts...	as the hamstrings relax...	to lift the leg and drive it forward.
Hip flexors contract...	as the tibialis anterior relaxes...	to bend the knee.
The quadriceps contracts...	as the gluteal muscles relax...	to lift the heel off the ground.

Rewrite the full sentences in the space below.

1. _____

2. _____

3. _____

4. _____

Activity: Arm swing during locomotion

Activity purpose

- To understand how the legs and arms work together during locomotion.

Science inquiry skills

- identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes.
- Design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics, including animal ethics.
- Conduct investigations including real or virtual dissections, investigating reaction time and hearing and eyesight tests, safely, competently and methodically, for the collection of valid and reliable data.
- Represent data in meaningful and useful ways, including the use of mean and median, range and probability; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental accuracy, the nature of the procedure and the sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions.
- Select, use and/or construct appropriate representations, to communicate conceptual understanding, solve problems and make predictions.

Safety

- Beware of trip hazards and sharp objects on the ground.
- Teacher to establish one-way traffic on the track to avoid collisions between students.

Hypothesis

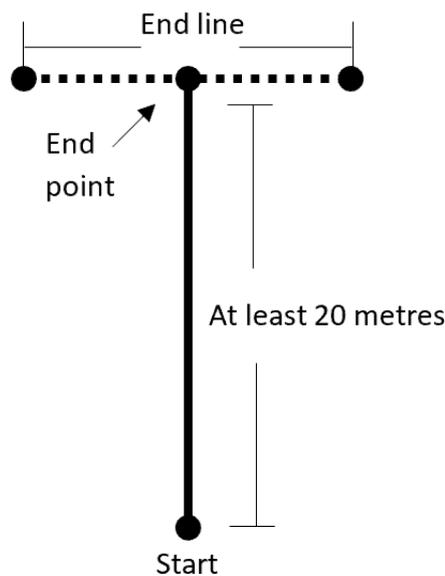
Read the procedure and create a hypothesis regarding the walking conditions and distance from the End point.

Materials

- Blindfolds
- 4 x markers
- Trundle wheels (one for each pair of students)
- Large area with marked lines, such as a racetrack or soccer field. If not available, additional markers can be laid out to plot a 'T' as shown below.

Procedure

1. Set up a track with the four markers as shown below. Check for and clear the area of trip hazards and sharp objects.
2. Find a partner to work with and assign each other Person A or Person B.



3. When instructed, Person A walks from the Start to the End as normal. Person B walks alongside the walker and instructs the walker to stop when the End point or anywhere along the End line is reached.
4. Person B uses the trundle wheel to measure the distance from the End point and Person A. Record this distance in the table.
5. Repeat steps 3-4 two more times.
6. Repeat steps 3-5, Person A keeps their arms firmly by their sides (no arm swing).
7. Repeat steps 3-5 blindfolded, but the arms are allowed to swing. Person B should walk closely by Person A for safety but should not guide Person A to the End point.
8. Repeat steps 3-5 blindfolded and arms kept by Person A's side, again preventing arm swing.
9. Alternate roles and repeat the procedure.

Results

Fill in the table:

Walking condition	Distance (cm)			
	Trial 1	Trial 2	Trial 3	Average
Normal (sight + arm swing)				
Sight + no arm swing				
No sight + arm swing				
No sight + no arm swing				

Use graph paper to plot the data in a bar graph. Remember to only graph the averages.

Questions

In which walking condition did you end up farthest from the End point?

Look at your results for 'sight + no arm swing'. Although you could see where you were going, did you have to consciously readjust your body?

Look at your results for 'no sight + arm swing'. Did you end up closer to the End point than you predicted, given you could not see where you were going?

Finally, look at your results for 'no sight + no arm swing'. Were they what you expected? What was the average difference between 'no sight + no arm swing' and 'no sight + arm swing'?

Write a conclusion about the effect of arm swing on locomotion. Remember to refer to data in your conclusion. Also identify which benefit of arm swing the experiment showed.

Variations

Perform a similar experiment 'sight + no arm swing' when jogging or running to investigate the counterbalancing effect of the arm swing.

Design an experiment that can measure the energy efficiency of the arm swing. What would the dependent variable be, and how would you measure it?

Chapter review

Name the relationship the muscles in the below scenarios have relative to the agonist. As the agonist contracts:

_____ relaxes.

_____ also contracts to aid the agonist.

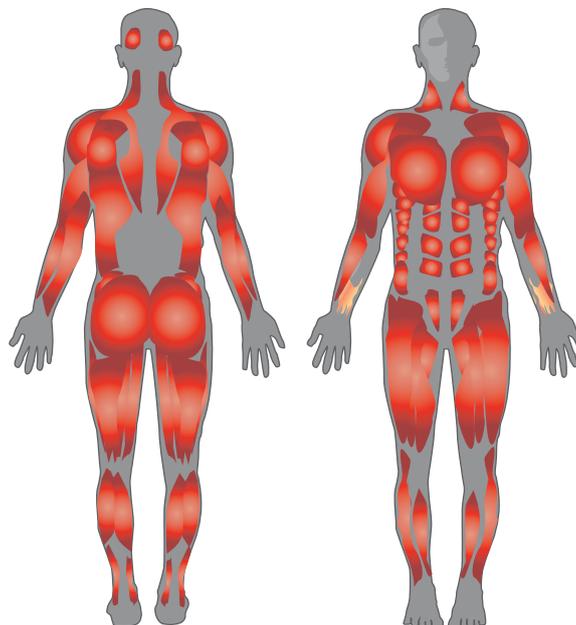
_____ contracts to stabilise another joint.

Research and name the antagonist to the agonist listed in the table below. Use the words below to help.

back extensors, tibialis anterior, gluteal muscles, hamstrings, triceps

Agonist	Antagonist
Biceps brachii	
Quadriceps	
Gastrocnemius	
Hip flexors	
Abdominal group	

Label the muscles from the table above on the diagram below.



Explain how a person can sit up straight, stand, or hold their head up without having to think about the muscles involved.

Describe the actions of the muscles in the leg when taking one step forward.

Describe the movement of the arms during locomotion.

Outline two benefits of arm movement during locomotion.

1. _____
2. _____

Extras for experts

Using your knowledge of the nervous system, name the part of the brain responsible for:

- Hammering a nail.
- Maintaining a standing position.
- The body's natural posture when sitting or standing.
- Lifting a leg to step on a ladder.

Identify the major muscles that are targeted when doing the following workouts:

- Bench press
- Lunge
- Chest fly
- Wall sit
- Sit up
- Chin-up
- Plank

CHAPTER 3

Nervous System



Syllabus dot points

Science understanding:

- The nervous system enables us to respond to external changes. Information from receptors passes along nerves to the brain where the brain coordinates the response
- The structures of the brain facilitate coordination of responses, including the central nervous system (brain, cerebellum, cerebrum, brainstem and spinal cord) and the peripheral nervous system
- The central nervous system is protected by bone, meninges and cerebrospinal fluid
- Receptors detect stimuli which include light, sound, changes in position, chemicals, touch, pressure, pain, and temperature
- The structure of the eye, ear and receptors in the skin allow the body to react to changes in the external environment
- Reflex actions are automatic and rapid, which involve sensory neurons, interneurons, and motor neurons
- The nervous system and the musculoskeletal system interact to provide coordinated actions of the body for walking and balance.

Science as a human endeavour:

- Dysfunctions of the nervous and/or the muscular systems can be debilitating to affected individuals, and ongoing research needs to occur to discover causes and/or improved treatment.
- Increased understanding of the central nervous system and muscle coordination have led to innovations in the treatment of injuries.

The Learning intentions and Success criteria are included as a guide to understanding expectations of students as outlined in the syllabus. Students could use them to review their understanding of the syllabus prior to assessments.

Learning intentions

1. Understand how a stimulus from the environment is processed and responded to by the brain.
2. Understand the structure of the brain is related to its function of coordinated response.
3. Understand that a receptors structure is related to its function, and that these react to the environment and relay messages to the brain.

Success criteria

- Label the structures found in and around the brain and describe their function.
- State what the peripheral and central nervous systems are and their functions.
- Describe the structure of the 3 types of neurons

- Describe the main components of a reflex arc and state the correct order of the components.
- Explain the function of the reflex arc
- Describe how receptors work with the brain to modulate a response to stimulus.
- Label and know the function of the parts of the ear, eye, nose, mouth, and skin – all have receptors that provide information to the brain.

Key terms

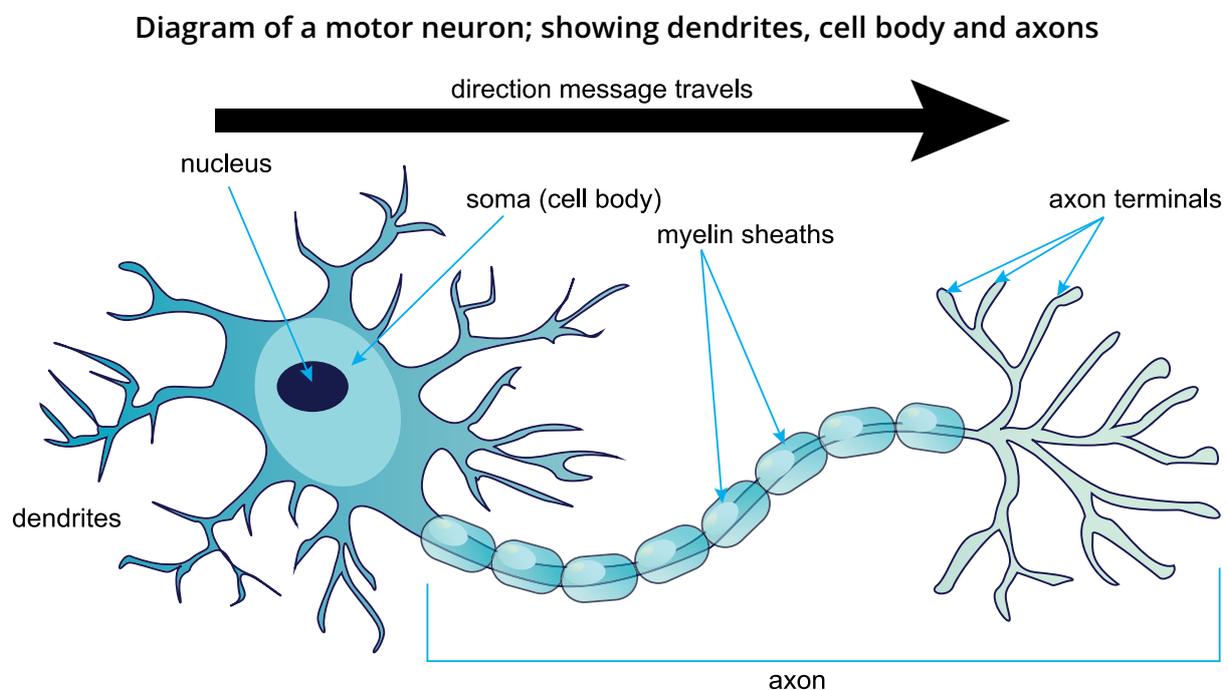
Identify and fill in the definitions for the following key terms:

Key term	Definition
Axon	
Central Nervous System	
Cerebrum	
Dendrite	
Effector	
Homeostasis	
Medulla Oblongata	
Nerve Fibres	
Nerve Impulses	
Neurons	
Peripheral Nervous System	
Receptor	
Stimulus	

Nerve cells

The nervous system is a communication network that controls all the other systems of the body and responds to changes in the external and internal environment. It consists of the brain, spinal cord and the nerves that are associated with them. It collects input from sensory organs which provide information about the surrounding environment, processes and interprets and responds to this information.

Nerve cells or neurons are specialised cells which are able to transmit electrical messages or nerve impulses from one part of your body to another at very high speed but only in one direction.



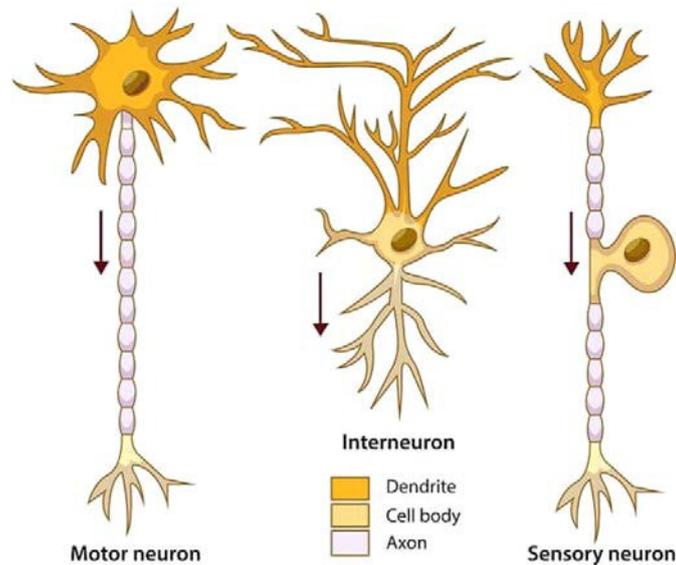
Small threads or nerve fibres called dendrites receive messages from other neurons or receptors. These impulses pass through the cell body, which contains the nucleus, the control centre of the cell. Axons then send the impulses away from the cell body to other neurons or muscle cells.

A bundle of nerve cells is called a nerve and are made mostly of 'white matter'. Some can be very long e.g., the nerve that extends to the foot from the spinal cord.

A 'synapse' is a tiny gap between neighbouring nerve cells. A 'neurotransmitter' is a chemical that transports the impulse across that gap in a split second, so the message is not interrupted between neurons.

Types of neuron

There are 3 types of neuron, each with a different structure depending on its role in the transmission of information in the nervous system. The diagram below shows the three neuron types and the direction of the impulse (see arrows).



Sensory Neurons: receive information from receptors, such as light, sound, taste receptors in the body and carry information from these to the central nervous system (brain and the spinal cord).

Connector Neurons (also known as an interneuron): transmit messages between neurons.

Motor Neurons: carry impulses to muscles or glands (they are collectively called effectors as they translate impulses into actions).

Checkpoint

State the other name for nerves cells.

Complete the table below.

Nerve cell	Position of cell body	Receive impulses from	Transmit impulses to
Sensory			
Connector			
Motor			

Parts of the nervous system

There are two main divisions of the nervous system.

Central Nervous System (CNS): This made up of the brain and the spinal cord. The CNS receives information from all over the body, processes the information and decides what to do with that information and how the body should respond.

Peripheral Nervous System (PNS): This is made up of all the nerves that carry messages to and from the CNS and to other parts of the body i.e., sensory and motor neurons.

Checkpoint

List two of the differences between the CNS and the PNS.

The brain

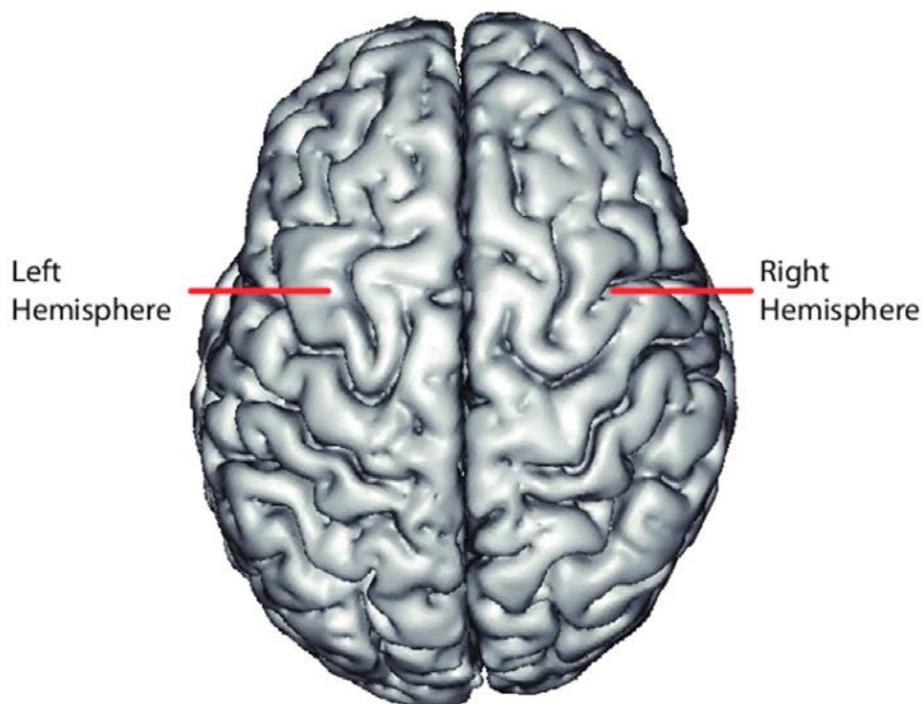
Although the human brain is not the largest in the animal kingdom there are certain characteristics that make humans different from other species. Our brains have allowed us to communicate by languages and develop complex tools like computers as well as regulate body functions like temperature, water balance and heart rate.

The brain is a very delicate organ. It is protected by the cranium, a bone which covers the brain and by the 3 layers of membranes collectively called the meninges. The brain and the spinal cord are also surrounded by cerebrospinal fluid (CSF) which acts as a shock absorber and provide nutrients to the neurons. CSF also maintains the temperature of the brain and spinal cord.

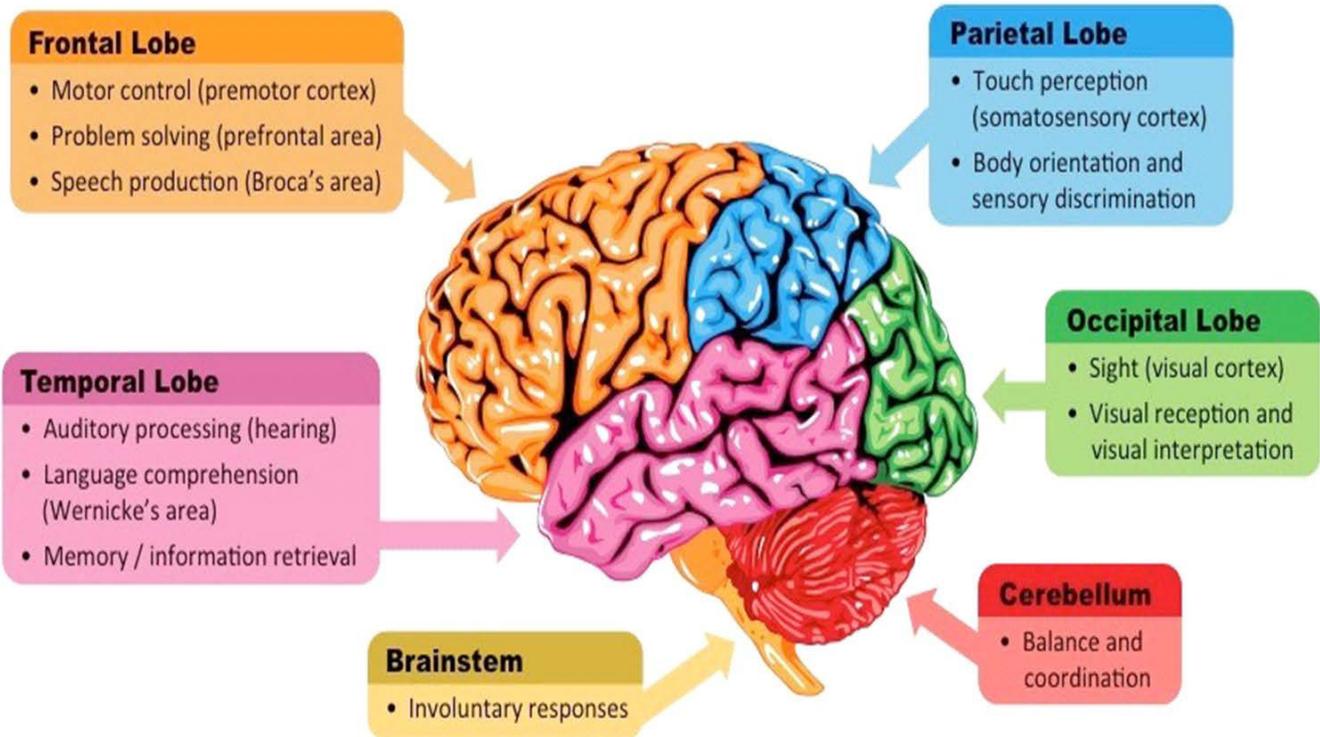
Parts of the brain

The Cerebrum: The cerebrum is folded with ridges and valleys which increase its surface area. It is associated with higher brain function such as planning, reasoning and decision making, and also short-term memory. The outer layer of the cerebrum, called the cerebral cortex, and is made up of grey matter. The cerebrum is separated by a fissure or opening that separates it into the left and right cerebral hemispheres.

Diagram of the two hemispheres of the cerebrum



Each hemisphere has different lobes or regions which are associated with different functions: these are the Frontal, Parietal, Temporal and Occipital.



Checkpoint

State the functions of the cerebrum.

Describe the cerebral cortex.

Parts of the brain (continued)

The Cerebellum: This is found at the back of the brain and is also called "the little brain". It is responsible for coordination, balance, and fine motor skills. Walking upright, in a smooth coordinated way is only possible because of the cerebellum.

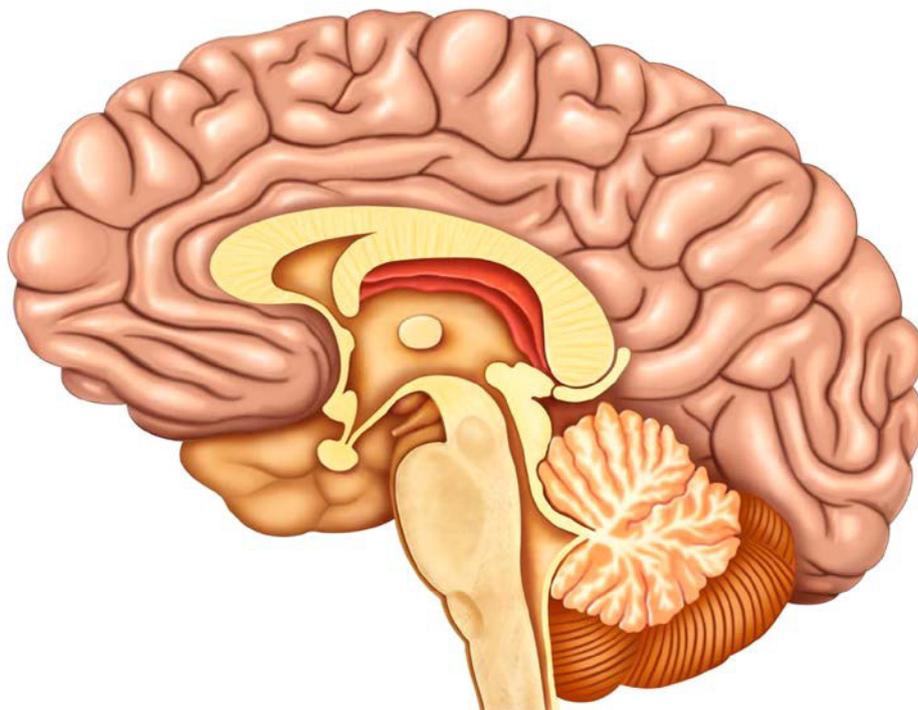
Brainstem: is continuous with the spinal cord and is comprised of the medulla, pons and midbrain. The medulla controls breathing, heart rate and blood flow and is essential for life. Vomiting, coughing and swallowing reflexes are controlled by the medulla.

The Spinal Cord: The spinal cord is essentially a long cord, usually around 44 cm long. It extends from the foramen magnum (hole where neck joins skull) to the second lumbar vertebra in the lower back. It has a cylindrical structure, with a central canal running down its length. This canal contains cerebrospinal fluid.

Checkpoint

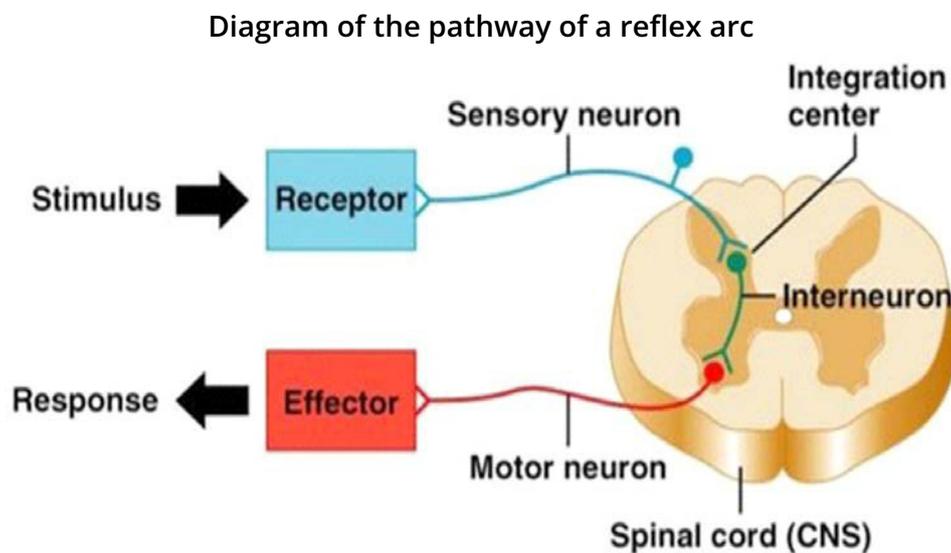
Label the following parts of the human brain in the diagram and provide their function in the table below:

	Function
Cerebral cortex	
Cerebellum	
Brainstem	



Reflex arc

Reflex responses are fast and involuntary (you do not have to think about them). It is a protective response to avoid danger or injury. The pathway taken by the nerve impulses in simple reflex is called a reflex arc. Receptors detect a stimulus such as heat, or pain, which activates a sensory neuron. This sends nerve impulses to the spinal cord where connector neurons pass the message directly to your motor neurons to activate muscles in your arm (the effectors) which initiate a response such as moving your arm away from the heat or pain when you touch something hot. This short cut means that the reactions to the stimulus are very much quicker than the normal route of going to the brain which then decides what to do. A message is sent to the brain shortly afterwards and only then does the pain or heat felt.



The pathway of a reflex arc is as follows (you will remember nerve impulses can only go in one direction):

stimulus → receptor → sensory neuron → connection (or interneuron)
 → motor neuron → effector → response

Checkpoint

Define stimulus.

Define response.

Sense organs

A stimulus is anything which activates a receptor. The receptors then produce a nerve impulse. Receptors are found all over the body or can be found in specific organs such as the eye. Nerve impulses from receptors are sent to the cerebrum for processing and we become aware of a sensation or impulses will go to unconscious parts of the brain to assist with body functioning. There are receptors for light, sound, changes in position, chemicals, touch, pressure, pain, and temperature.

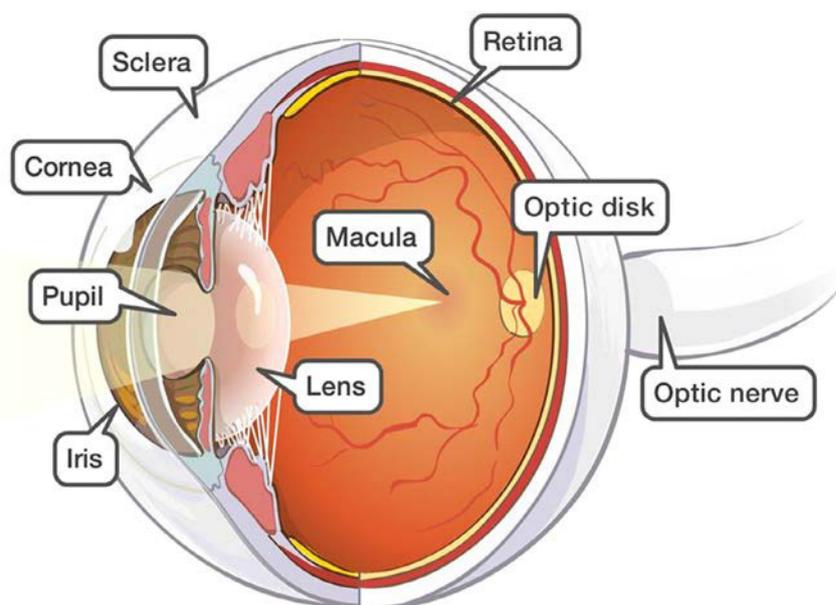
The eye

The eye focuses light rays on to light sensitive cells, which is then converted to nerve impulses by receptors and passed to the occipital area of the cerebrum for processing. The image formed is upside down on the back of your eye but interpreted as upright by your brain.

The cornea refracts (bends light) as it enters the eye and the lens, which can change shape, focuses the image on the retina at the back of the eye. The retina lines the back of the eye and contains rods and cones, specialised light sensitive cells. Cones are cone shaped! They are sensitive to bright light and enable us to see in colour. They are concentrated in the fovea or macula which gives us sharp colour vision. Rods are specialised for dim or night vision but cannot distinguish colour.

At the back of the eye there is also a blind spot or optic disc where there are no light sensitive cells as this is where the optic nerve leaves the eye to go to the brain.

Diagram of a human eye



The eye has many other parts that must work together to produce clear vision:

- The sclera, or white part of the eye, protects the eyeball.
- The pupil, or black dot at the centre of the eye, is an opening through which light can enter.
- The iris, or coloured part of the eye, surrounds the pupil. It controls how much light enters the eye by changing the size of the pupil. This prevents damage to the retina in bright sunlight.
- The aqueous and vitreous humours are clear fluids that fill the front of the eye between the cornea and the lens, and behind the lens but in front of the retina respectively. They help the eyeball keep its shape.

Checkpoint

Circle one of the alternatives in each of the following sentences to make them correct.

- Light entering the eye is refracted by the *sclera* / *cornea* and focused by the *lens* / *iris*.
- The optic *disc* / *macula* has a concentration of cones which gives us a clear colour image
- The image travels as a series of *light* / *electrical* impulses to the brain via the optic nerve.
- The *iris* / *pupil* gets smaller in bright light to protect the retina.
- The *lens* / *macula* changes shape to focus light on the retina.
- The lens loses flexibility as you get *older* / *younger* resulting in a deterioration of your eyesight.

The ear: hearing and balance

The ear contains receptors for sound waves and also receptors that detect head position and movement.

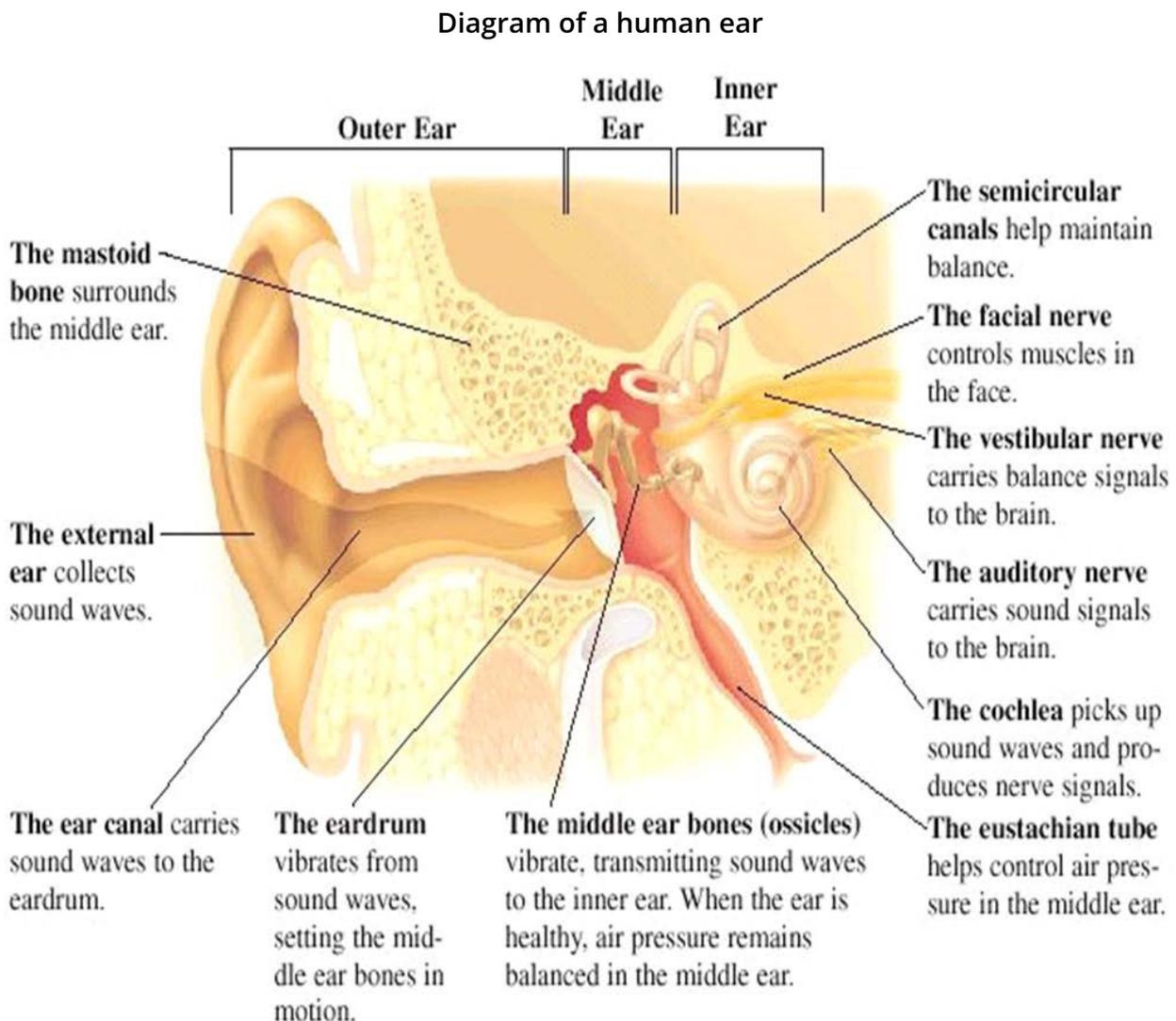
The outer ear collects and channels the sounds waves. The pinna, shaped like a funnel, collects and focuses sound waves down the ear canal which ends at the ear drum. The ear drum separates the outer ear from the middle ear.

The ear drum is a tight flap of tissue which vibrates when sound waves hit. These vibrations are passed to three tiny bones found in the middle ear (the smallest bones in the human body) called the ossicles. They magnify the vibrations and pass them into the inner ear.

The middle and inner ear are separated by the oval window, a membrane which passes the vibrations into the fluid filled inner ear.

The cochlea is a spiral shaped tube filled with fluid found in the inner ear. Vibrations in the oval window cause the fluid to move and this movement is detected by millions of hairs lining the surface of the cochlea. Receptors attached to these hairs convert their movement into electrical impulses which the temporal lobe of the cerebrum processes as different sounds.

The semicircular canals are also found in the inner ear. They play no role in hearing but are important for balance. There are three canals filled with fluid into which cilia are embedded. As the head moves the endolymph sloshes around moving the cilia and this causes receptors to send impulses to the brain about the position of the head. The canals can detect forward and backward movement, swiveling, and tilting the head to either shoulder.



Checkpoint

List the parts of the outer ear.

List the parts of the middle ear.

List the parts of the inner ear.

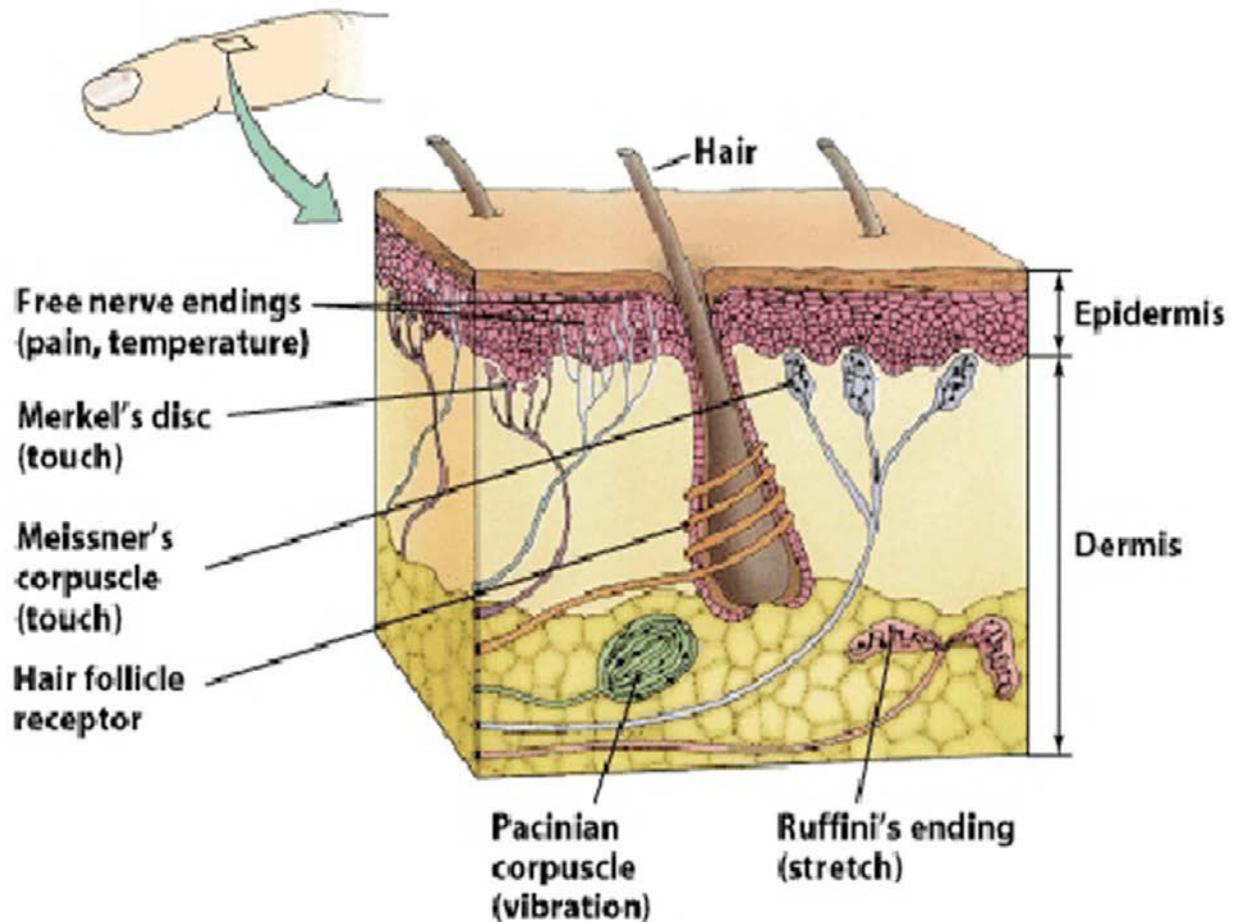
Describe how sound moves through the ear to the cochlea.

Describe the semicircular canals and where are they found?

The skin

The Skin is the largest organ of our body. It is related to the sense of touch. It contains general receptors which can detect touch, pain, pressure, and temperature. They are present throughout the skin. Skin receptors generate an impulse, and when activated, is carried to the spinal cord and then to the brain.

Diagram of the skin showing receptors responsible for different sensations



Chapter review

State the function of the nervous system.

Identify the two main parts of the nervous system.

1. _____
2. _____

Describe three ways the brain is protected from injury.

1. _____
2. _____
3. _____

Identify the two types of specialised cells found in the eye and describe how are they different from each other.

1. _____
2. _____

Put the following words into the correct order:

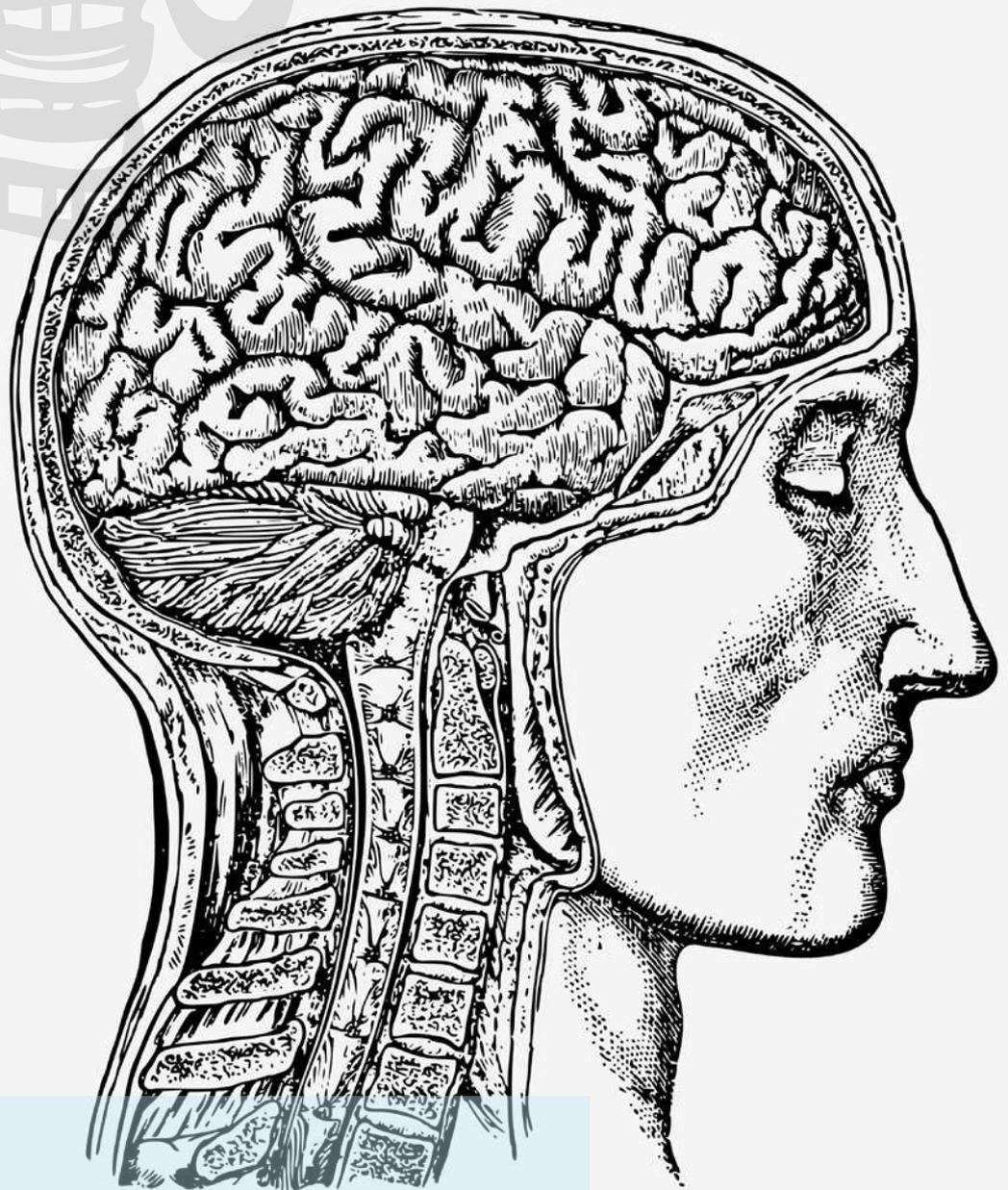
sensory neuron, motor neuron, connector or interneuron, effector, response, receptor, stimulus.

Describe the components of a reflex arc.

Explain how the cochlea and the semicircular canals are different?

CHAPTER 4

Endocrine System



Syllabus dot points

Science understanding:

- Many processes within the body are coordinated by hormones, which are secreted by glands and are transported to their target organs in the blood.
- Hormone action can be via negative feedback to maintain internal conditions within tolerance limits; stimulus receptor, modulator, effector, response, and feedback, are components of a feedback loop.
- The endocrine glands of the body include hypothalamus, pituitary, adrenal gland, pancreas, thyroid, pineal and parathyroid glands, testes, ovaries, and placenta.
- Thyroxine, cortisol, growth hormone and, to a lesser extent, adrenaline, all play a role in the regulation of metabolism.

Science as a human endeavour:

- Hormone replacement therapies can be used for the treatment of endocrine disorders to help improve the quality of life of affected individuals.

The Learning intentions and Success criteria are included as a guide to understanding expectations of students as outlined in the syllabus. Students could use them to review their understanding of the syllabus prior to assessments.

Learning intentions

1. Understand that hormones are chemical messengers that are secreted by glands.
2. Understand the roles of the major endocrine glands in regulating body processes – where they are located and what hormone they produce, and its effect on the body.
3. How feedback loops work - negative and positive feedback loops.

Success criteria

- Can define a hormone and be able to identify how hormones target specific cells.
- Can list the major endocrine glands, their position, and the function of their hormones in maintaining a balance in the body.
- Be able to complete a feedback back loop using the correct terminology.
- Can identify the parts of the negative feedback loop involved in glucose regulations and thyroxine levels.
- Describe diseases of the endocrine system as being due to the under or over production of hormones.
- Diseases due to under secretion of hormones are treat with hormone therapy.

Key terms

Identify and fill in the definitions for the following key terms:

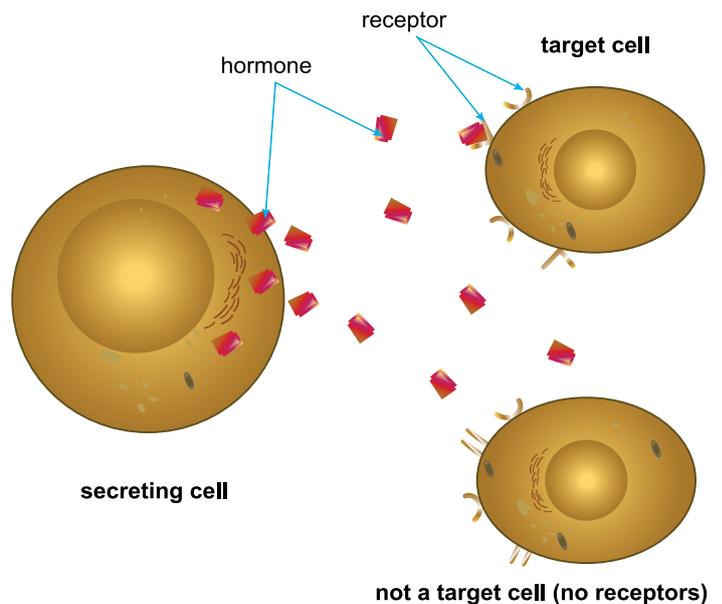
Key term	Definition
Adrenal glands	
Adrenalin	
Cortisol	
Diabetes	
Effector	
Glucagon	
Hormone	
Hypothalamus	
Insulin	
Metabolism	
Modulator	
Negative feedback	
Pituitary Gland	
Receptor	
Response	
Stimulus	
Thyroxine	

The endocrine system

The endocrine system regulates and coordinates biological processes in the body. The “fight or flight” response to danger, the growth and function of the reproductive system, metabolism and blood sugar levels are all controlled by hormones secreted by endocrine glands. The nervous system and the endocrine system work together to help the body to maintain a steady internal environment.

Endocrine system is made up of:

- Ductless glands located throughout the body.
- Hormones that are made by the glands and released into the bloodstream or the fluid surrounding cells; and
- Receptors in various target organs and tissues that recognize and respond to the hormones.



Hormones

Hormones are chemical messengers produced by glands scattered throughout the body.

The hormones are secreted directly into the bloodstream and travel to all parts of the body. Only the “Target” cells will respond to the hormone because it has a specific shape that only fits chemically to a receptor on the target cell. This way the right hormone gets to the correct cell and all others are blocked.

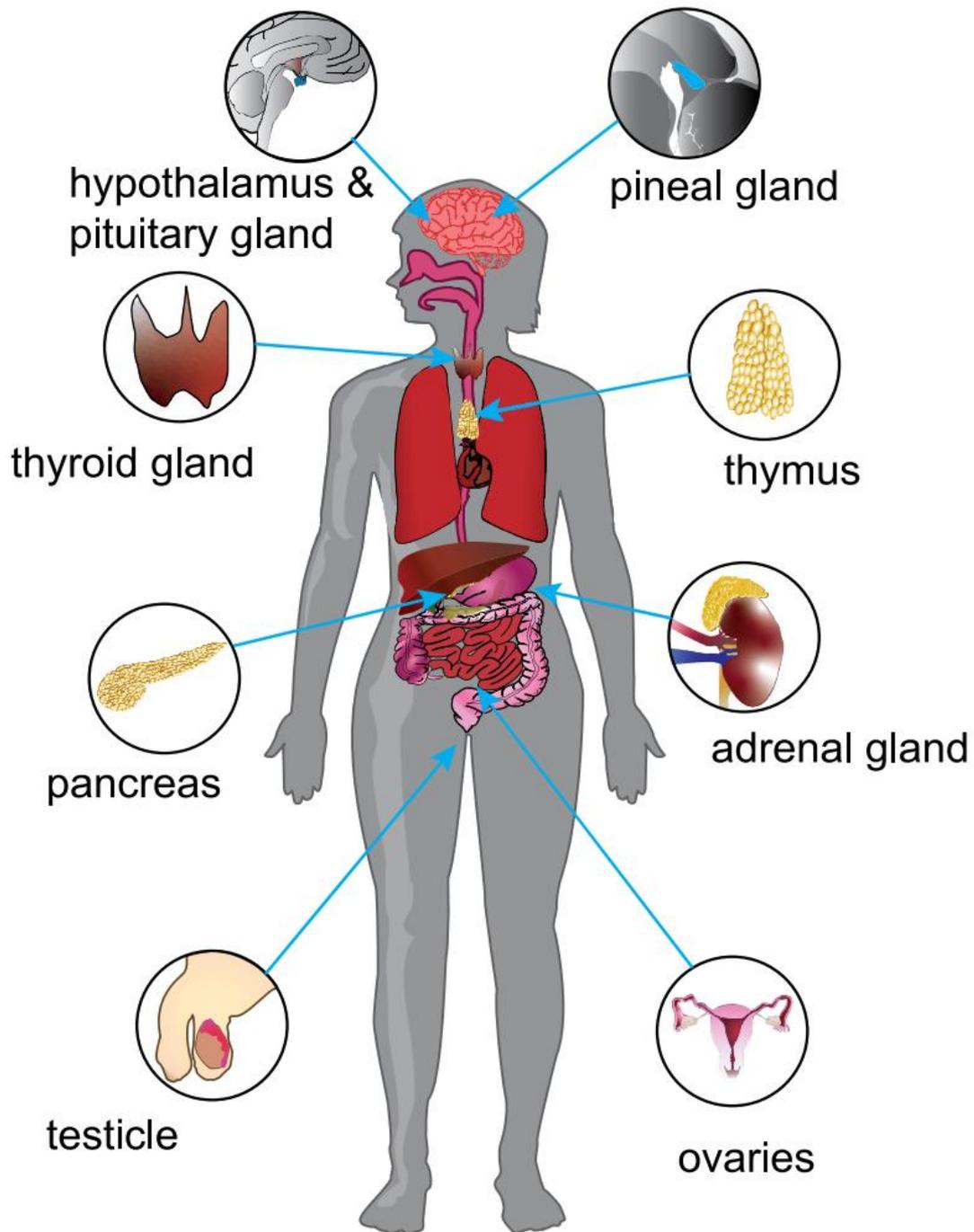
The effects of the endocrine system are slower than the nervous system but tend to lead to long term changes in the body.

Checkpoint

Describe the general characteristics of hormones.

Glands of the endocrine system

The endocrine system



The pituitary gland

One of the most important glands of the endocrine system is the pituitary gland found deep inside the brain just under the hypothalamus. This stimulates many of the other glands of the system to release their hormones, which is why it is called the “Master gland” of the endocrine system.

For example, it produces human growth hormone (GH) which controls cell growth and development, Antidiuretic Hormone (ADH) which affects how the kidneys function and thyroid stimulating hormone (TSH) which stimulates the thyroid gland to secrete thyroxine. It produces hormones which affect the menstrual and ovarian cycles in women and quite a few other hormones. It has a close relationship with the hypothalamus which interprets information from receptors on changes in the internal environment of the body.

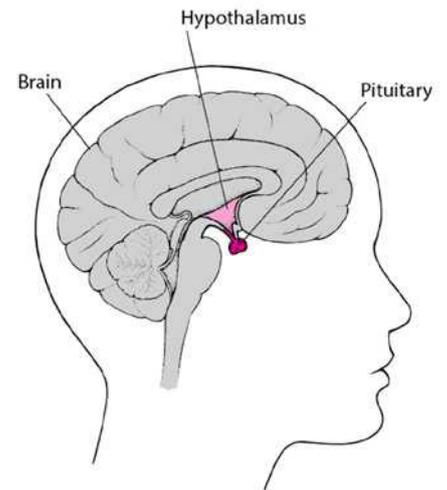
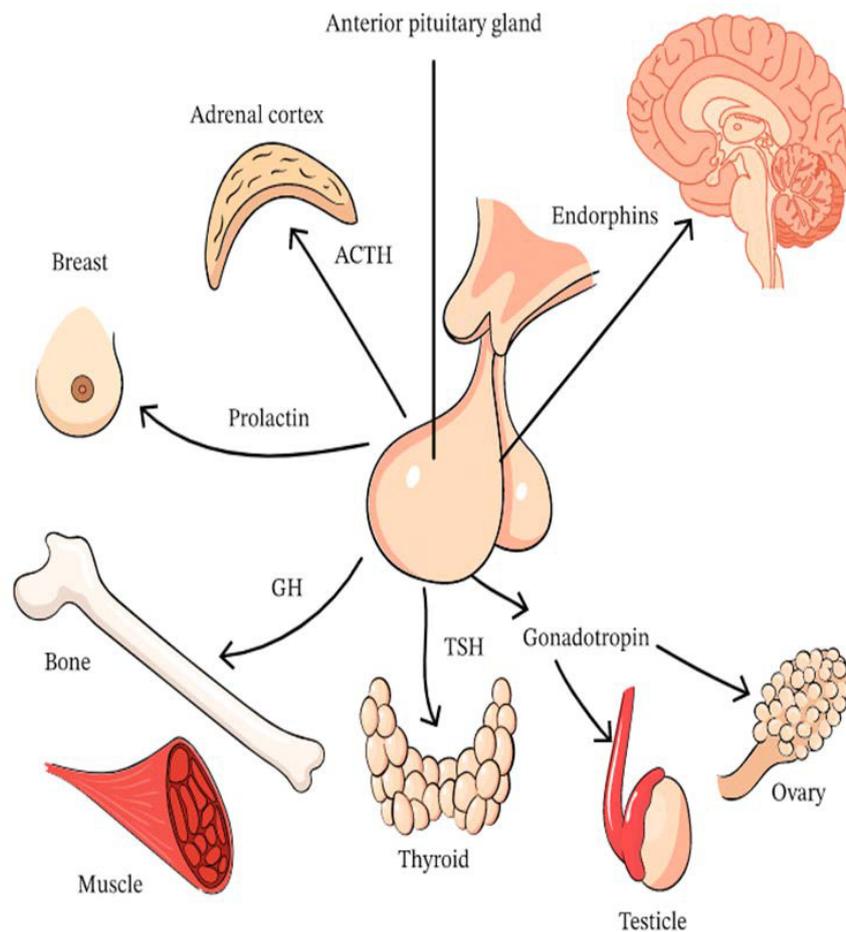
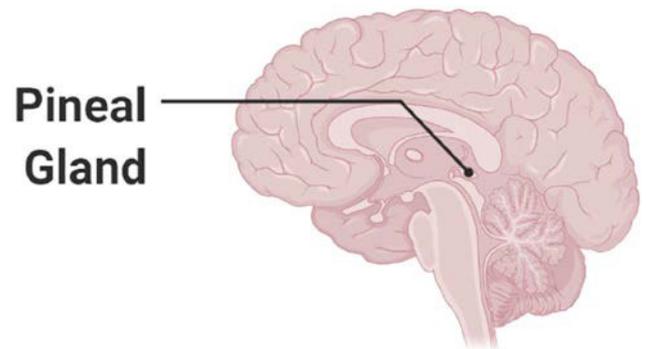


Diagram showing the different hormones produced by the pituitary gland



The pineal gland

The pineal gland is a small, pea-shaped gland in the brain. If you are not sleeping well, you might blame your Pineal Gland as it produces and regulates melatonin. Melatonin is best known for the role it plays in regulating sleep patterns.



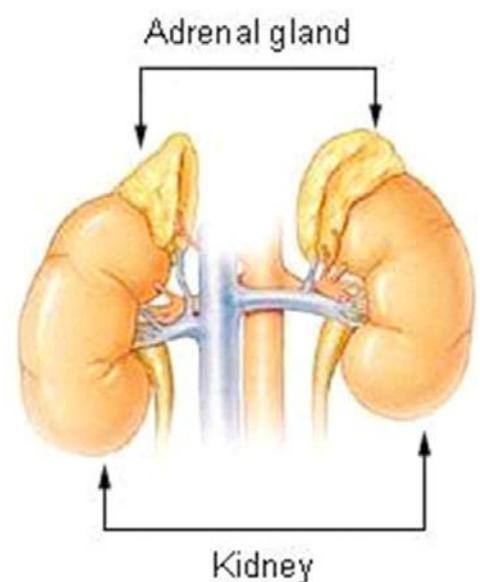
The thyroid and parathyroid glands

These are found in the neck underneath the larynx or the “Adam’s apple”. The Thyroid Gland is shaped like a butterfly and secretes thyroxine an iodine containing hormone needed for normal growth and metabolism. Thyroxine levels are directly proportional to the rates of metabolism e.g., more thyroxine the faster the metabolic rate. The thyroid gland and production of thyroxine is regulated by the pituitary hormone – thyroxine stimulating hormone (TSH).

Sitting on either wing of the butterfly shaped thyroid gland are the parathyroid glands. These produce parathyroid hormone and calcitonin that are hormones that regulate calcium levels in the blood.

Adrenal glands

These are found on the kidneys (they look like a beanie on the very top of the kidney!). The adrenal glands produce a number of hormones such as cortisol, which raises blood sugar levels. Adrenalin and noradrenaline are also produced in the adrenal glands. These are hormone involved in the “fight or flight” survival mechanism, increasing heart and breathing rates.



The pancreas, islets of Langerhans

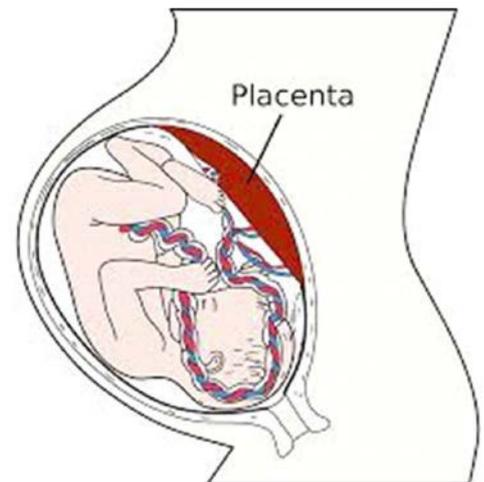
Blood sugar levels are always changing depending on when and what you eat. The Islets of Langerhans in the pancreas produce hormones that raise or lower the sugar levels when needed. Glucagon increases sugar in the blood by changing glycogen, a stored form of glucose in the liver and muscles to glucose, whereas insulin lowers blood sugar levels by increasing the uptake into cells and promoting the formation of glycogen stored in the liver and muscles. When there is an imbalance between these hormones diseases such as Diabetes type I and II can result.

The gonads

Both male and female gonads produce hormones which affect the growth of male and female secondary characteristics. The ovaries produce oestrogen which causes the development of breasts and widening of hips in females. Levels of oestrogen and progesterone also affect the lining of the uterus during menstruation. Testosterone produced by the testes causes greater growth in facial and body hair in males plus other “male’ characteristics.

The placenta

In pregnant females the placenta nourishes the embryo whilst developing in the uterus but is also an endocrine gland. It produces hormones to help maintain the pregnancy and development of the embryonic sac which surrounds the growing baby. It also secretes prolactin which stimulates the production of milk in the breasts.



Checkpoint

Explain why the pituitary gland is known as the “master gland” of the endocrine system.

Describe the role that the hypothalamus plays in the endocrine system.

Summarise the above information about the endocrine glands and hormones by completing the table below:

Gland	Name of hormone/s	Effect/s on the body
Pituitary		
Thyroid		
Pancreas		
Adrenal		
Ovary		
Testes		

Feedback mechanisms

In order to make sure the conditions in the body are optimal, the endocrine system uses feedback mechanisms, in response to changes to the internal environment. These optimal conditions are referred to as “homeostasis”. There are two types of feedback mechanisms: negative and positive. Negative feedback mechanisms are the most common because they attempt to maintain a target level. In contrast, positive feedback mechanisms are amplifications away from a target level.

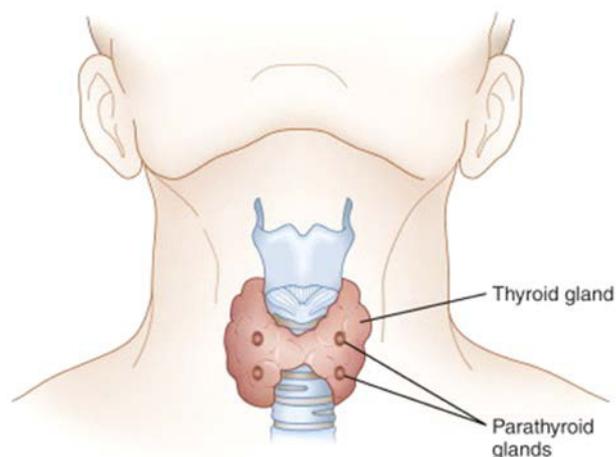
Feedback loops consist of the following:

- Stimulus – a change in the environment which is detected by the receptor.
- Receptor – this detects the change and sends information about the stimulus to the modulator. There are different types of receptors, for example, chemoreceptors which detect changes in hormone levels, and thermoreceptors detect changes in temperature.
- Modulator – This is the control centre or decision maker which processes the information from the receptor and decides what to do.
- Effector – is usually a gland or a muscle which acts on instructions from the modulator.
- Response – the action of the effector that causes a change to the original stimulus.
- Feedback – this is how the original response is affected or changed.

Negative feedback loops

These feedback mechanisms reverse the original stimulus. Using thyroxine levels as an example. Recall that thyroxine has an affect on the metabolic rate.

- If there are low levels in the blood the metabolic rate is reduced.
- In this feedback loop the stimulus is the low level of thyroxine.
- This is detected by chemical receptors in the hypothalamus.
- The hypothalamus releases hormones to the modulator, the pituitary gland, to secrete thyroid stimulating hormone (TSH).
- This stimulates the effector, the thyroid gland, to produce more thyroxine.
- The response is increased secretions of thyroxine and the metabolism increases. T
- This has reversed the initial stimulus and increased the levels of thyroxine in the blood = **NEGATIVE** feedback.

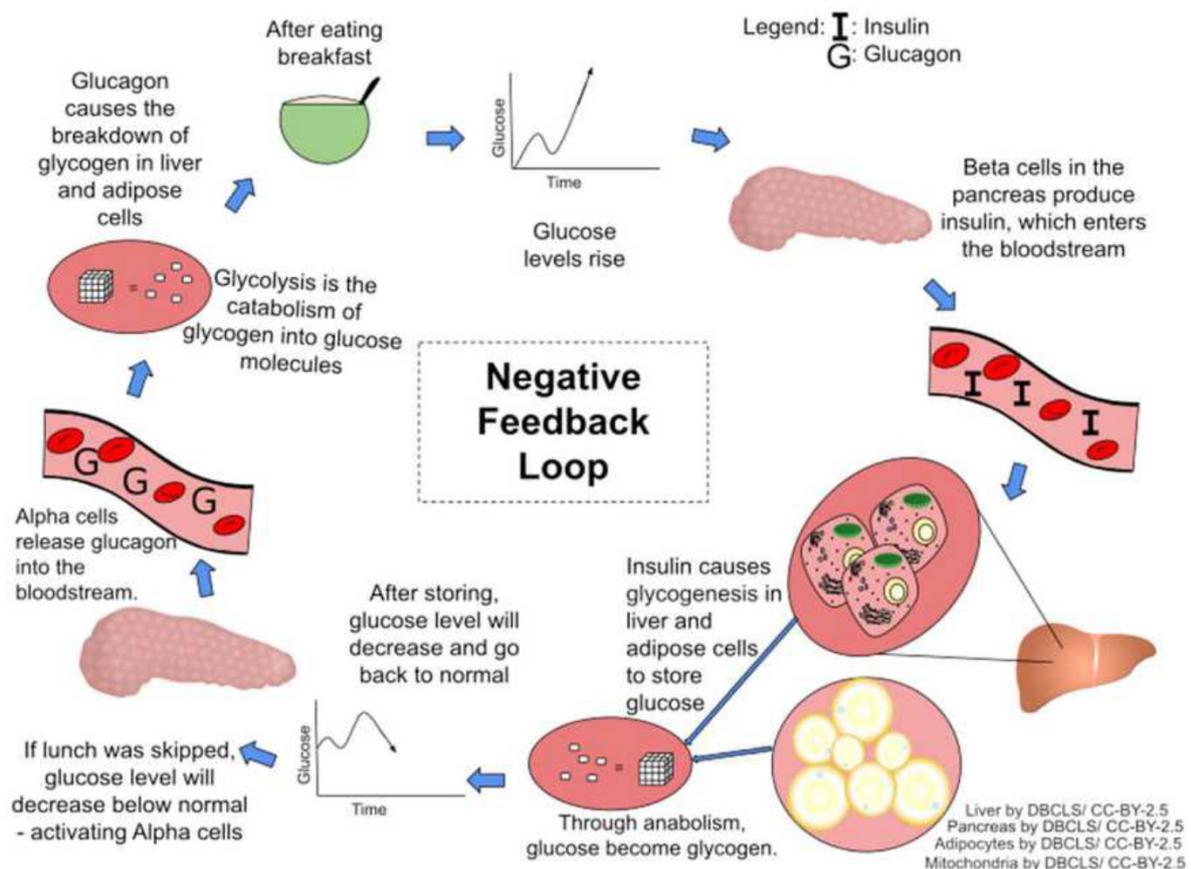


Checkpoint

Draw a negative feedback loop flow chart to show what happens when there are low levels of thyroxine.

As mentioned previously the maintenance of glucose levels in the blood is very important, they are controlled by the pancreatic hormones, insulin and glucagon, in negative feedback loops as indicated below in the diagram.

You will notice in this feedback loop that the pancreas itself is the modulator and regulation of this important process is controlled not by the brain but by the pancreas.



Positive feedback loops

There are very few positive feedback mechanisms in the body. They do not reverse the stimulus they REINFORCE it.

The release of oxytocin from the posterior pituitary gland during childbirth or labour is an example of positive feedback mechanism.

When a baby pushes against the cervix during childbirth it stimulates the production of oxytocin. Oxytocin causes the muscle contractions that push the baby through the birth canal. The release of oxytocin result in stronger or augmented contractions during labour until the baby is born. Once born the stimulus of pushing against the cervix is removed and the production oxytocin stops.

Diseases of the endocrine system and hormone replacement therapy

Disorders of endocrine glands can cause serious disruption to the body functions, in other words homeostasis is disrupted. Diseases such as diabetes mellitus and Addison's disease can result in damage to various tissues and organs throughout the body and can cause death if left untreated. Disease caused by a lack of or undersecretion of a particular hormone can be treated using replacement hormones. These hormones are synthetic and are the basis for hormone replacement therapy or HRT.

Checkpoint

Research the disease diabetes mellitus Types 1 and 2.

Find out:

- the causes
- the symptoms
- the treatments available, both medical and lifestyle

Use a table to show the similarities and differences between Type 1 and 2.

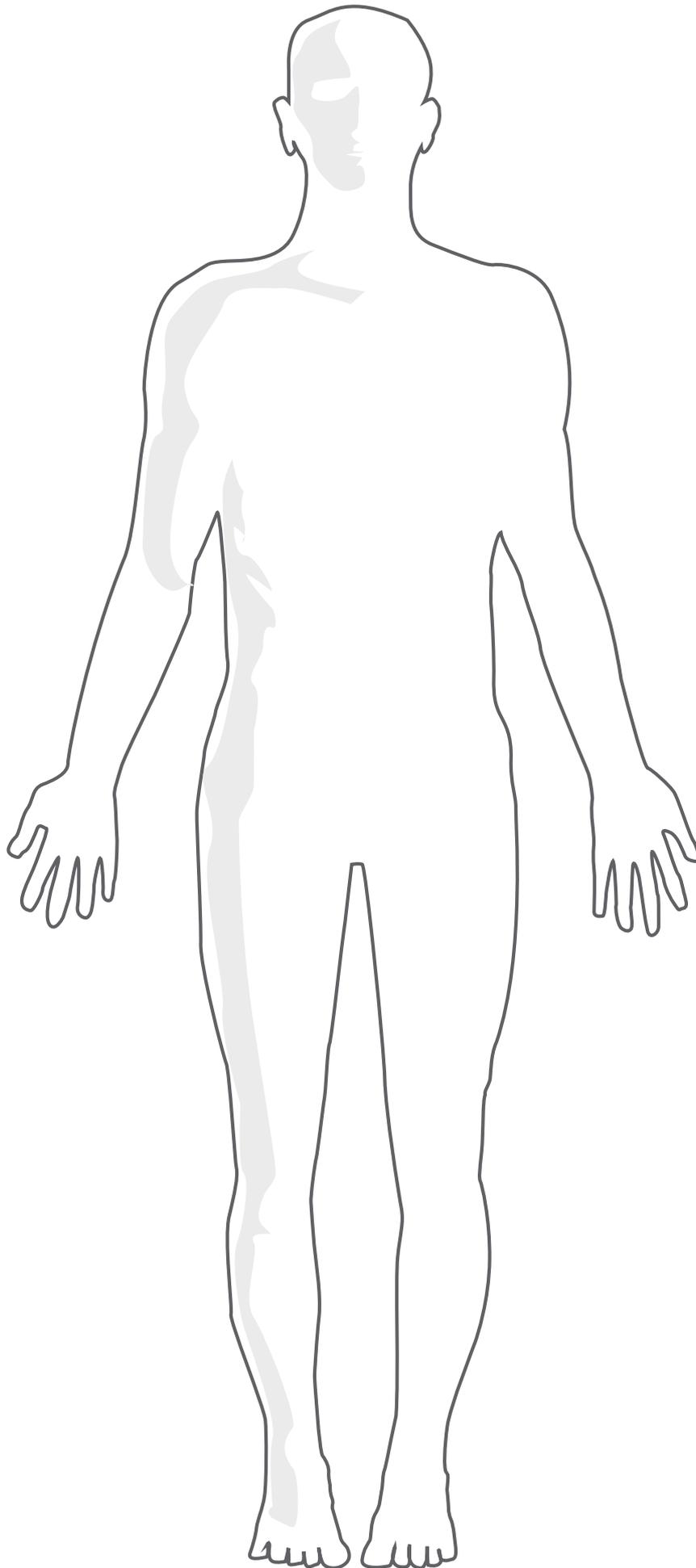
Activity: Pin the label on the endocrine gland

This activity is similar to the traditional party game “pin the tail on the donkey”, but without the blindfold! This activity involves pinning the correct label on the endocrine system (no donkeys are involved either).

Procedure

Photocopy and cut out the labels below and scramble them. Allocate the labels randomly to members of the group. Using the diagram of the body on the next page (if you can photocopy to A3 or bigger that would be ideal), correctly label the position of the gland, the hormone produced, and the function of the hormone.

Pineal Gland	Melatonin	Regulates sleep patterns
Pituitary Gland	TSH, ADH, Growth Hormone	Controls the production of other glands
Pancreas		Regulates blood glucose levels
Thyroid Gland	Produces Thyroxine	Regulate the metabolic rate
Parathyroid Gland	Produces Calcitonin	Regulates levels of Calcium in the blood
Adrenal Glands	Produces Cortisol, Adrenaline and Noradrenaline	Involved in the “flight or fight” reaction to stress
Ovaries	Produce oestrogen and progesterone	Regulate the menstrual cycle
Testes	Produce Testosterone	Responsible for male characteristics
Placenta	Produces prolactin	
Hypothalamus	Not a gland	Regulates the actions of the Pituitary Gland
Islet of Langerhans - Alpha Cells	Produces Glucagon	Increases the levels of sugar in the blood
Islet of Langerhans - Beta Cells	Produces Insulin	Decreases the levels of glucose in the blood.

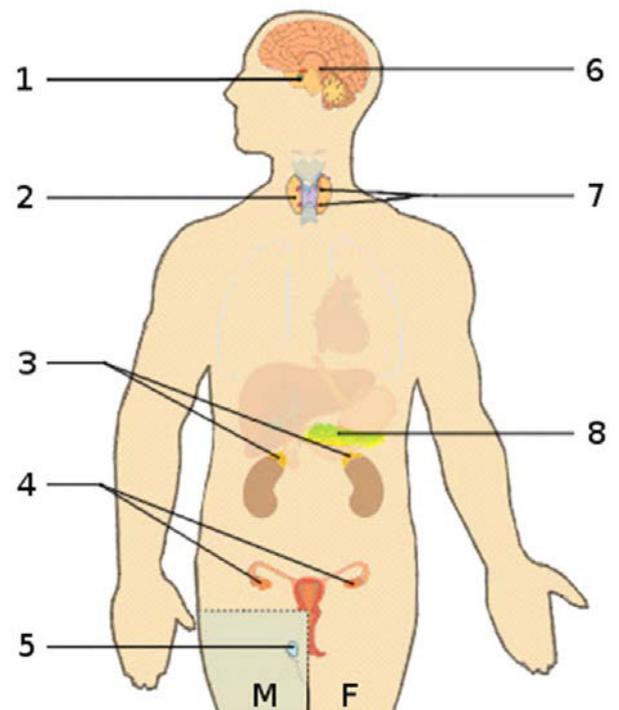


Chapter review

- Describe the purpose of the endocrine system.
- Describe how hormones are transported around the body.
- What is meant by the "target site" or target cell/organ?
- How does a hormone affect some cells but not others?
- Explain what is meant by the term "negative feedback".

Name the 8 endocrine glands indicated on the diagram below. State the hormone/s they produce.

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____



Extras for experts

Name the endocrine dysfunctions produced by:

Insufficient Insulin

Too little Thyroxine

Too much Thyroxine

CHAPTER 5

Disease



Syllabus dot points

Science understanding:

- Infectious disease is caused by invasion of a pathogen, and can be transmitted from one host to another.
- Pathogens include bacteria, viruses, fungi, parasites, and are the causes of common diseases, including Ross River disease, influenza, food poisoning, tinea and malaria.
- The transmission and spread of infectious disease is facilitated by local, regional and global movement of individuals.
- Pathogens have adaptations that facilitate their entry into the body and transmission between hosts; transmission occurs by various mechanisms, including through:
 - Direct and indirect contact
 - Contaminated food and water
 - Disease-specific vectors, including airborne transmission
- Preventing the transmission of disease includes strategies of quarantine, immunisation and disruption of pathogen life cycle.
- Hygiene practices by individuals in work places, especially in places of food preparation and in hospitals, affect the transmission of disease.

Science as a human endeavour:

- The development of the microscope was important in linking specific pathogens to specific diseases, which then allowed for the appropriate treatment or preventative measures to be used, including antiseptics, antibiotics, quarantine measures and improved hygiene for water and food, which have reduced the impacts of myths and misconceptions around disease and its transmission.
- Use and misuse of medicinal treatments against pathogens can cause the development of multi-resistant bacteria that increase risks associated with the infection

The Learning intentions and Success criteria are included as a guide to understanding expectations of students as outlined in the syllabus. Students could use them to review their understanding of the syllabus prior to assessments.

Learning intentions

1. Understand that not all diseases are transmissible but can be caused by other genetic or lifestyle factors.
2. Understand that diseases that are transmitted between persons are caused by pathogens.
3. Understand there are different types of pathogens that have their own mechanism of causing disease.
4. Understand methods of transmission of disease between hosts can be both direct and indirect.
5. Understand that by taking precautions to limited exposure to infected persons it is possible to prevent and slow down the transmission of pathogens.

Success criteria

- Define the term disease.
- Distinguish between the cause of infectious and infectious disease.
- Describe the advantages of the use of microscopes in the identification and diagnosis of disease-causing organisms.
- Label and describe the parts of a compound light microscope.
- Describe how to focus a microscope on low and high power.
- Recall types of pathogens; bacteria, viruses, fungi and parasites.
- Recall examples of diseases caused by bacteria, fungi, viruses and parasites and describe how they cause disease.
- Describe indirect and direct methods of disease transmission.
- Discuss methods used to prevent the transmission of pathogen.
- Discuss protocols used in healthcare settings to prevent transmission of disease.

Key terms

Identify and fill in the definitions for the following key terms:

Key term	Definition
Antibiotics	
Bacteria	
Binary Fission	
Communicable	
Contagious	
Disease	
DNA	
Ectoparasite	
Endoparasite	
Flagella	

Key term	Definition
Fungi	
Fungicide	
Host	
Incubation period	
Infectious	
Micro-organism	
Parasite	
Pathogen	
Protein Coat	
Protozoan	
RNA	
Spores	
Symptoms	
Transmission	
Vector	
Virus	

Describing disease

The term **disease** is used to describe any condition that prevents the body from functioning normally. In ancient times disease was thought to be caused by evil spirits or gods. Religious ceremonies and rituals were practiced in the hope of pleasing the gods and releasing any evil spirits from the afflicted. Around 400BC Hippocrates, a Greek physician, became known as the 'father of modern medicine' as he believed disease was caused by natural causes and therefore could be treated and cured. He separated the idea that disease was caused by the supernatural and witchcraft, he studied symptoms of disease and offered suggestions for treatment. It wasn't until much later in the early 1600's that an understanding of human anatomy and how the human body worked allowed disease to be better understood. The discovery of the microscope around the same time led to the detection of micro-organisms which uncovered the world of pathogens and infectious disease.

Types of disease

Disease can be classified as **infectious** or **non-infectious**.

Non-infectious diseases are not able to be spread from one person to another, they are not **transmissible**. Non-infectious diseases are inherited, such as haemophilia or cystic fibrosis, whilst others are caused by lifestyle related issues, such as anemia, heart disease, asthma or rickets.

Infectious diseases or communicable diseases are caused by **pathogens**. Pathogens are micro-organisms that cause disease by invading the body. Any disease caused by a pathogen can be transmitted, infecting others when they come into contact with an infected person.

Check point

Fill in the missing words.

Any condition that prevents the body from functioning normally is called a _____.

Diseases they can be transmitted from one person to another are called _____ and are

caused by a _____ that invades the body. _____ and _____

are examples of these types of diseases. _____ are caused by

either genetic factors or lifestyle conditions. They are not able to be _____ from one

person to another. _____ and _____ are examples of

these types of diseases.

Activity: Myth or truth?

Science inquiry skills

- Interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, including interpreting confidence intervals in secondary data; and use reasoning to construct scientific arguments

What do you already know about diseases, their causes and how we get sick?

- You might like to work with a partner to complete this activity.
- For each of the beliefs below choose whether you think the statement is true or a myth.
- Research to find out if science says it is the truth or a myth.

Belief	Myth or truth?	What does the science say?
Cold or wet weather makes you sick.		
Drinking too much milk makes you phlegmy.		
If you pick up food within seconds of it hitting the ground, it's safe.		
It's safe to double dip.		
Flu shots can cause the flu.		
Green mucus indicates a sinus infection.		
Vitamin C will keep you from getting a cold.		

Importance of the microscope

Infectious disease refers to disease caused by a **pathogen**. In 1861, Louis Pasteur demonstrated experimentally that micro-organisms can be present in non-living matter and can cause disease. The development of the microscope was important in linking specific pathogens to specific diseases.

The invention of the **microscope** has opened up a whole new dimension in science and medicine. By using microscopes scientists were able to discover the existence of microorganisms, study the structure of cells, and see the smallest parts of plants, animals, and fungi. Today, the microscope is still a commonly used tool to diagnose illness in hospitals and clinics all over the world.

Scientists call the study of the structure of cells, *cytology*. Since cells are so small, your naked eye is not capable of observing cells and you must use a microscope to study cells. The instrument you use in the school laboratory is called a **compound light microscope**. The magnification range of most of these microscopes is from around x40 to x600, depending on the combination of lenses the microscope has. To study any living tissue with this type of microscope the material must be only a few thousands of a millimetre thick to allow light to pass through.

The scientist will then put the thin section on a glass slide and can stain it with special chemicals to highlight various features. Finally, the scientist covers the thin section with a thin, glass coverslip. This process is called mounting the specimen. The slide is then ready to use.

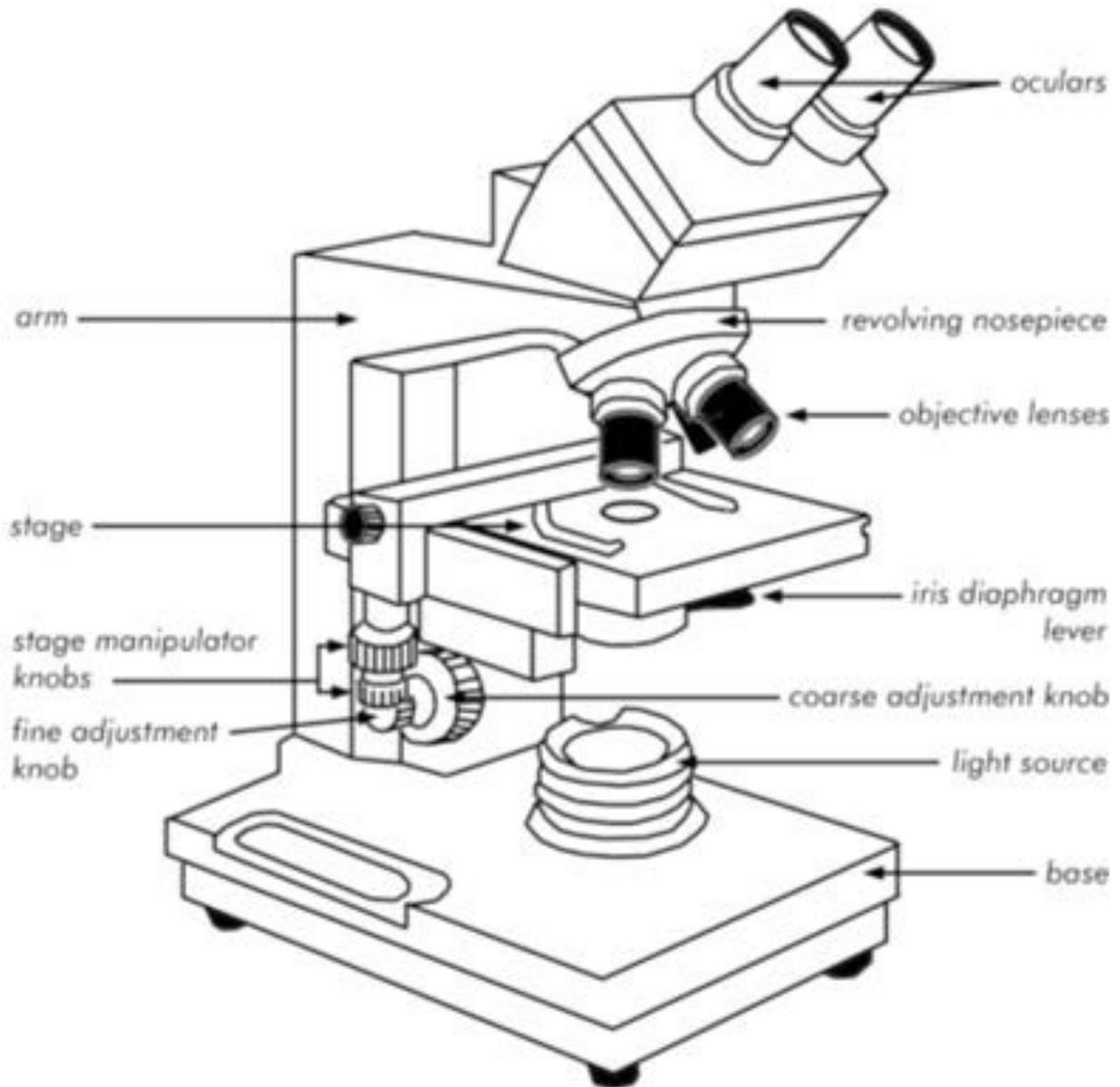
When you place a slide on the stage of your microscope, light passes through the thin section on the slide, then through a series of lenses. The lenses produce a magnified image of the thin section for you to see.

Remember that microscopes are expensive and delicate instruments, so treat them carefully!

Care of the microscope:

- Try not to wet the objectives lenses and the stage.
- Carry the microscope by its arm, with your other hand under the base. Hold it close to your body and place it down carefully on the desk.
- Always look from the side when moving the tube downwards with the coarse focus, otherwise you may smash the slide and the objective lens.
- Always change to LP before removing a slide from the stage, otherwise you may chip the objective lens.
- When you finish with the microscope leave the LP in position and return it as you found it!

Parts of the microscope



Activity: Microscopes

Science inquiry skills

- Conduct investigations safely, competently and methodically for the collection of valid and reliable data

Part A: Preparing the compound microscope for use.

Procedure

- Place the microscope on a flat surface, with the arm pointing towards you.
- Use the diagram on the previous page to identify all the parts of the microscope.
- Turn on your microscope.
- The eye piece contains the ocular lens that magnifies objects. It has its magnification written on its side.

What is the magnification on the ocular lens? _____

- Carefully observe the objective lenses. Note that you can find the magnification etched on each lens casing, for example 5X.
- Complete the following table to calculate the total magnification for each objective lens.

TOTAL MAGNIFICATION = Objective Lens x Ocular Lens

Ocular lens	Objective lens	Total magnification

- Use the coarse adjustment knob to lower the stage so that the objective lens does not hit the stage when the revolving nosepiece is rotated.
- Rotate the nosepiece until the lowest power objective lens (the shortest lens) is in line with the barrel.
- Make sure that the iris diaphragm on your microscope is open. It's a good idea to gently move the lever backwards and forwards while looking down through the ocular lenses to see what happens when the diaphragm is adjusted.
- Do not move the microscope and you are now set up ready to go.

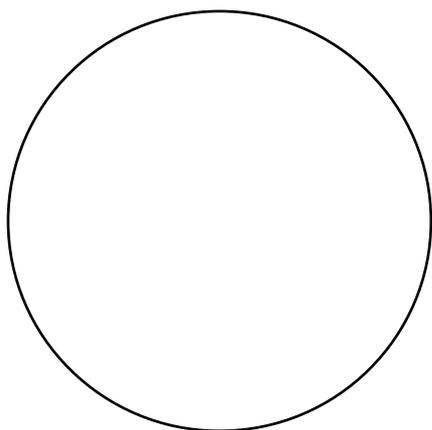
Part B: Focusing on low power and high power.**Materials**

- Compound light microscope
- One prepared slide e.g., daphnia

Procedure

1. Set-up the microscope (see part A).
2. Use the nosepiece to turn the objective lenses so that the smallest lens is in position. You are now at low power.
What is the total magnification at low power? _____
3. Use the coarse focus to make sure that you move the stage down, or as far away as possible from the objective lens.
4. Now place your prepared slide on the stage in the correct position using the stage clip.
Remember to hold the slide on the side – you don't want any fingerprints on your glass slide! What you are looking at is written on the slide.
5. Now use the stage manipulator knobs to centre the slide in the middle of the field of view (the field of view is the circle of light you look down at).
6. While **looking at the microscope from the side**, turn the coarse adjustment to bring the low power objective within about 2mm of the slide.
7. Now, looking through the ocular lens, slowly turn the coarse adjustment to increase the distance between the objective lens and the slide until the specimen is in focus.
8. Use the fine focus to adjust if required to bring the image into sharp focus. Try to keep both eyes open when making observations. If you cannot, try to alternate between your left and right eye to reduce fatigue.
9. In the space provided on the next page, draw what you see at LP (low power).
10. Turn the nosepiece to the next largest objective lens. **DO NOT TOUCH THE COARSE ADJUSTMENT.** The specimen should be in focus still but if need be, you can use the fine focus knob. You are now focused on high power.
11. Draw what you see at HP (high power) in the space provided on the next page.

LOW POWER



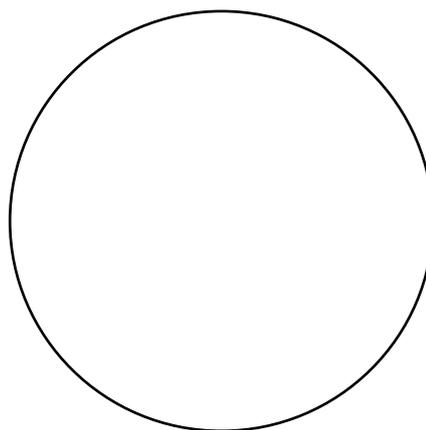
Specimen: _____

Ocular magnification: _____

Objective magnification: _____

Total magnification: _____

HIGH POWER



Specimen: _____

Ocular magnification: _____

Objective magnification: _____

Total magnification: _____

Checkpoint

Name the lens system closest to your eye when looking down a microscope.

Name the lens system closest to the specimen.

Of the low and high-power objective lenses, the shortest is the _____ and the longest is the _____.

Which objective lens is always used first when focusing on a specimen?

Why do you always look from the side when using the coarse focus to bring a slide and objective lens closer together?

Which adjustment knob is used with the high-power lens?

When we increase the magnification, we are actually observing *smaller / larger* (circle the answer) pieces of the specimen.

The section that we are observing just looks *smaller / larger* (circle the answer).

This circle is called the field of view. The higher the magnification, the more detail is seen and vice versa.

Complete the following table:

Microscope part	Function (job)
Ocular lens	
Objective lens	
Coarse adjustment knob	
Fine adjustment knob	
Stage	
Stage clip	
Stage manipulator knob	
Nosepiece	
Iris diaphragm	

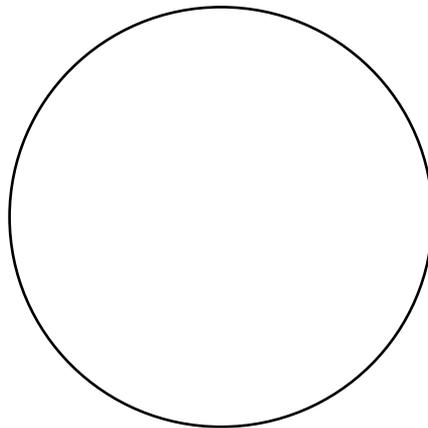
Part C: The field of view and size of objects viewed.

Materials

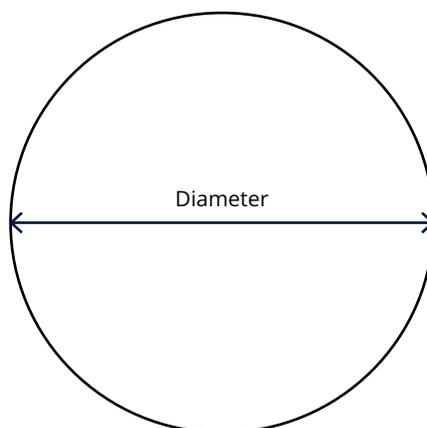
- Compound light microscope
- One prepared slide of the letter “e”
- Mini-grid
- One prepared slide

Procedure

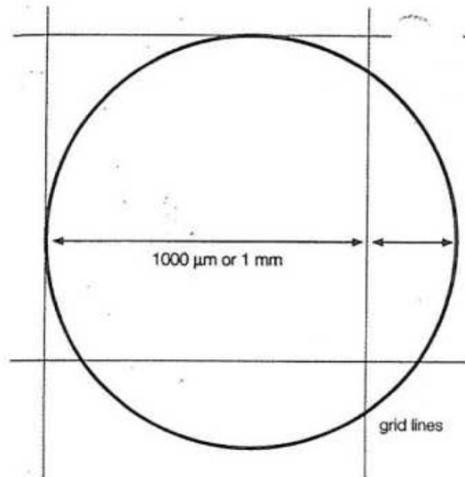
1. Set up your microscope at low power.
2. Hold the letter “e” slide up to the light so you can read the letter.
3. Now, place the prepared letter “e” slide on the stage so it is in the same position (i.e., you can read it) and following the correct procedures, focus the letter “e” at low power.
4. In the space below, draw what you see. Hint: The letter “e” should be inverted (upside-down and back-to-front).



5. Remove the letter “e” slide from your microscope and leave your microscope at **low power**.
6. Scientists call the circle of light you see when you look through your microscope the **field of view (FOV)**. It is important to know the **diameter** of the field of view so you can estimate the size of structures you are examining.



7. Collect a mini-grid slide and place it in position on the stage of your microscope. Move the mini-grid slide so that one of the grid lines is on the very left of the field of view (see diagram below).



8. As the grid lines are 1 mm apart, estimate how many millimetre squares there are across the diameter of the field of view at low power. Convert the diameter length into micrometres (don't forget that **1 mm = 1000 μm**).

_____ mm = _____ μm

Enter this number into the table below.

9. If you increase your magnification, you will proportionally reduce your field of view because you will be looking at a smaller area in greater detail. If you double your magnification, you will halve the field of view; but, if you reduce your magnification, you will increase your field of view by a similar factor. Complete Table below by calculating the fields of view of the magnifications on your microscope starting from the lowest magnification, the field of view of which you have already measured.

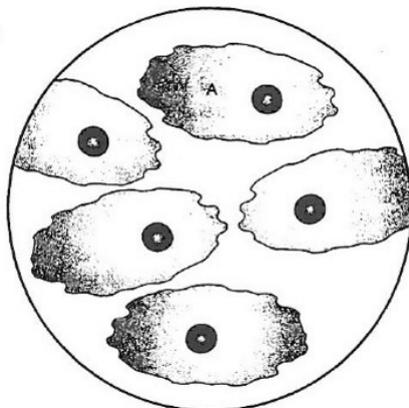
Microscope Measurements

Ocular magnification	Objective magnification	Total magnification	Diameter of field of view (μm)

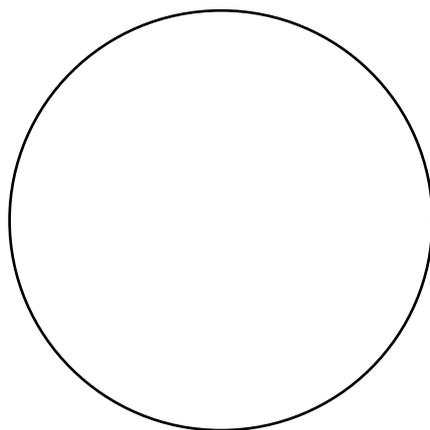
**If you are not sure how to calculate the numbers to complete this table, see your teacher for help!*

10. Once you have determined the diameter of the field of view, you can now estimate the size of the object you are viewing under the microscope. We do this by judging what proportion of the diameter of the field of view that the object takes up. Before we do the real thing with a microscope practice with the example below:

- If the field diameter is 0.5mm, what is the approximate length of cell A in millimetres and micrometres?



- Draw and measure a small animal from a prepared slide. To measure the animal, estimate the fraction of the field of view it takes up. Multiply the field of view diameter by this fraction.



Checkpoint

**Show all working out*

Convert the following:

(a) 1mm = _____ μm

(f) 6 μm = _____ mm

(b) 0.27mm = _____ μm

(g) 21 μm = _____ mm

(c) 1.32 mm = _____ μm

(h) 165 μm = _____ mm

(d) 0.018 mm = _____ μm

(i) 2183 μm = _____ mm

(e) 0.002mm = _____ μm

(j) 89362 μm = _____ mm

A student used a microscope with a **10X** ocular lens and a **10X** objective lens. The diameter of the field of view observed was **1200 μm** . The object observed occupies a quarter of the field, calculate the:

1. Total magnification.

2. Size of object under LP.

3. Diameter of HP field, when the objective lens is changed to 40x.

4. Size of the object if it has a length of $\frac{3}{4}$ of the field and a width of $\frac{1}{3}$ of the field.

For each letter below, draw what it would like when viewed under a microscope:

H _____ E _____ T _____ P _____ b _____

Complete the following table:

Ocular	Objective	Total magnification
5	4	20
5	10	
5	10	
10	10	100
15	10	

Types of pathogens

Pathogens are organisms that cause **disease**. The body has several ways of defending itself from these organisms, but sometime pathogens manage to evade these defence systems and enter the body causing illness. Diseases caused by pathogenic organisms are called **infectious diseases** and may also be referred to as **contagious** or **communicable** diseases as they are able to be transferred by **direct contact** with someone infected with the disease or through indirectly coming into contact with something that the infected person has touched.

There are four main categories of pathogens.

1. Bacteria
2. Viruses
3. Fungi
4. Parasites

Bacteria

Only some bacteria cause disease. Most bacteria are harmless (non-pathogenic) and many are considered essential to life on Earth. They play an important role in decomposing and the recycling of organic matter, food, and medicine production.

Bacteria are **unicellular** (contain only one cell) which can only be seen using a microscope. Their diameter is around one thousandth of a millimetre in diameter or $1\mu\text{m}$. A bacterial cell contains a cell membrane like a body cell but also contains a cell wall that protects each single bacterial cell from damage. There is no nucleus and the DNA is found tangled and floating free in the cytoplasm. Some bacteria have flagella that assist in movement.

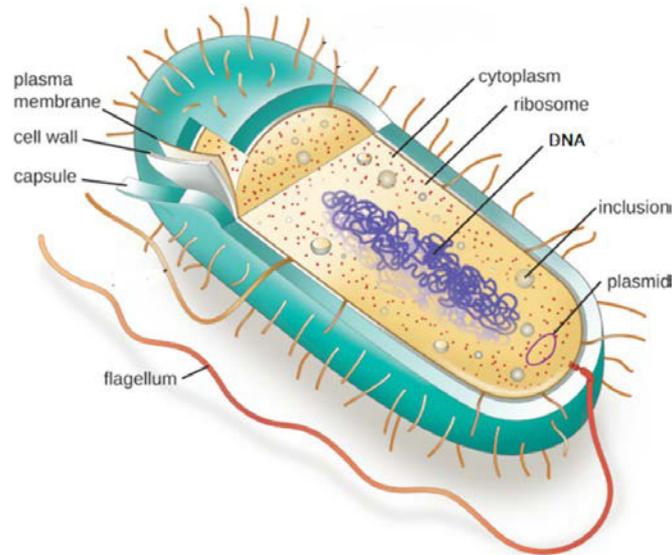
There are several main shapes of bacteria that can be used by scientists to classify them.

Bacilli are rod shaped, **cocci** are round or spherical in shape, **spirilla** are spiral shape. Bacteria regardless of shape that contain flagella are called **flagellated bacteria**. An example of flagellum containing bacteria is, E coli, that is known to cause food poisoning.

Bacteria reproduce asexually by a process called **binary fission** where exact copies are reproduced. This allows bacteria multiply quickly and large colonies are able to form over short periods of time if the conditions are right.

Pathogenic bacteria cause disease by injecting a toxin produces inside the bacterial cell that destroys cells and disrupting their function.

Diagram showing a typical bacterial cell



The discovery of penicillin in the early 1900's and the subsequent development of other **antibiotics** since has revolutionised the treatment of bacterial infections. They act by breaking down the cell wall of the bacteria thus destroying it.

Examples of diseases caused by bacteria are salmonella, tuberculosis, tonsillitis, chlamydia, gonorrhoea, the bubonic plague, and leprosy.

Checkpoint

Are all bacteria pathogenic? _____

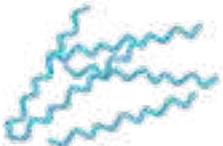
State the size of a typical bacteria. _____

Draw and label a generalized bacterial cell- include cell wall, cell membrane, DNA, and flagella:

Explain the purpose of flagellum.

Explain how bacteria reproduce.

Scientists classify bacteria based on their shape. In the table below name the type of bacteria and describe their shape:

Type of bacteria	Diagram	Description
		
		
		
		

Explain how bacteria cause disease.

List the two major ways bacteria cause illness.

1. _____
2. _____

Name three bacterial diseases.

1. _____
2. _____
3. _____

State how a bacterial infection can be treated.

Viruses

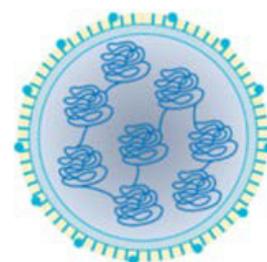
Viruses are much smaller than bacteria and can only be seen by powerful electron microscopes. Viruses are non-cellular as they do not perform life processes like cells do. They consist of genetic material (either DNA or RNA) and are surrounded by a protein layer.

Virus particles are not able to reproduce on their own they need a host in which they inject their genetic material into. The virus's genetic material instructs the cells to start producing new virus particles. The cell is destroyed, and hundreds of new virus particles are released to infect other host cells. The process continues destroying more and more of the hosts cells and producing more virus particles, causing the host to become ill.

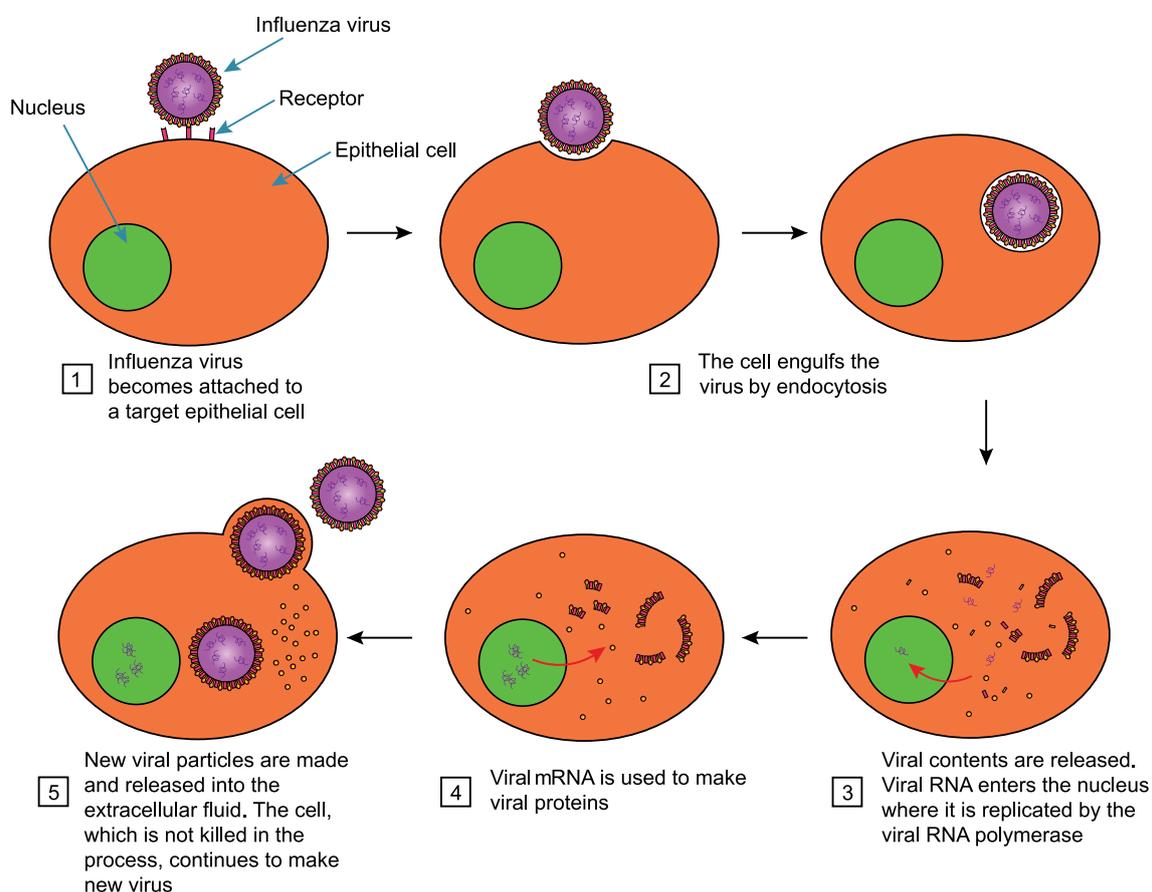
Unlike bacteria, viruses do not respond to antibiotics. Vaccination is the only way to prevent viral infection.

Diseases caused by viruses include COVID-19, Ross River, chicken pox, measles, mumps, polio, cold sores, influenza, rabies, HIV, rubella and genital herpes.

Virus particle



Virus mechanism of infecting cells



Checkpoint

Compare the size of viruses to bacteria.

Name the scientific instrument needed to see a virus particle.

Explain why a virus is not considered a living organism?

Draw and label a diagram of the general structure of a virus particle:

Draw and label a diagram showing the life cycle of a virus as it infects a cell:

Fungi

Like bacteria, most **fungi** do not cause disease and are essential for breaking down organic matter in the environment. Only some fungi are pathogenic to humans mainly causing skin infection, very few are life threatening. Fungi cells contain a cell wall and nucleus but unlike plant cells do not contain chlorophyll so do not photosynthesis instead relying on absorbing nutrients from other organisms. Fungal disease is spread by spores that need a warm moist place to grow. Most fungal infections are found on and round the skin in the warmest and most sweat prone areas.

Types of fungal infections that affect humans are tinea, thrush, and ringworm. They can in the right environment be highly contagious and sometimes be difficult to treat. A chemical called a fungicide is used to kill the fungus.

Thrush infection in mouth



Tinea infection between toes



Ringworm infection



Checkpoint

Are all fungi pathogenic? _____

Fungi are not able to produce their own _____. They live off the nutrients provided by another o_____.

Fungal diseases are spread by s_____ and grow well in m_____ and d_____ areas.

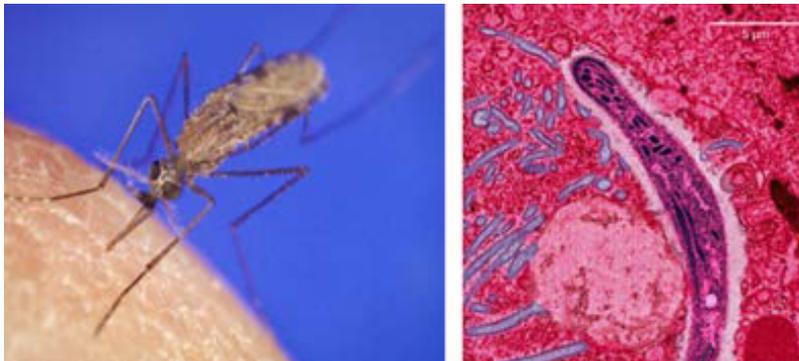
Most fungal diseases in animals are n_____ l_____ threatening and affect the s_____.

Examples of common fungal diseases are _____.

Parasites

A **parasite** is any living organism that lives on or in another organism called the **host**. Taking in nutrients from that organism and providing nothing in return and in some cases causing great harm. Parasites that live on the outside of the host are called **ectoparasites**, such as lice, ticks, and fleas. **Endoparasites** live inside the host, often not detected until the host becomes sick, such as tapeworm and roundworm. Small single-celled organisms called **protozoans** are also parasites that cause diseases such as malaria, amoebic dysentery, and toxoplasmosis. Parasites are often transmitted via vectors, a third host, that passes the pathogen on between one host to another. For example, malaria, is caused by a protozoan parasite transmitted by mosquitoes infected with the pathogen.

Mosquito carrying the parasite that causes malaria



Checkpoint

Define an ectoparasite.

Name some examples of ectoparasites.

Define an endoparasite.

Name some examples of endoparasites.

How disease is transmitted

The human body, like that of other large animals, is under constant attack from a wide range of potential parasites and pathogens. **Pathogens** may be transferred, or transmitted, from one individual to another by several methods. It is possible for some diseases to be transmitted in more than one way.

Direct transmission

This occurs when there is direct **physical contact** with a source of infection. This may involve touching the person directly or through being exposed to their **body fluids** e.g., touching, kissing, sexual intercourse and sharing needles.

Indirect transmission

This includes touching objects that have been in contact with the source of infection. Examples include eating utensils, drinking cups, bedding, toys, money and used syringes.

Airborne transmission

Occurs when droplets of the pathogen are released when talking, coughing, or sneezing. These droplets may be breathed in by another person in close proximity or land on utensils or surfaces that may then enter the mouth.

Foodborne transmission

Consuming food that is contaminated with the pathogen may cause illness. Common examples are bacteria that cause food poisoning (e coli and salmonella) and some endoparasites (tapeworm).

Waterborne transmission

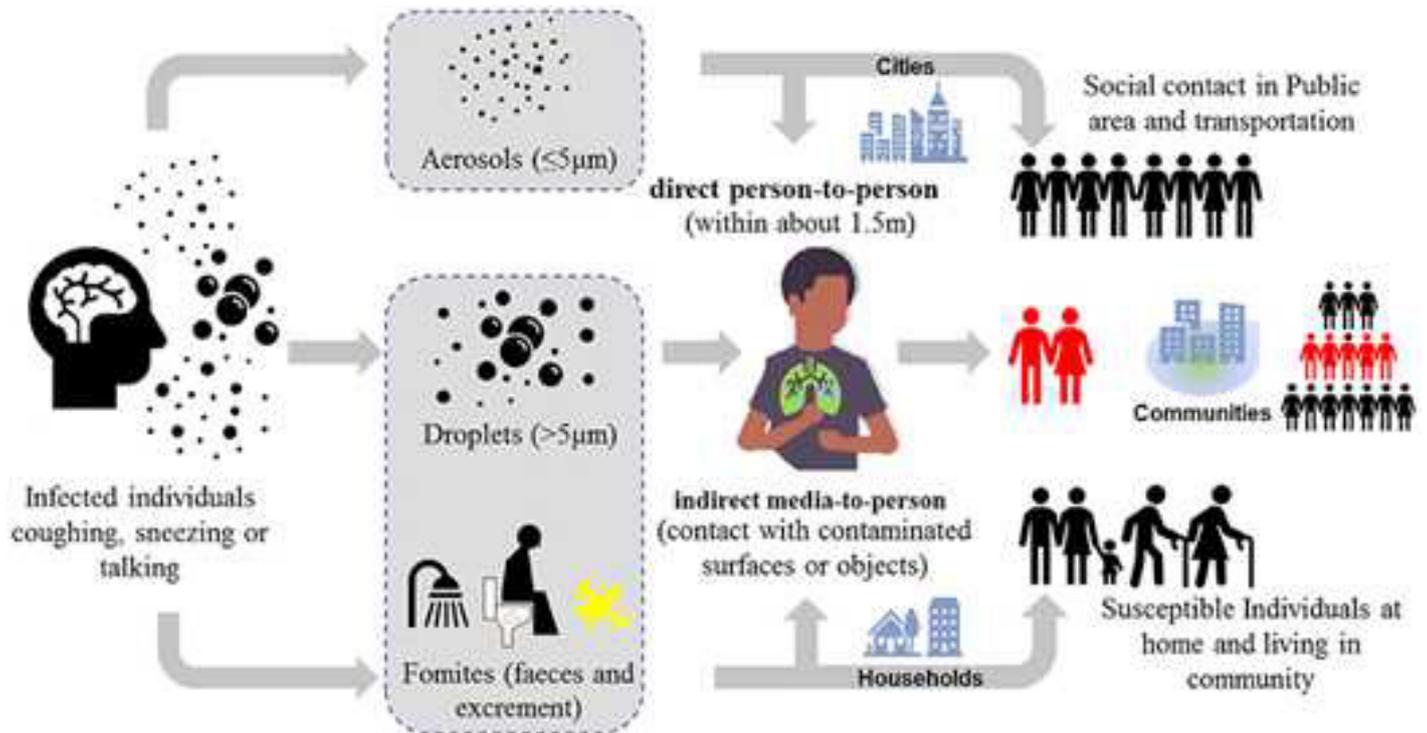
Disease can be spread while bathing, washing, drinking water, or by eating food exposed to contaminated water. Examples of these are cholera, typhoid fever, giardiasis, and dysentery.

Vector transmission

Vectors are organisms that carry the disease-causing pathogen without being affected by the disease themselves. Mosquitos, houseflies, rats, and mice are all examples of vectors. Malaria is mostly

commonly known to be spread by the female anopheles' mosquito, while the bubonic plague was spread by fleas on rats.

Methods of disease transmission



Checkpoint

Summarise the various forms of disease transmission in the table below: use the internet to assist you with your research.

Form of transmission	Description	Example of pathogen / disease
Direct contact		

Form of transmission	Description	Example of pathogen / disease
Body fluids		
Foodborne transmission		
Waterborne transmission		
Airborne transmission		
Vector transmission		

Preventing transmission of pathogens

Many factors can influence the spread of disease, including the social climate, diet, general health, and access to medical care. There are several ways to slow down and even stop the spread of disease.

Behavioural factors

Human intervention and modification of behaviour can reduce the transmission rate of some diseases and inhibit their spread. This can be done by:

- The use of personal **physical barriers** e.g. condoms, protective clothing such as masks, gloves and mosquito nets.
- Adoption of good **personal hygiene** practices e.g. regular handwashing, covering nose and mouth when coughing and sneezing or using tissues.
- **Isolation** of people infected by the illness.
- **Quarantine** for those people that may be infected but have not yet fallen ill.

Public sanitation

Cleaning up the environment also lowers the incidence of disease by reducing the likelihood that pathogens or their vectors will survive. The effective control of infectious disease depends on knowing the origin of the outbreak (its natural reservoir), its mode of transmission within the population, and the methods that can be feasibly employed to contain it.

This can be done ensuring effective management of sewerage, garbage disposal and treatment of drinking water.

Environmental management

The environment can be made less suitable for the survival of growth of some pathogens. Reduction of open drainage areas and draining swamps can reduce stagnant suitable breeding environments for mosquitos carrying disease.

Public vaccination schedules

The use of widespread vaccination programs adopts the **herd immunity** theory that if most of the public is immune then outbreaks of disease will be limited to sporadic cases and the symptoms are not as severe. Some people cannot be vaccinated for many reasons and herd immunity is essential for the decrease in transmission to everyone.

Public laws

The Australian Quarantine Inspection Services (AQIS) play a critical role in keeping Australia free from many plant and animal pests and disease that affect other countries. Australia has strict quarantine rules. By limiting or prohibiting the entry of certain goods ensures protection of Australian agricultural industries and the entry of unwanted diseases or pests that may affect the plant, animal and human health or our environment.

Chemicals and sterilisation techniques

The use of disinfectants and autoclaves to sterile equipment and destroy pathogenic microbes on surfaces before they have the chance to infect.

Diseases are often classified according to how they behave in a particular population. Any disease that spreads from one host to another, either directly or indirectly, is said to be a **communicable disease**. Those that are easily spread from one person to another, such chicken pox or measles, are said to be **contagious**. Such diseases are a threat to **public health** and many must be notified to health authorities.

Checkpoint

Describe when you should carry out the following behaviours to reduce the spread of disease:

Behaviour	When to follow
Cover your mouth	
Wear gloves	
Stay at home away from school	
Wipe surfaces with disinfectant	
Use tongs, pliers, or tweezers	
Never share personal items	

Define "mechanical barrier" and name some examples.

Describe why surgeons wear surgical masks?

Explain briefly how each of the following assists in the control of a specific disease:

The use of condoms to control HIV infection rates.

Drainage of stagnant water to control malaria.

Thorough handwashing to stop infection with *Campylobacter*.

Describe how each of the following methods is used to control the growth of disease-causing microbes. You may need to do some research on-line to complete this question.

Method	How this is used to control disease-causing microbes
Disinfectants	
Antiseptics	
Heat	
Ionising radiation (gamma rays)	
Desiccation	
Cold	

Activity: Tinea between my toes

Tinea is a fungus that can grow on the skin, hair, or nails. As it grows, it spreads out in a circle, leaving normal-looking skin in the middle, which makes it look like a ring. Because of the way it looks, tinea infection is often called “ringworm.” When tinea infects the feet, it is called “athlete’s foot”. Fungi are plant-like organisms that grow best on living tissue. Given the right conditions, a fungal infection called tinea can attack the skin of the feet or groin. Tinea is a highly contagious infection.

Activity purpose

- To design and conduct an investigation to determine the most favourable conditions for growth of fungi.

Science inquiry skills

- Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes.
- Design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics, including animal ethics.
- Conduct investigations safely, competently and methodically for the collection of valid and reliable data.
- Represent data in meaningful and useful ways, including the use of mean and median; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental accuracy, the nature of the procedure and the sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions.
- Select, use and/or construct appropriate representations, to communicate conceptual understanding, solve problems and make predictions.
- Communicate to specific audiences, and for specific purposes, using appropriate language, nomenclature, genres and modes, including scientific reports.

Materials

- 1 slice of 3 day old bread - cut into 6 equal pieces
- 6 plastic petri dishes or sealable plastic bags
- 6 labels
- sticky tape
- water

List the conditions existing around your feet that differ from those of your hands.

Procedure

1. You have 6 pieces of bread, representing your skin's surface. Decide on the conditions you will test to observe the growth of fungus on the bread.
2. Discuss your ideas with your team members.
3. Once you have decided, label each petri dish and its conditions.
4. Refine your ideas to determine the variables to be tested, measured and controlled in your investigation.
5. At the end of one week, record your results in the table below.
6. Wrap the petri dishes and leave for your lab technician to dispose of.

Experimental variables

Independent variable

Dependent variable

Controlled variables

Results

Petri dish	Experimental conditions	Results
1	Control	
2		
3		
4		
5		
6		

Questions

Describe the changes to the contents of petri dishes that occurred over the week.

Was there more than one type of fungus growing on the bread? How can you tell?

Why was the fungus able to grow on the bread?

Explain why the conditions you chose provided different levels of fungal growth.

State the precautions that can be taken to reduce the chance of transmission of tinea from one person to another.

State the general name given to a chemical that kills fungi.

Explain why does tinea grows between the toes and not the fingers.

Activity: The 5 second rule - myth or truth?

How many times have you dropped food you were about to eat on the floor, shouted “Five seconds!” picked up the food and continued to eat it? This urban myth has unknown origins but is an accepted routine for many people. The stipulated time frame of five seconds can also change from three to 10 seconds. Little thought goes into what could be on the ground where the food dropped or, more importantly, what is transferred from the ground to the food you proceed to eat.

Bacteria are all around us – in the air we breathe, the money we touch, hand rails and computer keyboards and of course on the ground the food was dropped on but many of us do not give this a second thought when counting three, five or 10 seconds. How long does food have to stay on the ground before it becomes contaminated with bacteria?

Activity purpose

- To investigate bacterial growth from food that has been dropped on the ground for various amounts of time.

Science inquiry skills

- Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes.
- Design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics, including animal ethics.
- Conduct investigations safely, competently and methodically for the collection of valid and reliable data.
- Represent data in meaningful and useful ways, including the use of mean and median; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental accuracy, the nature of the procedure and the sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions.
- Select, use and/or construct appropriate representations, to communicate conceptual understanding, solve problems and make predictions.
- Communicate to specific audiences, and for specific purposes, using appropriate language, nomenclature, genres and modes, including scientific reports.

Materials

- 5 x Jelly Babies
- 6 x prepared Agar plates
- plastic forceps (sterile)
- sticky tape
- incubator (or heat lamps)
- stopwatch

Procedure

1. Without opening the prepared Agar plates, label the bottom of the petri dishes with a permanent marker with which test it is e.g., 0 sec, 3 sec, 5 sec, 10 sec, 20 sec and Untouched.
2. Use the sterile forceps to place a Jelly Baby on the floor and time for 3 seconds.
3. Use the forceps to pick up the Jelly Baby and wipe it over the surface of the Agar thoroughly over the entire surface. Ensure that you only open the lid just enough to fit the Jelly Baby and the forceps through. Try not to breathe over the petri dish while you are doing this.
4. Close the lid and sticky tape the petri dish closed.
5. Repeat steps 2 to 4 for the 5 seconds, 10 seconds, and 20 seconds Agar plates.
6. Use the forceps to take one Jelly Baby and wipe it on the surface of the Agar without dropping it on the floor.
7. Close the lid and sticky tape the petri dish closed.
8. Take the remaining petri dish and sticky tape it closed without opening it.
9. Give the petri dishes to your teacher to be incubated.
10. Examine the petri dishes for growth of micro-organisms every 24 hours for 2 – 3 days.
11. Do not remove the sticky tape or open the petri dishes at any time.
12. Record your observations.

Experimental variables

Independent variable

Dependent variable

Controlled variables

Results

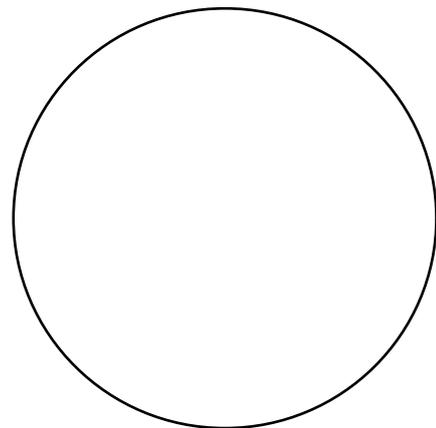
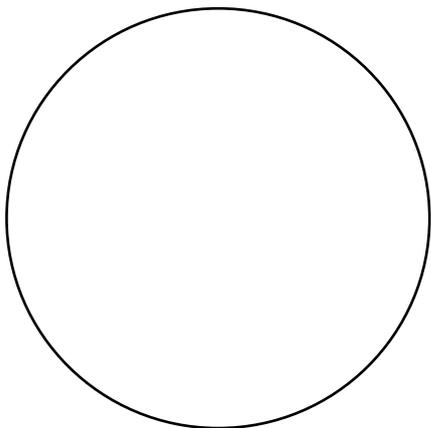
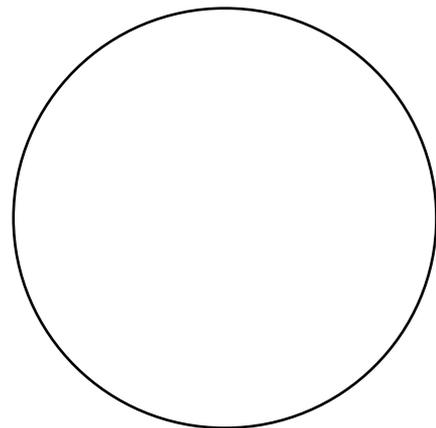
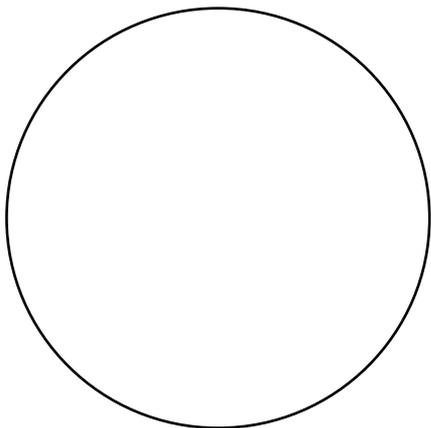
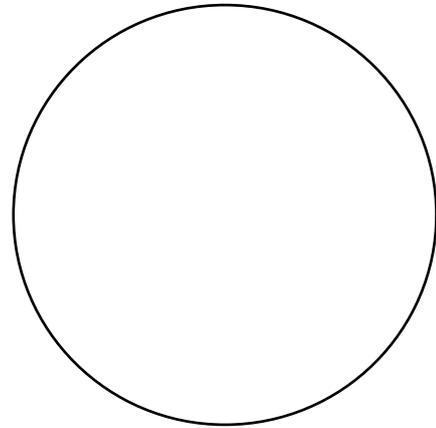
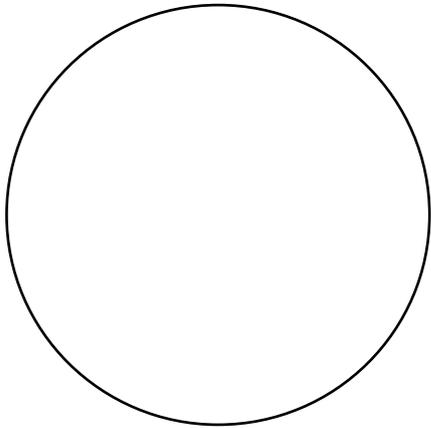
The following will assist you in your descriptions of the colonies grown

- Shape & Size – small, large, round, irregular.
- Edge of colony – smooth, curved, wavy, has lobes.
- Elevation – flat, raised, concave.
- Texture – “hairy”, smooth.

Agar plate	Shape	Size	Edge	Elevation	Texture	Other observations
Untouched						
0sec						
3 sec						
5 sec						
10 sec						
20 sec						

Questions

Draw/insert photo each plate below to show how the bacterial colonies have spread across the Agar surface.



Describe any changes in the appearance of the cultures over the incubation period. Are you able to explain any of these changes? Consult some reference material to assist you in your answer.

What was the purpose of including an untouched petri dish?

What was the purpose of testing a Jelly Baby that had not touched the floor?

Did you expect to find any micro-organisms on the Jelly Babies? Why or why not?

If you were successful in culturing any micro-organisms, do you think they could be harmful? Why or why not?

Were there any aspects of the investigation that could have influenced your results? If so, what could you do next time to ensure your results were as accurate as possible?

What can you conclude from this experiment?

What is a "colony" of bacteria?

List the various defences the body has to protect itself from various bacterial invasions.

If we follow "The 5 Second Rule" why don't we get sick every time?

Activity: Pathogen case study

Use <https://www.healthywa.wa.gov.au/> to research information on the following infectious diseases:

Disease	Pathogen type	Transmission method	Symptoms
Salmonella			
Ross river			
Malaria			
Tinea			
Influenza			

Who is most at risk?	Treatment options	Prevention strategies

Activity: Prevention of disease in healthcare

Use the resource Australian Guidelines for the Prevention and Control of Infection in Healthcare (<https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare>) to answer the following questions.

Describe the steps of routine hand hygiene in hospitals in WA.

Describe each item of PPE and when it must be used.

Describe the term 'aseptic technique'.

How must sharps be safely handled and disposed of?

List the areas that must be cleaned in workplaces- add detail about how each one should be cleaned (e.g. what with)?

See section 'Transmission- based precautions'. List 3 areas of transmission are covered by this protocol.

Chapter review

- Define the term infectious disease.
- Describe how infectious diseases differ from non-infectious diseases.
- Define the term pathogen.
- How has the development of the microscope aided in our understanding of infectious disease?
- Outline the general characteristics of bacteria and describe how bacteria are classified.
- Name the method by which bacteria reproduces.
- Outline how bacteria cause illness in humans.
- Describe why viruses are considered non living and explain how they infect a human to cause disease.
- Describe the main types of diseases caused by fungi, and give two examples.
- Explain the difference between endoparasites and ectoparasites, provide examples of each. How do they cause disease?
- Explain the difference between direct and indirect contact.
- Name and describe the ways in which disease can be transmitted
- Define the term vector? Give an example of vector transmission of disease.
- How do physical barriers prevent spread of disease? Explain by using an example.
- Describe some behaviours that people can adopt to prevent the spread of disease?
- Present some things that local councils and governments can do to ensure the public are protected from infectious diseases?
- Distinguish between isolation and quarantine.

Extras for experts

- Do a quick Google search and find out what the 'Hippocratic oath' is. What is the significance of the oath and how does it impact the medical profession today?
- Until the middle of the 20th Century infectious diseases account for more deaths worldwide than non-infectious diseases. Since around 1930 in developed countries such as Australia, USA, and the UK more people have died of non-infectious diseases. Can you explain some of the reasons for this occurrence?
- Investigate the history of the microscope. Create a timeline of events that describe significant developments that lead to the discovery of microbes and diagnosis of disease.
- Who was Alexander Fleming? Explain why is he is well known in the area of microbiology.
- Research the different types of viruses. State the group of viruses that Covid-19 belongs to?

CHAPTER 6

Vaccines and Immunology



Syllabus dot points

Science understanding:

- Inherent responses in humans target pathogens, including through the inflammatory response, which involves the actions and components of the circulatory system.
- Responses to specific antigens include the production of antibodies and memory cells for short-term and long-term immunity (details of t and b cells are not required).
- Modern medicines which assist in reducing the rate of infection, or the severity of the infection, include antiseptics, antivirals and antibiotics.
- Immunity to specific diseases is acquired as a result of natural exposure to the pathogen, or through the use of vaccines to produce memory cells.

Science as a human endeavour:

- Use and misuse of medicinal treatments against pathogens can cause the development of multi-resistant bacteria that increase risks associated with the infection.
- The 'hygiene hypothesis' proposes that the increase in allergy disorders in modern society, is a consequence of decreased exposure to infection in early childhood.

The Learning intentions and Success criteria are included as a guide to understanding expectations of students as outlined in the syllabus. Students could use them to review their understanding of the syllabus prior to assessments.

Learning intentions

1. Understand that the body can target pathogens and uses various responses to overcome their effects.
2. Understand that the body can respond to specific antigens and produce an immune response.
3. Understand that medicines are developed to reduce the rate of infections and reduction of symptoms.
4. Understand that we develop immunity to specific disease-causing pathogens in a naturally or acquired by vaccines. Our immune system develops memory cells.

Success criteria

- Explain the difference between non-specific and specific in terms of defence mechanism of the body.
- Describe the body's (non-specific) **external and protective reflexes** defences that acts to defend against pathogens entering the body.
- Describe the (non-specific) **inflammatory response** and how it acts to defend the body against invading pathogens.
- Explain the significance of the (specific defence) **immune response** - the 3rd Line of Defence.

- Describe antigens and antibodies.
- Discuss medical interventions to pathogens (use of antibiotics, antivirals and antiseptics).
- Describe how the overuse of antibiotics have led to development of multi resistant organisms (superbugs).
- Explain how immunity to specific diseases is obtained.
- Explain the difference between “passive” and “active”, “natural” and “artificial” immunity and provide examples.
- Describe herd immunity.
- Describe the purpose of vaccines.
- Describe the different types of vaccines.
- Explain how vaccines work.
- Explain why a vaccine was important in combating the spread of the disease polio.

Key terms

Identify and fill in the definitions for the following key terms:

Key term	Definition
Active immunity	
Antibiotic	
Antibody	
Antibody mediated	
Antigens	
Antiseptic	
Antiviral	
artificial immunity	
Autoimmune disease	
Cell mediated	

Key term	Definition
Herd immunity	
Histamine	
Immune response	
Inflammation	
Natural immunity	
Non-self-antigen	
Non-specific immunity	
Passive immunity	
Pathogen	
Protective reflexes	
Self antigen	
Specific immunity	
Vaccine	

Specific and non-specific response

Non-specific immunity is the term used to describe the body's response to all pathogens. This response is to stop the pathogen from entering the body. Barriers to pathogens are in different parts of the body and can include the skin, mucous membranes, cilia, chemicals and secretions of fluids or oils. We have also developed reflex responses to stop the pathogen entering the body. Coughing and sneezing are example of these.

Specific immunity is the term used to describe the body's response to specific pathogens. If the pathogen has entered the body, there are mechanisms to target a specific pathogen to reduce the effect it has on the body.

Checkpoint

Describe how non-specific immunity is different to specific immunity.

Complete the table to show the key features of non-specific immunity to specific immunity.

	Non-specific response	Specific response
Pathogen		
Mechanism body uses on pathogen.		

External and protective reflexes

External reflexes

Non-specific external responses to pathogens include skin, mucous membranes, chemical barriers.

Skin - Unbroken skin provides a barrier that pathogens cannot enter through. Skin also has sweat and sebaceous glands which produce substances that do not support the growth of pathogens. Skin has two layers: the epidermis and dermis. The surface epidermal layer is waterproof, tough and flexible. It contains a tough protein called keratin which aids in the defence of pathogens.

Mucous membranes – provide barrier to pathogens. Mucous membranes can be found in many organ systems such as the reproductive, respiratory, urinary, and digestive system. These systems are likely pathways for pathogens to enter. Mucous membranes provide a thick covering of mucus to trap pathogens. Some have cilia that will beat to create movement of the fluid and help to remove the pathogen.

Chemical barriers - provide properties that can destroy the pathogen. These can include antiseptic oils in the skin, tears that contain an enzyme that can kill pathogens and flush them away. Saliva in the mouth, acids in the stomach and vagina inhibit or destroy growth of bacterial pathogens. Urine cleans and flushes the urinary tract.

Ear wax or cerumen -contains an enzyme that protects the outer ear from infection by bacterial pathogen by providing another barrier.

Protective reflexes

The body has protective reflexes are natural response to pathogens that have entered the body. This includes vomiting, diarrhoea, sneezing and coughing.

Vomiting - can remove the contents of the stomach and the pathogen with it. The muscles of the abdomen and diaphragm contract to eject the contents.

Diarrhoea - is the result of an irritation of the small intestine by the pathogen. This increases the contraction of the muscles of the small intestine and removes the pathogen by emptying the small and large intestine. The substance is watery as the water cannot be absorbed by the large intestine.

Sneezing - occurs as the pathogen irritates the lining of the nasal cavity. Air is powerfully expelled by the lungs through the nose and mouth. Mucus and the pathogen or foreign particle are removed.

Coughing - forces the pathogen or irritant up and out of the lungs and trachea to the throat and mouth. Mucus, pathogen, or foreign particle is forced out by the powerful expulsion of air.

Checkpoint

List in the table below all the described nonspecific external barriers and the protective reflexes.

Non-specific external	Protective reflexes

Inflammatory response

Inflammatory response occurs when the skin is broken, cells are injured or tissue is damaged, and the pathogen has entered the body. This injured tissue will become red, swollen, hot and painful as the body responds to the pathogen.

This is a nonspecific response as the body inflames the area to reduce the chance of the pathogen spreading further.

If the tissue becomes damaged and the pathogen enter to body this will begin the inflammatory response.

Histamine is released by the cells in response to the injury. Histamine causes the blood vessel in the area to dilate [get wider] and allow more blood flow to the area.

Histamine also makes the blood vessels more permeable [leaky] and fluid from the blood plasma moves into the tissue.

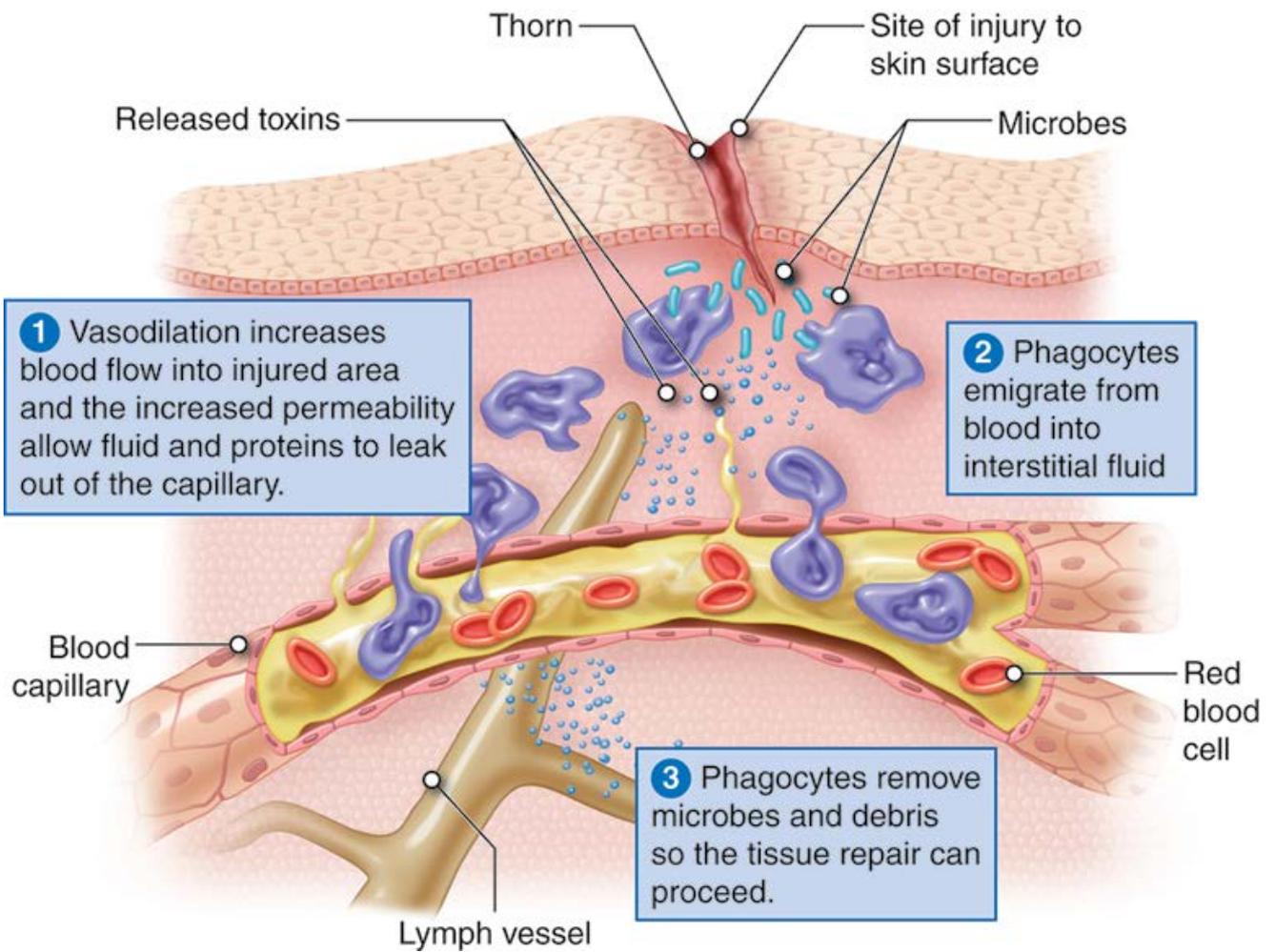
This fluid contains substance that can reduce the spread of the pathogens, help remove damaged tissues and begin the repair the tissue.

White blood cells move into the tissue and begin to engulf the pathogen by a process known as phagocytosis which traps the pathogens to prevent them from moving out to infect nearby tissue. More white blood cells are attracted to the area to actively consume the pathogens.

The increased fluid and blood to the area means it becomes hot, red in that area and swollen. This change in the tissue cause the pain receptors to be activated and the person feels pain at the site of the injury.

White blood cells that have consumed pathogens accumulate and when they die 'pus' is formed.

The cells in the area repair the injury site by undergoing mitosis and the damaged tissue is converted back to healthy tissue.



Checkpoint

Describe the purpose of inflammation.

Describe four signs that the tissue is injured.

Outline the steps of the inflammatory response.

Specific immune response

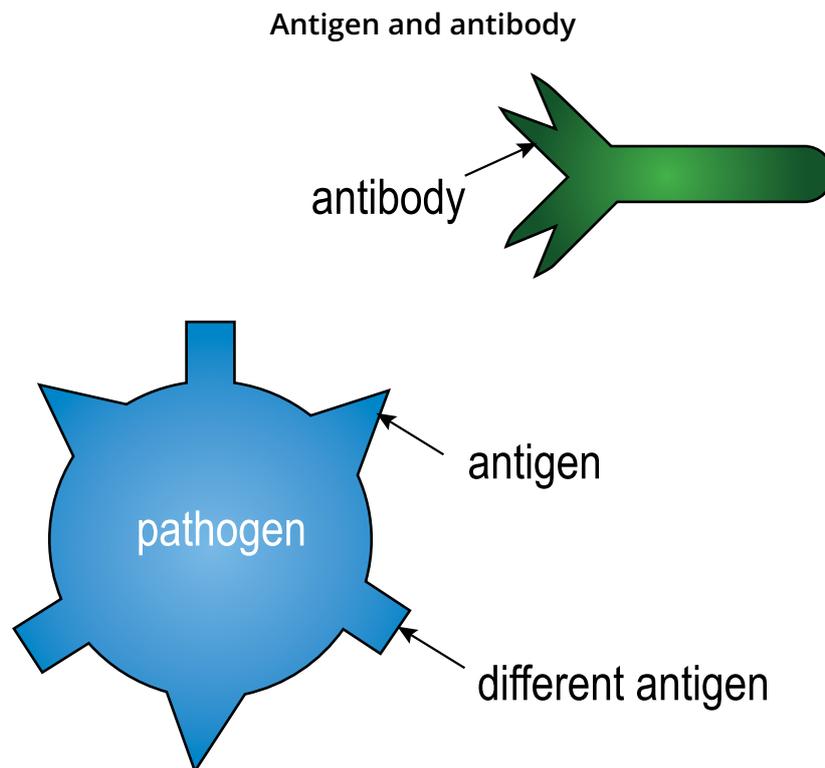
Specific response to pathogens occurs once the pathogen has broken through the other lines of defence. Specific pathogens that enter will begin an immune response by the body.

The immune response involves specialised white blood cells and the detection of the pathogen. They create an immediate response to fight the pathogen and create memory cells. If the body encounters this pathogen again the memory cell can quickly activate the immune response and reduce the symptoms and duration of the effects of the pathogen.

Pathogens will cause a change to the body normal homeostatic state. The immune response works to return the body back to its normal homeostatic state.

What are antigens?

- Antigens are a substance that can cause a specific immune response.
- Antigens are usually large carbohydrate or protein molecules.
- Antigens can be self-antigens or non-self-antigens.
- Self-antigens are antigens that the body produces and do not cause an immune response
- Non-self-antigens are antigens that body recognises to be foreign and trigger a specific immune response
- An Antibody is produced to respond to a specific antigen.



Antibody mediated response

Antibodies are created by a process called antibody mediated response. This is where the body produces antibodies specific to the antigen.

When a non-self-antigen has entered the body, it is detected by white blood cells, called macrophages. These cells engulf the pathogen /antigen by phagocytosis and a piece of the antigen protein is on the surface of the white blood cell. This is presented to lymphocytes. A lymphocyte is a white blood cell that is responsible for the immune response.

Lymphoid tissue contains lymphocytes. The B lymphocytes are produced in the red bone marrow and develop in the lymph tissue. T lymphocytes are produced in the red bone marrow but develop in the thymus gland.

The B lymphocyte is able to produce antibodies and memory cells.

B lymphocytes or B cells are specific to specific antigens.

Memory cells are present in the cells tissue and can recognise the antigen if it is present in the body again. This will quickly start the immune response called a secondary response. The memory cells cause a rapid response by recognising the antigen and the plasma cells are formed quickly and release antibodies into the blood stream and lymph fluid. Vaccines rely on these memory cells to recognize pathogens quickly and prevent symptoms of disease.

This response is effective at reducing the effect the pathogen has on the body.

Checkpoint

Describe the significance of memory cells.

Cell mediated response

Types of T lymphocytes or T cells.

When a pathogen (non-self antigen) has entered the cell, then the immune response will require the T Lymphocytes or T- cells to respond. The pathogen that has entered the cell can be bacterial or viral. This immune response can also respond to fungi, parasites, and donated tissue organ as in organ transplants.

These cells attack pathogens that have entered body cells.

Memory T cells created and spread in the body tissue and are ready to produce an immune response to the pathogen on the next encounter. Memory cells are present in the cells tissue and can recognise the antigen if it is present in the body again. This will quickly start the immune response called a secondary response. The memory cells cause a rapid response by recognising the antigen and the T cells are formed quickly. This response is effective at reducing the effect the pathogen has on the body.

Checkpoint

Describe the difference between how B cells and T cells respond to pathogens.

Describe the difference between antigens and antibodies.

Medical interventions

Antibiotics are a medical intervention created to inhibit the growth of or kill bacteria. They can work by weakening the bacteria cell wall, these are called bactericidal antibiotics. Penicillins are an example of an antibiotic.

They can block ribosomes in the bacterial cell from making functioning proteins during translation and stop the bacteria from transcribing the DNA in the nucleus. These are called bacteriostatic antibiotics and they stop the bacteria from multiplying. Tetracycline is an example of this type.

Antibiotics are effective only to certain types of bacteria and can't work on all bacteria in general.

Broad spectrum antibiotics are a group of antibiotics that affect and kill many types.

Narrow spectrum antibiotics are a group of antibiotics that affect and kill only specific bacteria.

Antibiotic resistance

Bacteria cause disease by producing toxins or invading and living in cells. Bacteria can reproduce quickly and over time they have been able to evolve through natural selection to become resistant to certain types of antibiotics. This is called antibiotic resistance, or if they are resistant to many antibiotics available, they are called multiple drug resistant bacteria, superbugs.

Medical practitioners previously may have over prescribed antibiotics. This has led to the bacteria, that have been exposed to the antibiotic treatment course and survived, to become immune to it or resistant to it. This means the next time they are exposed to the same antibiotic, they are not affected by the antibiotic, and it is no longer effective on them. The bacteria are said to be resistant.

A patient may receive a prescription for a course of antibiotics as a treatment to their bacterial infection. The course will be effective, and soon the patient feels better as the symptoms have gone. They decide to stop taking the antibiotic because they have 'recovered' from their infection without completing the whole course. In fact, some of the bacteria are still present and have now been exposed to the antibiotic drug. They evolve with ways to overcome that antibiotic next time they are exposed to it.

Animals produced for food are given antibiotics to prevent infection. This is another way that bacteria have been exposed to the antibiotics and evolve resistance.

These are ways resistance to antibiotics develops in bacteria.

Multi resistant bacteria

Bacteria that are multi resistant to different types of antibiotics are called superbugs. The existing antibiotics are no longer effective on these organisms and the patient has no treatment for the infection.

Antibiotics are being reviewed and developed to overcome these multi resistant organism, superbugs, with the hope of creating a new antibiotic that will be able to treat the bacteria causing the infection.

Antiviral drugs

Antiviral drugs are a medical intervention developed to control viral infections or stop the virus from replicating.

Viruses contain DNA or RNA. They are non-living but reproduce by invading living cells. These cells are host cells and reproduce the virus, so that it is able to spread. Viruses require a host cell to reproduce. The virus will insert their DNA or RNA into the cell. The cell's own DNA or RNA will be changed to become the virus's DNA or RNA. The cell will now reproduce the viral information. The virus is now able to affect other cells and the virus can spread.

Antiviral drugs can block the virus from entering the host cell and some can stop the virus from releasing the DNA or RNA into the host cell. Developing antiviral drugs that can affect only the infected host cell and not the other cells require an understanding of the viral proteins. This will lead to better antiviral drugs. Antiviral drugs available include drugs to treat the HIV virus and 'Tamiflu' to treat influenza.

Antiseptics

Antiseptics are a medical intervention used to treat the skin or tissue to lessen the chance of infection occurring. The surface is treated with a substance that removes bacteria from the surface where the medical procedure will take place. When the skin is punctured or broken bacteria can enter the wound and cause an infection. Antiseptics may prevent growth of bacteria.

Checkpoint

Describe how antibiotics work.

Describe the difference between a narrow spectrum and broad-spectrum antibiotic.

Describe what is meant by antibiotic resistance.

Describe how antibiotic resistance can occur.

Describe how antiviral drugs work.

Describe how antiseptics work.

How is immunity specific to disease?

Immunity is the resistance to infection by the invading pathogen.

To develop immunity, there must be exposure to a pathogen such that antibodies are developed and memory cells respond quickly if there is a secondary infection.

Checkpoint

How is immunity to a specific pathogen developed?

How immunity can be gained

How the immunity is obtained can be categorised as **natural immunity** or **artificial immunity**.

Immunity is also **passive** or **active**. Passive occurs without the person creating their own immunity (there is no effort involved), where active occurs when the person is exposed to an antigen and creates their own immunity (energy is needed to achieve this).

Natural immunity is where there has been no intervention.

Passive, natural immunity occurs when the antibodies are received through breast milk or through the placenta. The person does not produce the antibodies themselves; the antibodies are from the mother. This is a short-lived immunity but allows newborn babies to have some immunity until they can develop their own.

Alternatively, you have active, natural immunity as you have had the antigen by being exposed to the disease and created antibodies and memory cells for it.

Artificial immunity is when a person is given an antibody made by someone or something else, or a vaccine.

Passive, artificial immunity occurs when the antibodies are injected into the blood stream. This immunity is given to you if you have been exposed to a pathogen causing serious disease. E.g., Tetanus or snake bite.

Alternatively, active, artificial immunity occurs when the antigen is given by vaccination, and you have manufactured your own antibodies for that antigen. This is vaccination for specific disease-causing pathogens.

Checkpoint

Describe the difference between passive and active immunity.

Describe the difference between artificial and natural immunity.

Herd immunity

In a population the individuals will vary in many ways, age, health and immunity to disease.

We call the population the herd. If the population has been exposed to a disease-causing pathogen some of the population may have had the disease and some may not have. Those that have had the disease will have antibodies to fight the disease if they are exposed again. Those in the population who haven't had the disease do not have any antibodies for the pathogen that causes the disease.

The disease is contagious when it is able to be transferred between the members of the population. Often people are reservoirs of the pathogen but they don't have any symptoms of the disease. The disease is contagious during this time and can easily be spread. Once symptoms appear they are more aware they have the disease and take care not to spread it. The pathogen causing the disease may be able to mutate if it is widespread in a population that has low resistance to the disease. Not everyone on a population will survive the disease caused by the pathogen.

Vaccines are made to help the population fight the diseases. The vaccine will activate the body's immune system and the person will have active artificial immunity. As the population is exposed to the pathogen and survive or have the vaccination, the number of the people in the population who have immunity increases. The pathogen that causes the disease is less likely to mutate and it will be less virulent and have a shorter time where people are contagious and can catch it.

Not all members of a population can be vaccinated or survive the disease caused by the pathogen. Those that can't include the very young, the very old, the very sick, and people who have an immune system that is weakened by other diseases. For these members of the population, they rely on the rest of the population having antibodies to the pathogen, either by surviving the disease or by vaccination for the disease.

These members rely on the herd and the immunity of the herd. This is called herd immunity. This is the immunity provided by the other members of the population. It relies on a high number of the population having been vaccinated thus reducing the chance of transmitting the disease. The result is that in that population, the pathogen should have a much lower presence and less chance of being passed on, be less virulent and have a lower chance to mutate. This protects the vulnerable from being infected by the disease.

Checkpoint

Describe who benefits from a high number of the population being vaccinated for a certain disease.

Describe what is meant by herd immunity.

Describe how having high immunity in a population can reduce the potency of the disease.

Types of vaccines

Vaccines are the antigen preparation used in artificial immunity. The way they are prepared depends on the pathogen.

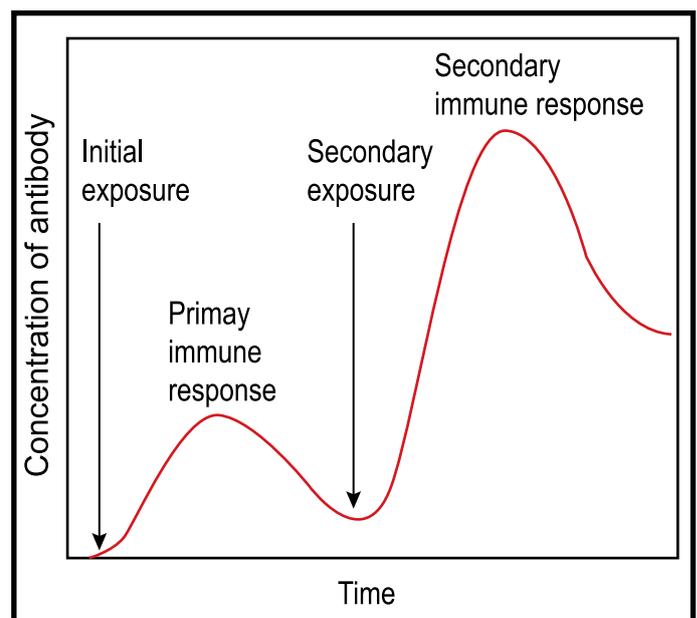
- Vaccines can contain either the dead bacteria or virus – Cholera or Typhoid
- Contain live attenuated forms, live but have reduced effect – Rubella and Poliomyelitis
- Contain toxoid – the inactivated toxin that is produced by the pathogen – Diphtheria and Tetanus
- Contain a sub-unit or fragment of the of the pathogen – Hepatitis B and Human Papilloma Virus (HPV)

Vaccines work by producing an immune response. The person produces antibodies to the pathogen. Vaccines are given to a population via a public immunisation program. Once complete, the population will be vaccinated and have increased immunity.

Without a vaccine the person would have had to be exposed to the antigen to produce their own antibodies – this is called a primary response.

This takes a longer time as the body needs to identify the antigen and create the antibodies. During this time the pathogen is able to infect others and spread through the population. Vaccines are used in populations to reduce the effect of dangerous pathogens and reduce symptoms, length of suffering and the loss of life caused by the infection caused by the pathogen.

The graph to the right shows the rapid increase in concentration of antibodies over a shorter amount of time on the second exposure to the antigen.



Checkpoint

List the different types of vaccines that can be produced.

Describe how vaccines work.

Describe what is meant by a secondary response. Describe how this differs in time taken and concentration of antibodies compared to primary response (*the previous graph helps to demonstrate this*).

Ethical risks associated with vaccines and allergic reactions

Vaccines and how they are made can pose a health risk to individuals. These can be an allergic reaction.

An allergic reaction occurs when the antigen produces a very strong immune response in the individual. The reaction may be mild or severe. In severe cases the person may die from the immune response to the antigen. Anaphylaxis is a severe allergic response to an antigen that if untreated may lead to death.

Allergic reactions can include a reaction to the medium used to create the vaccine such as the egg protein, yeast or the preservative used.

Factors that influence if a person chooses to vaccinate

These can include ethical concerns about how the vaccine was produced.

1. If animals were involved in the production, were they ethically treated? If they were grown in human cells that originated from a foetus.
2. If they were tested on animals before human trials.
3. If they were trialled in human populations that weren't empowered to refuse the trial and were exploited by the vaccine developer in some way?
4. If the vaccine is for a sexually transmitted pathogen, does having immunity to it result in increased sexual activity?
5. Is the vaccine readily available for the population to undergo an immunisation program?

Checkpoint

Describe how an allergic reaction can occur?

List risks and ethical concerns surrounding vaccine use.

Immunisation programs

Immunisation programs are designed to reduce the outbreak and spread of disease. Childhood immunisation programs are set by governments to ensure the health and wellbeing of the young and vulnerable as well as the general population. The benefits of immunisation programs are evident in the low number of outbreaks of preventable diseases in the population.

Another preventable disease, Poliomyelitis [Polio], is a viral disease that causes paralysis.

The World Health Organisation describe Poliomyelitis as:

“Poliomyelitis (polio) is a highly infectious viral disease that largely affects children under 5 years of age. The virus is transmitted by person-to-person spread mainly through the faecal-oral route or, less frequently, by a common vehicle (e.g. contaminated water or food) and multiplies in the intestine, from where it can invade the nervous system and cause paralysis.”

https://www.who.int/health-topics/poliomyelitis#tab=tab_1

Poliovirus is highly infectious. It can take 7-10 days to incubate. It is spread by infected people through their faeces. Poor hygiene practices can lead to rapid spread in a population. Most people can recover from the virus. Some people rapidly develop paralysis of the legs which is permanent. Some people die due to the failure of the muscles surrounding the lungs.

The virus is ingested and reproduces in your intestines. It affects the nervous system.

General symptoms can include fever, headache, vomiting, tiredness. Also, stiffness in neck and limbs.

There is no cure for Polio and the only prevention is through immunisation. Immunisation programs to vaccinate for Polio have been in place since the 1950's in Australia. In the year 2000 Polio was considered eradicated from the Australian population. Immunisation continues as it is not globally eradicated. There are two vaccines available: oral polio vaccine and inactivated polio vaccine. Both are effective and safe.

There is a global effort to eradicate Polio.

The development of vaccines and the implementation of immunisation programs instigated by governments have enabled populations to have immunity to preventable diseases and increased life expectancy.

Checkpoint

Describe how an immunisation program can prevent disease?

Use the table below to draw a graph to show the year vs the number of people with polio per thousand AND draw another graph to show the year vs the % of people vaccinated.

**Ask your teacher for some graph paper.*

Number of people per thousand with polio and percentage getting polio vaccination in the USA 1942–1965

Year	People with polio per thousand	% people vaccinated	Year	People with polio per thousand	% people vaccinated
1942	120	0	1954	150	70
1943	190	0	1955	80	80
1944	140	0	1956	30	90
1945	260	0	1957	40	80
1946	110	0	1958	50	80
1947	280	0	1959	30	90
1948	420	0	1960	8	90
1949	340	0	1961	1	90
1950	290	0	1962	0.4	90
1951	580	0	1963	0.1	90
1952	360	0	1964	0.05	90
1953	190	0	1965	0.01	90

Describe the trends in the graphs, and comment on the relationship between the vaccination rate and the number of people who had polio.

Chapter review

- State the difference between an antigen and an antibody.
- Explain how antibiotics work.
- Describe the use of antiviral medication.
- Describe how antibiotic resistance occurs.
- Explain herd immunity in simple terms.
- Describe the difference between active and passive immunity.
- Describe the difference between natural immunity and passive immunity.
- Describe the difference between specific immunity and non-specific immunity.
- Describe the purpose of 'memory cells' in an immune response.

Extras for experts

- You have a cut finger and you notice that it has become hot, swollen, red and painful. Describe the inflammation response.
- List and explain some ethical concerns regarding vaccines. Use the recent COVID pandemic as an example of people choosing not to be vaccinated due to various concerns.

CHAPTER 7

Community and Global Health



Syllabus dot points

Science understanding:

- Standards of hygiene, including sanitation of water, waste treatment and the presence of pathogens and disease vectors, varies between global communities; travel warnings provide information to help reduce risk of infection.
- Population density and movement patterns influence the transmission of disease.
- Social behaviour is an important factor in the transmission, spread and persistence of sexually transmitted infections.

Science as a human endeavour:

- International collaboration is often required when responding to global issues of disease transmission, such as severe acute respiratory syndrome (SARS) and bird flu, and reducing the impact of foreign disease on isolated populations.
- The introduction of foreign bacteria and viruses to isolated communities may have a more severe affect than in the outside world.

The Learning intentions and Success criteria are included as a guide to understanding expectations of students as outlined in the syllabus. Students could use them to review their understanding of the syllabus prior to assessments.

Learning intentions

1. Understand that global communities have varying standards of hygiene depending on their geographical location, population density, travel and economic stability.
2. Understand that travelling throughout the world increases the risk of transmission of infections.
3. Understand that social behaviour greatly influences the transmission of sexually transmissible diseases.

Success criteria

- Define hygiene.
- State the various ways of achieving hygiene such as hand washing.
- Describe the issues associated with unclean water and lack of hygiene.
- Describe how unclean water can lead to greater transmission of disease throughout populations.
- Describe what is meant by waste treatment.
- Explain how lack of appropriate treatment of wastes can result in an increase in the transmission of disease.
- Define the term pathogen and provide examples.

- Describe how levels of hygiene vary between different countries depending on the availability of sanitised water and waste management.
- Define the term disease vector and provide examples.
- Describe how levels of hygiene vary between different countries depending on the types of pathogens and disease vectors that are present.
- Identify travel warnings to and from various countries.
- Describe the significance of travel warnings in the prevention of disease transmission.
- Define population density.
- Describe how population density has an effect on disease transmission.
- Describe how movement within and between geographical localities can have an effect on disease transmission.
- Provide examples of diseases that have been transmitted across the world due to travel between countries.
- Describe some examples of diseases that have had a significant impact on global health due to travel, both historically and in recent times.
- Define sexually transmitted infection and provide examples of these.
- Identify types of social behaviours that can lead to the spread of sexually transmitted diseases.
- Provide examples of how sexually transmitted disease transmission can be prevented.

Key terms

Identify and fill in the definitions for the following key terms:

Key term	Definition
Disease	
Disease Transmission	
Disease Vector	
Epidemic	
Global	
Hygiene	
Pandemic	
Pathogen	

Key term	Definition
Population Density	
Potable Water	
Sanitation	
Sexually Transmitted Disease	
Waste Treatment	
Sexually Transmitted Disease	
Waste Treatment	

Hygiene

Hygiene is defined as conditions or practices that assist in maintaining health and preventing disease, especially through cleanliness. Hygienic practises include hand washing, brushing teeth and keeping cooking surfaces and implements clean before and whilst preparing food.

Good personal hygiene is one of the best ways to protect from getting gastrointestinal infections or infectious diseases such as COVID-19, colds and flu. Washing hands with soap removes pathogens that can cause illness. Maintaining good personal hygiene will also help prevent individuals from spreading diseases to other people.

Personal hygiene includes:

- Cleaning the body every day, by showering for example.
- Washing the hands with soap after going to the toilet.
- Brushing the teeth twice a day.
- Covering the mouth and nose with a tissue (or sleeve) when sneezing or coughing.
- Washing hands after handling pets and other animals.
- Washing hands before preparing or eating food.

The pathogens that cause many diseases can be passed on through touching other people, getting faeces on the hands, handling contaminated food, or coming into contact with dirty surfaces or objects.

Some conditions that can develop if people have poor personal hygiene include:

- COVID-19 and other infectious diseases
- Diarrhoea and vomiting, especially caused by gastroenteritis
- Respiratory infections, including colds and flu
- Bacterial infections such as staphylococcus
- Worm-related conditions, such as threadworms
- Scabies
- Trachoma, an eye infection which can lead to blindness
- Tinea or athlete's foot
- Tooth decay

Checkpoint

Define the term hygiene.

State four ways people can maintain good personal hygiene.

1. _____
2. _____
3. _____
4. _____

Explain why maintaining good personal hygiene is important.

State four diseases that could develop due to poor personal hygiene.

1. _____
2. _____
3. _____
4. _____

Research the best way to wash hands and describe this method. You may like to use diagrams or a flow chart.

Water and sanitation

Everyone has the human right to safe drinking water. This holds true in stability and in crisis, in urban and rural contexts, and in every country around the world. When children don't have access to clean water, it negatively impacts their health, nutrition, education and every other aspect of their lives. Girls, women and people living with disabilities are particularly impacted.

"785 million people today do not have basic access to water.

<https://www.unicef.org/wash/water>

Apart from the availability of water, it must be safe, accessible and affordable. Water must come from a source like a well, a tap or a hand-pump that will provide water on a regular basis. The water must be free from chemical contamination, and any other source of pathogens such as worms and bacteria such as faeces or dead and decaying animals. It needs to be located within a reasonable distance from the peoples' dwellings and should be accessible every 12 hours. In many developing countries potable water can only be found many kilometres from home bases, and it is often up to the children and women to collect and carry it from the source to the home. This exposes them to many dangers and makes them vulnerable to being harmed or becoming unwell.

Other issues include the lack of appropriate waste treatment and basic toilets. Many water sources are contaminated with faeces and other excrement because there are no or minimal effective sewage systems or treatment plants. This exposes people to bacterial infections and is the reason for most of the deaths of children from diseases such as cholera and typhoid that cause extreme diarrhoea and vomiting. This results in dehydration.

Another source of contamination is chemicals. Many contaminants come from mine site tailings and can include very harmful chemicals such as arsenic and lead. All forms of pollution eventually make their way to water. Air pollution settles onto lakes and oceans. Land pollution such as chemicals from fertilisers and herbicides from farms can seep into an underground stream and then to a river, and other sources of water that would normally be available for drinking, cooking and cleaning.

Checkpoint

List three conditions for people to be able to have water for everyday use.

1. _____
2. _____
3. _____

Describe how water may become unsuitable for drinking, cooking with or for personal hygiene.

Suggest reasons for children and women being most vulnerable if water is not available to them.

Explain how faeces is able to get into water sources.

Disease transmission

Transmissible diseases are caused primarily by pathogens and parasites. A pathogen is any organism that is capable of causing disease in living things, such as humans. Diseases are transmitted from the source or reservoir of the pathogen to the susceptible host. This can occur through many different ways such as direct contact with the source, including contaminated water, or ingesting it through food and drink. The less people are able to conduct daily personal hygiene, the more likely they are to transmit disease to others. The less availability of clean water, the more likely the transmission of diseases.



Key facts

- Over 2 billion people live in water-stressed countries, which is expected to be exacerbated in some regions as result of climate change and population growth.
- Globally, at least 2 billion people use a drinking water source contaminated with faeces. Microbial contamination of drinking-water as a result of contamination with faeces poses the greatest risk to drinking-water safety.
- While the most important chemical risks in drinking water arise from arsenic, fluoride or nitrate, emerging contaminants such as pharmaceuticals, pesticides, per- and polyfluoroalkyl substances (PFASs) and microplastics generate public concern.
- Safe and sufficient water facilitates the practice of hygiene, which is a key measure to prevent not only diarrhoeal diseases, but acute respiratory infections and numerous neglected tropical diseases.

Microbiologically contaminated drinking water can transmit diseases such as diarrhoea, cholera, dysentery, typhoid and polio and is estimated to cause 485 000 diarrhoeal deaths each year.

- In 2020, 74% of the global population (5.8 billion people) used a safely managed drinking-water service – that is, one located on premises, available when needed, and free from contamination.

“When water comes from improved and more accessible sources, people spend less time and effort physically collecting it, meaning they can be productive in other ways. This can also result in greater personal safety and reducing musculoskeletal disorders by reducing the need to make long or risky journeys to collect and carry water. Better water sources also mean less expenditure on health, as people are less likely to fall ill and incur medical costs and are better able to remain economically productive.

With children particularly at risk from water-related diseases, access to improved sources of water can result in better health, and therefore better school attendance, with positive longer-term consequences for their lives.”

<https://www.who.int/news-room/fact-sheets/detail/drinking-water>

Checkpoint

Define the term pathogen.

State how diseases are transmitted.

Name three sources of disease-causing pathogens.

1. _____

2. _____

3. _____

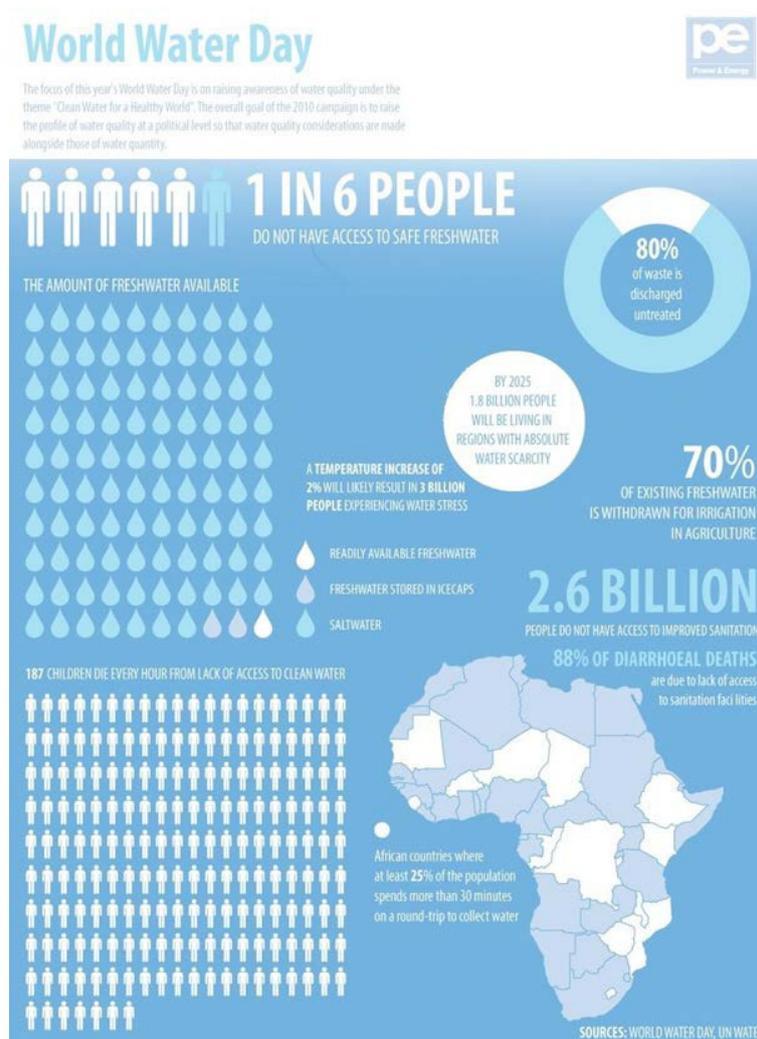
Approximately how many people are currently living with poor water sources?

Name four diseases caused by people being in contact with contaminated water.

1. _____
2. _____
3. _____
4. _____

Describe how the availability of clean water can improve the standard of living of humans in places where water availability is compromised.

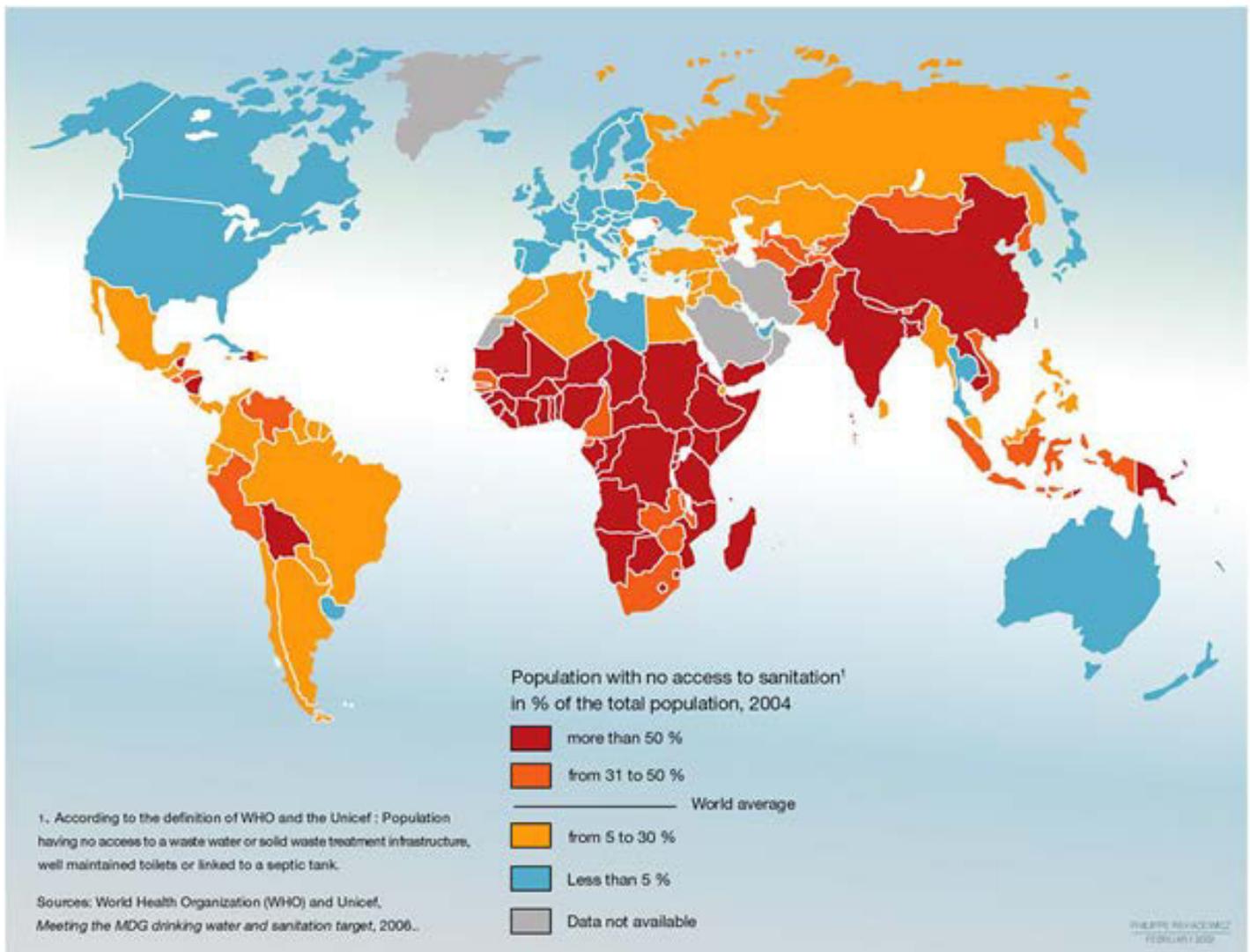
This infographic demonstrates the issues with contaminated water in developing countries on continents such as Africa. There are similar statistics in many Asian countries and countries in South America.



Activity: Disease transmission

Science inquiry skills

- Represent data in meaningful and useful ways, including the use of mean and median; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental accuracy, the nature of the procedure and the sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions.
- Interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, including interpreting confidence intervals in secondary data; and use reasoning to construct scientific arguments.
- Select, use and/or construct appropriate representations, to communicate conceptual understanding, solve problems and make predictions.



Using dot points, summarise the information that is available in the infographic on the previous page.

Research the same information but from a developed country such as Australia or England.

Write a paragraph that compares the chances of disease transmission between people due to unsanitised water and clean water.

Based on the data in the previous map, identify four countries that are MOST likely to have greater transmission of disease, and identify four countries that are less likely to have issues with transmission of disease due to access to sanitation.

Disease vectors

Disease can be transmitted in many different ways. Most contagious diseases are transmitted through direct contact, from the source to the host, by contact with body fluids and droplets, via contaminated food or water, and by disease-specific vectors. Vectors are animals, usually insects, that act as intermediate hosts to a pathogen, and transmit through contact with humans. This can in one of two ways:

1. Mechanical transmission: When a vector simply carries pathogenic microorganisms on their body and transfers them to food. eg. flies and cockroaches.
2. Biological transmission: the agent multiplies and develops in a vector, such as a mosquito transferring malaria by biting the skin and injecting the pathogen.

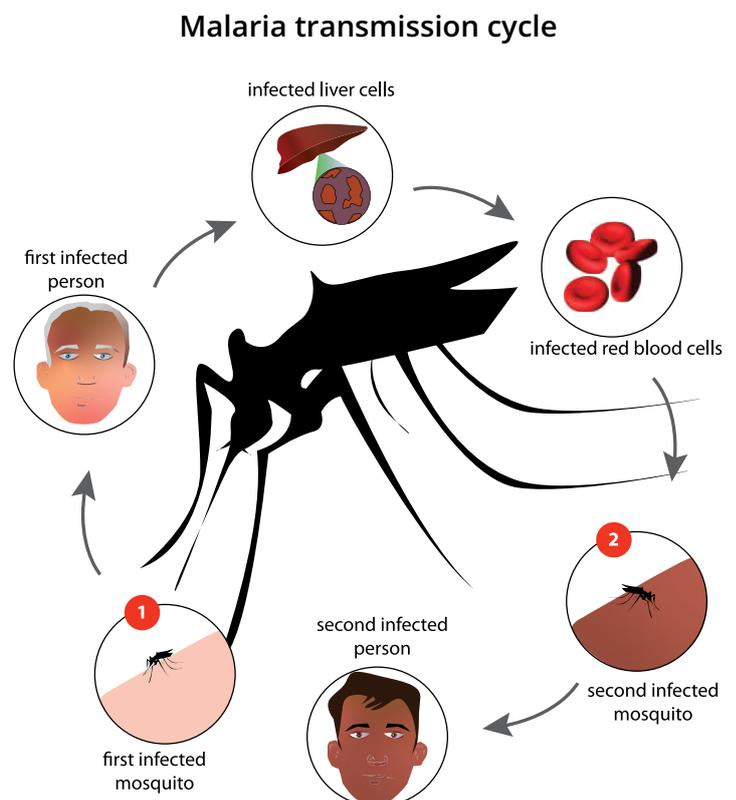
Malaria - a case study

Malaria is an acute febrile illness caused by *Plasmodium parasites*, which are spread to people through the bites of infected female Anopheles mosquitoes. There are 5 parasite species that cause malaria in humans, and 2 of these species – *P. falciparum* and *P. vivax* – pose the greatest threat. *P. falciparum* is the deadliest malaria parasite and the most prevalent on the African continent. *P. vivax* is the dominant malaria parasite in most countries outside of sub-Saharan Africa.

The first symptoms – fever, headache and chills – usually appear 10–15 days after the infective mosquito bite and may be mild and difficult to recognize as malaria. Left untreated, *P. falciparum* malaria can progress to severe illness and death within a period of 24 hours.

In 2020, nearly half of the world's population was at risk of malaria. Some population groups are at considerably higher risk of contracting malaria and developing severe disease: infants, children under 5 years of age, pregnant women and patients with HIV/AIDS, as well as people with low immunity moving to areas with intense malaria transmission such as migrant workers, mobile populations and travellers.

According to the latest World malaria report, there were 241 million cases of malaria in 2020

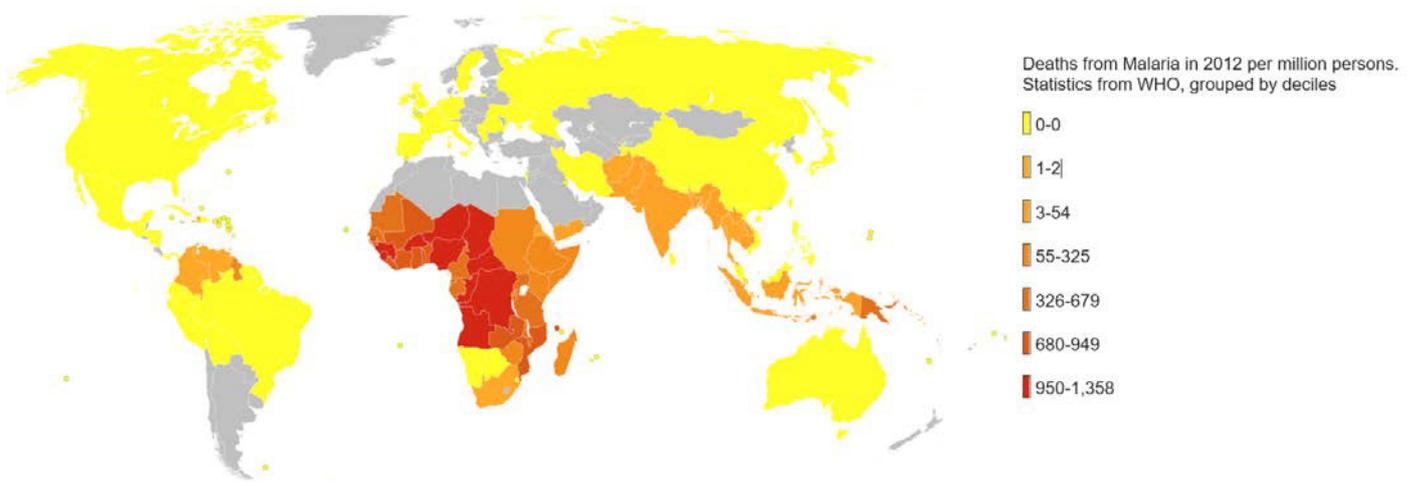


compared to 227 million cases in 2019. The estimated number of malaria deaths stood at 627 000 in 2020 – an increase of 69 000 deaths over the previous year.

Sub-Saharan Africa shoulders about 93% of all malaria deaths globally. The WHO African Region continues to carry a disproportionately high share of the global malaria burden. In 2020 the Region was home to 95% of all malaria cases and 96% of deaths. Children under 5 years of age accounted for about 80% of all malaria deaths in the Region.

Four African countries accounted for just over half of all malaria deaths worldwide: Nigeria (31.9%), the Democratic Republic of the Congo (13.2%), United Republic of Tanzania (4.1%) and Mozambique (3.8%).

Malaria deaths world map



References

- <https://www.who.int/news-room/fact-sheets/detail/malaria>
- https://commons.wikimedia.org/wiki/File:Malaria_world_map-Deaths_per_million_persons-WHO2012.svg

Activity: Malaria

Based on the previous information from the World Health Organisation, the map and diagrams, identify the areas of the world that are most susceptible to malaria.

Suggest reasons for the increased incidence of malaria in those countries.

Travel warnings

Over the last one hundred years, people have had an increased capacity to be able to travel. With the invention of large ships, electric trains and jet aeroplanes, people can travel thousand of kilometres in just hours. As you have seen from the maps provided in previous sections, many countries around the world have diseases that are common (endemic) to that country. Governments must provide warnings to travellers to make sure that they take every precaution, including vaccination, to prevent becoming ill themselves and, more importantly, so that they don't spread it to other areas.

Below is an example of health advice provided by the Australian Government in 2019. This applies to travel to Bali, Indonesia.

Health advice for travelling to Indonesia, Asia

COVID-19

COVID-19 remains a risk in Indonesia. Foreign nationals have died from COVID-19 in Indonesia, including in Bali. COVID-19 health protocols can change at short notice for foreign nationals and domestic travellers.

Critical care for Australians who become seriously ill, including in Bali, is significantly below the standard available in Australia. Medical evacuation may not be possible. The Australian Government cannot guarantee your access to hospital and other health services in Indonesia. These services have often been under significant strain during the COVID-19 crisis.

If you show any COVID-19 symptoms or a temperature above 37.5°C on arrival in Indonesia, you must take a COVID-19 (PCR) test on arrival. If your result is positive, and you have moderate or severe symptoms, you may be taken to a central isolation facility or hospital for treatment at your own expense.

- Indonesian authorities advise that COVID-19 patients will be required to be initially treated in Indonesia.
- Medical evacuation to Australia for medical conditions including COVID-19 is possible but is very expensive and may not be covered by travel insurance.

For information on Indonesia's COVID-19 vaccination program, refer to the Indonesian Ministry of Health (Bahasa Indonesia <https://www.kemkes.go.id/>), or the COVID-19 Enquiries Hotline on 119. You should consult your local health professional for advice on vaccine options, including vaccine eligibility and availability. Vaccines may be subject to local supply constraints. The Australian Government cannot provide advice on the safety, quality and efficacy of vaccines that have been approved for use outside of Australia's regulatory process.

More information:

- Coronavirus (COVID-19)
<https://www.smartraveller.gov.au/news-and-updates/coronavirus-covid-19>

Legionnaires' Disease

Cases of Legionnaires' disease have been reported in people who have travelled to the Kuta region of Bali. Travelers who are unwell with flu-like symptoms within 10 days of returning from Bali are advised to consult their GPs.

Polio

Cases of vaccine-derived polio virus (type 1) are reported in Papua Province.

Check that you're vaccinated against polio.

Rabies

Rabies is a risk throughout Indonesia, especially in:

- Bali
- nearby islands
- Nias, off the coast of Sumatra

You're at risk of contracting rabies if you visit a market where live animals and fresh food are sold because:

- live rabies-positive dogs may be present
- rabies-positive dog meat may be sold as food

Talk to your doctor about getting a pre-exposure rabies vaccination if you're planning to:

- stay in Indonesia for a long time
- work with animals

Avoid contact with monkeys, even in places where you're encouraged to interact with them. This includes:

- popular markets
- tourist destinations
- sanctuaries

If bitten or scratched by an animal:

- immediately use soap and water to wash the wound thoroughly
- seek urgent medical attention

Rabies treatment in Indonesia may be limited. If you're bitten you may need to return to Australia, or travel to another country, for immediate treatment.

Measles

Periodic outbreaks of measles continue to be reported in Indonesia, including Bali.

You need 2 doses of vaccine 4 weeks apart to be fully vaccinated against measles.

If you have symptoms of measles, seek medical attention.

Measles is highly infectious. Call before attending a healthcare facility.

Insect-Borne Illnesses

Insect-borne illnesses are common throughout the year.

To protect yourself from disease:

- research your destination
- ask locals for advice
- make sure your accommodation is mosquito proof
- use insect repellent
- wear long, loose, light-coloured clothing

Zika Virus

Zika virus can occur in Indonesia.

Protect yourself from mosquito bites.

The Australian Department of Health advises pregnant women to:

- discuss any travel plans with their doctor
- consider deferring non-essential travel to affected areas

Malaria

Malaria, including chloroquine-resistant strains, is widespread in rural areas. It isn't common in Jakarta.

Consider taking medicine to prevent malaria.

Dengue

Dengue occurs in Indonesia, including Bali and major cities.

Dengue is common during the rainy season.

Australian health authorities have reported an increase in dengue infections in people returning from Bali in recent years.

There's no vaccination or treatment available for dengue.

Japanese Encephalitis and Filariasis

Japanese encephalitis and filariasis occur in Indonesia, especially in rural agricultural areas.

Japanese encephalitis has been present in Australian travellers returning from Indonesia, including Bali.

HIV/AIDS

HIV/AIDS is a risk for travellers. Take steps to reduce your risk of exposure to the virus.

Other Health Risks

Waterborne, foodborne, parasitic and other infectious diseases are widespread. These include:

- cholera
- hepatitis
- tuberculosis
- typhoid

Serious outbreaks sometimes occur.

To protect yourself from illness:

- boil drinking water or drink bottled water
- avoid ice cubes
- avoid raw food, such as salads

To minimise the risk of food poisoning, only eat meat from reputable suppliers.

Seek urgent medical attention if you suspect food poisoning or have a fever or diarrhoea.

References

- <https://www.smartraveller.gov.au/destinations/africa/kenya>
- <https://www.smartraveller.gov.au/destinations/asia/indonesia>

Activity: Health advice

<https://www.smartraveller.gov.au/destinations>

Choose a place to travel to outside of Australia and use the website link above to find out about the travel health warnings for that destination.

Find out what you should do to prevent being infected and spreading the diseases that are common to the country you chose.

Population density and movement

Population density is a measurement of population per unit area. In simple terms, population density refers to the number of people living in an area per square kilometre. The population of Australia is very spread out over vast distances. The current (2022) population density of Australia is 3.38 people per square kilometre. The countries with the highest population densities are Macau, Hong Kong and Singapore with up to 22500, 8300 and 6700 people per kilometre respectively (<https://www.macrotrends.net/countries/AUS/australia/population-density#:~:text=The%20current%20population%20density%20of,a%200.98%25%20increase%20from%202020>). European countries such as Italy and Germany have between 195 and 230 people per km². People living in small spaces with large populations tend to live in small apartments in high rise buildings, or in very small homes with many people occupying them as families tend to be much larger than they are in Australia. This results in the inability for social distancing and increases the potential for spread of disease. Disease transmission occurs through direct contact with humans and the things they touch, as well as airborne transmission, and the increased likelihood of vector transmission via mosquitos and vermin such as rats.

COVID19 and influenza have a much greater impact on populations that have higher density. The ability for health care systems in these situations can be limited so more deaths due to these types of diseases are recorded compared with places like Australia where there are less people that are more spread apart in the community. Some of the worst outbreaks of COVID19 that occurred in Australia between 2019 and 2022 were in apartment buildings where people were confined to small areas and were more likely to come into contact with one another, even through touching the buttons in the lifts!

Checkpoint

Define population density.

Describe the effects of high population density on the spread of disease.

Population movement

Travel within and between countries has become much more accessible and accepted in modern times. Unfortunately the more people move around geographically, the higher the risk of spreading disease. COVID19 is the most recent example of a virus spreading extremely quickly across the world and causing millions of deaths within a very short period of time. Many countries around the world went into “lockdown” in order to prevent the movement of people and thus slow down the spread of COVID. This was particularly important as scientists worked to produce a vaccine. All over the world people were forced to wear masks, follow strict hand hygiene practices and social distancing. Schools were shut down as well as many other venues that were not considered necessary so that people could not gather to spread COVID. Most travel into and out of countries was stopped. With vaccines and the decreased movement of humans around the world, the spread slowed down and the death rates declined accordingly.

Historically, diseases such as smallpox and influenza caused the same devastation of human populations as they spread due to their virulence and the movement of humans.

“Smallpox is an acute contagious disease caused by the variola virus, a member of the orthopoxvirus family. It was one of the most devastating diseases known to humanity and caused millions of deaths before it was eradicated. It is believed to have existed for at least 3000 years. The smallpox vaccine, created by Edward Jenner in 1796, was the first successful vaccine to be developed.

The World Health Organization launched an intensified plan to eradicate smallpox in 1967. Widespread immunization and surveillance were conducted around the world for several years. The last known natural case was in Somalia in 1977. In 1980 WHO declared smallpox eradicated – the only infectious disease to achieve this distinction. This remains among the most notable and profound public health successes in history.”

https://www.who.int/health-topics/smallpox#tab=tab_1

“More recently, the Flu pandemic of 1968 caused a death toll of about 1 million people. A category 2 Flu pandemic sometimes referred to as “the Hong Kong Flu,” the 1968 flu pandemic was caused by the H3N2 strain of the Influenza A virus. From the first reported case on July 13, 1968 in Hong Kong, it took only 17 days before outbreaks of the virus were reported in Singapore and Vietnam, and within three months had spread to The Philippines, India, Australia, Europe, and the United States. While the 1968 pandemic had a comparatively low mortality rate (.5%) it still resulted in the deaths of more than a million people, including 500,000 residents of Hong Kong, approximately 15% of its population at the time.

First identified in Democratic Republic of the Congo in 1976, HIV/AIDS has truly proven itself as a global pandemic, killing more than 36 million people since 1981. Currently there are between 31 and 35 million people living with HIV, the vast majority of those are in Sub-Saharan Africa, where 5% of the population is infected, roughly 21 million people. As awareness has grown, new treatments have been developed that

make HIV far more manageable, and many of those infected go on to lead productive lives. Between 2005 and 2012 the annual global deaths from HIV/AIDS dropped from 2.2 million to 1.6 million.”

<https://www.mphonline.org/worst-pandemics-in-history/#:~:text=Cholera%2C%20bubonic%20plague%2C%20smallpox%2C,in%20its%2012%2C000%20year%20existence.>

Checkpoint

Explain why diseases spread more quickly throughout the world in the 21st Century compared with the 18th – 19th Centuries.

Describe some ways that populations can prevent the spread of contagious diseases such as influenza and COVID.

Explain why it is easier to prevent the spread of disease in modern times compared with the 1700 or 1800s.

Sexually transmitted infection

A sexually transmitted infection (STI) is a disease that is spread through sexual and intimate contact during sexual behaviour. Examples of STIs are syphilis, gonorrhoea, HIV/AIDS, chlamydia, and genital herpes. These diseases have been studied in Year 11.

Sexually transmitted diseases can be transmitted in many ways. For example, genital herpes is caused by a virus. It is present in semen and vaginal fluids as well as blisters on the skin around the genital area of an infected person and so can be transmitted via vaginal, anal, or oral sex. Human Immunodeficiency Virus (HIV) is also spread through body fluids via vaginal and anal sex.

Most STIs can be prevented from spreading. Despite this, STIs remain a significant health issue throughout the world. There are many factors that contribute to the transmission of STIs including poverty and general health status. In countries where there are few effective hygiene practices and limited access to health care and medicines, STIs spread much more readily than in more economically sound countries. If people are infected and don't get the diseases diagnosed and treated, they will spread it to everyone they have sexual contact with.

Many people, especially males, are too embarrassed or 'proud' to seek the help of health care workers if they suspect they have an STI. People don't discuss STIs as there is a social stigma associated with these diseases. Cultural factors will often cause the non-use of barrier contraceptives such as condoms, that would normally prevent the spread. Unfortunately the symptoms of some STIs are not apparent until they have been spread to others. Females, for example, have very few signs that they may have chlamydia.

Substance abuse, including alcohol, can alter sexual behaviour of people, as they indulge in sexual practices that they might not normally engage in. People who have sex with more than one partner, which is common practise throughout much of the world, increase the risk of, not only themselves developing the disease, but every person they contact sexually and their sexual partners. Many people now travel regularly and can thus spread STIs to others in other countries.

People can prevent the transmission of STIs by practising cautious sexual behaviour and engage in sexual intimacy with people they know are 'safe'. Using condoms during sexual intercourse is an effective way of preventing skin and membrane contact, as well as decreasing the transfer of sexual fluids. People who suspect that they may have been exposed to an STI should seek medical advice as soon as possible and not have sexual intercourse with anyone until they are no longer infectious.

Checkpoint

Name three examples of sexually transmitted diseases.

1. _____
2. _____
3. _____

Describe how STIs can be transmitted from person to person.

Describe two types of human behaviour that can lead to the transmission of STIs.

1. _____
2. _____

Describe three ways of preventing STIs from being transmitted.

1. _____
2. _____
3. _____

Chapter review

- Define hygiene and state the various ways of achieving hygiene such as hand washing.
- Describe the issues associated with unclean water and lack of hygiene.
- Describe how unclean water can lead to greater transmission of disease throughout populations.
- Explain how lack of appropriate treatment of wastes can result in an increase in the transmission of disease.
- Define the term pathogen and provide 2 examples.
- Define the term disease vector and provide examples.
- Describe how levels of hygiene vary between different countries depending on the types of pathogens and disease vectors that are present.
- Describe the significance of travel warnings in the prevention of disease transmission.
- Define population density and describe how population density effect disease transmission.
- Describe how movement within and between geographical localities can effect disease transmission.
- Provide examples of diseases that have been transmitted across the world due to travel between countries.
- Describe some examples of diseases that have had a significant impact on global health due to travel, both historically and in recent times.
- Identify types of social behaviours that can lead to the spread of sexually transmitted diseases.
- Provide examples of how sexually transmitted disease transmission can be prevented.

Extras for experts

- Explain why levels of hygiene between different countries determine the risk of the transmission of disease.
- Describe how people who travel can prevent becoming infected with contagious diseases and how they can thus prevent the spread to other geographical areas.
- COVID19 caused many deaths throughout the world, but the cases of influenza decreased dramatically. Suggest some reasons for this occurring.

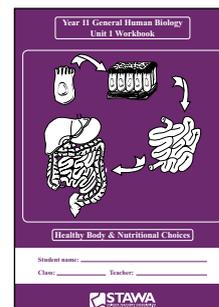
Image References

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- Pg 18 Synovial knee joint https://commons.wikimedia.org/wiki/File:907_Synovial_Joints.jpg
- Pg 21 Synovial knee joint without Labels https://commons.wikimedia.org/wiki/File:907_Synovial_Joints.jpg
- Pg 23-24 Body movements: L. M., Dawson, S., Harwell, A., Hopkins, R., Kaufmann, J., LeMaster, M., Matern, P., Morrison-Graham, K., Quick, D., & Runyeon, J. (2019, September 26). 9.5 types of body movements. *Anatomy Physiology*. Retrieved May 1, 2022, from <https://open.oregonstate.edu/aandp/chapter/9-5-types-of-body-movements/>
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- Pg 42 Structure of skeletal muscle https://commons.wikimedia.org/wiki/File:1002_Organization_of_Muscle_Fiber.jpg
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- Pg 48-49 Activity Steps 1-4: Marron Publications: *Human Physiology* p. 53, 54
- Pg 52 Skeleton https://commons.wikimedia.org/wiki/File:Ischial_spine_-_00_-_lateral_view.png
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- Pg 66 Types of neuron https://cdn-acgla.nitrocdn.com/bvlhCjyiWKFqIMsFAAXRLitDZjWdRILX/assets/static/optimized/rev-5131b73/wp-content/uploads/2020/06/Types_of_Neuron.jpg
- Pg 68 "Diagram of the two hemispheres of the cerebrum" <https://www.researchgate.net/profile/Alexandre-ramfort/publication/278634318/figure/fig2/AS:669459744297000@1536623049824/Brain-hemispheres-At-first-glance-the-two-hemispheres-are-very-similar-but-their.png>
- Pg 69 Brain regions https://ib.bioninja.com.au/_Media/brain-sections_med.jpeg
- Pg 70 Brain for labelling <https://i.pinimg.com/originals/98/9b/c7/989bc73000cd0b09eb19443f90178004.jpg>
- Pg 71 "Diagram of the pathway of a reflex arc" <https://qph.cf2.quoracdn.net/main-qimg-e20738a7f1c6c601643666e0b117edb3-lq>
- Pg 72 "Diagram of a human eye" <https://kidshealth.org/en/kids/eyes.html>
- Pg 74 "Diagram of a human ear" <https://i.pinimg.com/originals/41/95/6e/41956e078c00220b99d298940171c41f.jpg>
- Pg 76 "Diagram of the skin showing receptors responsible for different sensations" <https://www.researchgate.net/profile/Roman-Kacprzak/publication/228459716/figure/fig3/AS:302022491426825@1449019181775/A-cross-section-of-the-skin-showing-the-location-of-receptors-left-and-Ruffinis.png>
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- Pg 84 Brain endocrine glands https://media.istockphoto.com/vectors/the-endocrine-system-3d-medical-vector-illustration-isolated-on-white-vector-id1143710566?k=20&m=1143710566&s=612x612&w=0&h=kZyuanDX6q8DCn_HhFJ4jQkw6qeFlgJLJZ9EQw8fbAhg=
- Pg 84 "Diagram showing the different hormones produced by the pituitary gland" <https://www.nagwa.com/en/explainers/510153659461/>

- Pg 88 Thyroid <https://ars.els-cdn.com/content/image/3-s2.0-B9780080919065000094-f09-05-9780080919065.jpg>
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- Pg 102 "Parts of the microscope" Shenton College Yr12 Workbook 6, pg 11
- Pg 112 "Diagram showing a typical bacterial cell" https://commons.wikimedia.org/wiki/File:OSC_Microbio_03_03_ProkCell.jpg
- Pg 115 "Virus particle" Human Perspectives 1A1B, pg 169
- Pg 115 "Virus mechanism of infecting cells" Illustration by David Keigwin
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- Pg 117 "Tinea infection between toes" https://s3.amazonaws.com/static.wd7.us/4/45/Tinea_pedis01.jpg
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- Pg 118 "Mosquito carrying the parasite that causes malaria" https://s3-us-west-2.amazonaws.com/courses-images/wp-content/uploads/sites/110/2016/05/02182928/Figure_12_02_07.jpg
- Pg 120 "Methods of disease transmission" https://www.frontiersin.org/files/Articles/687937/fpubh-09-687937-HTML/image_m/fpubh-09-687937-g001.jpg
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- Pg 171 Drinking from polluted water https://en.wikipedia.org/wiki/File:A_picture_of_a_boy_drinking_polluted_water.jpg
- Pg 173 World water day https://commons.wikimedia.org/wiki/File:World_Water_Day_%284462056279%29.jpg
- Pg 174 Population (map) with no access to sanitation <https://www.flickr.com/photos/gridarendal/31551594883>
- Pg 176 "Malaria transmission cycle" Illustration by David Keigwin
- Pg 177 "Malaria deaths world map" http://www.who.int/entity/healthinfo/global_burden_disease/GHE_Deaths_2012_country.xls?ua=1

General Human Biology Resources

Year 11 General Human Biology Unit 1 Workbook Healthy Body & Nutritional Choices



Year 11 General Human Biology Unit 2 Workbook Maintaining Healthy Body Systems



Year 12 General Human Biology Unit 3 & Unit 4 Workbook

The STAWA General Human Biology resources support teachers and students of the Western Australian General Human Biology Courses.

Chapters correspond to the topics outlined in the Science Understanding strand of the syllabus. Science Inquiry and Science as a Human Endeavour have been incorporated where appropriate. *Syllabus Dot Points, Learning Intentions* and *Success Criteria* are provided to help support teaching and learning programs.

Practical activities: Experiments, dissections, and interpretation of second-hand data are included, with safety considerations highlighted where applicable. Practical activities provide opportunities for students to further develop science inquiry skills including to formulate tables for data collection and presentation, to practice graphing skills, to draw labelled scientific diagrams and to communicate findings.

Learning support structures: Students are encouraged to define key terms in the glossary and to write their own notes guided by the '*Checkpoints*' as they work through the resources. Checkpoints enable students to consolidate their understanding and to summarise key concepts. *Chapter Review Questions* support revision, while '*Extras for Experts*' enable students to extend their depth of understanding of concepts.

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