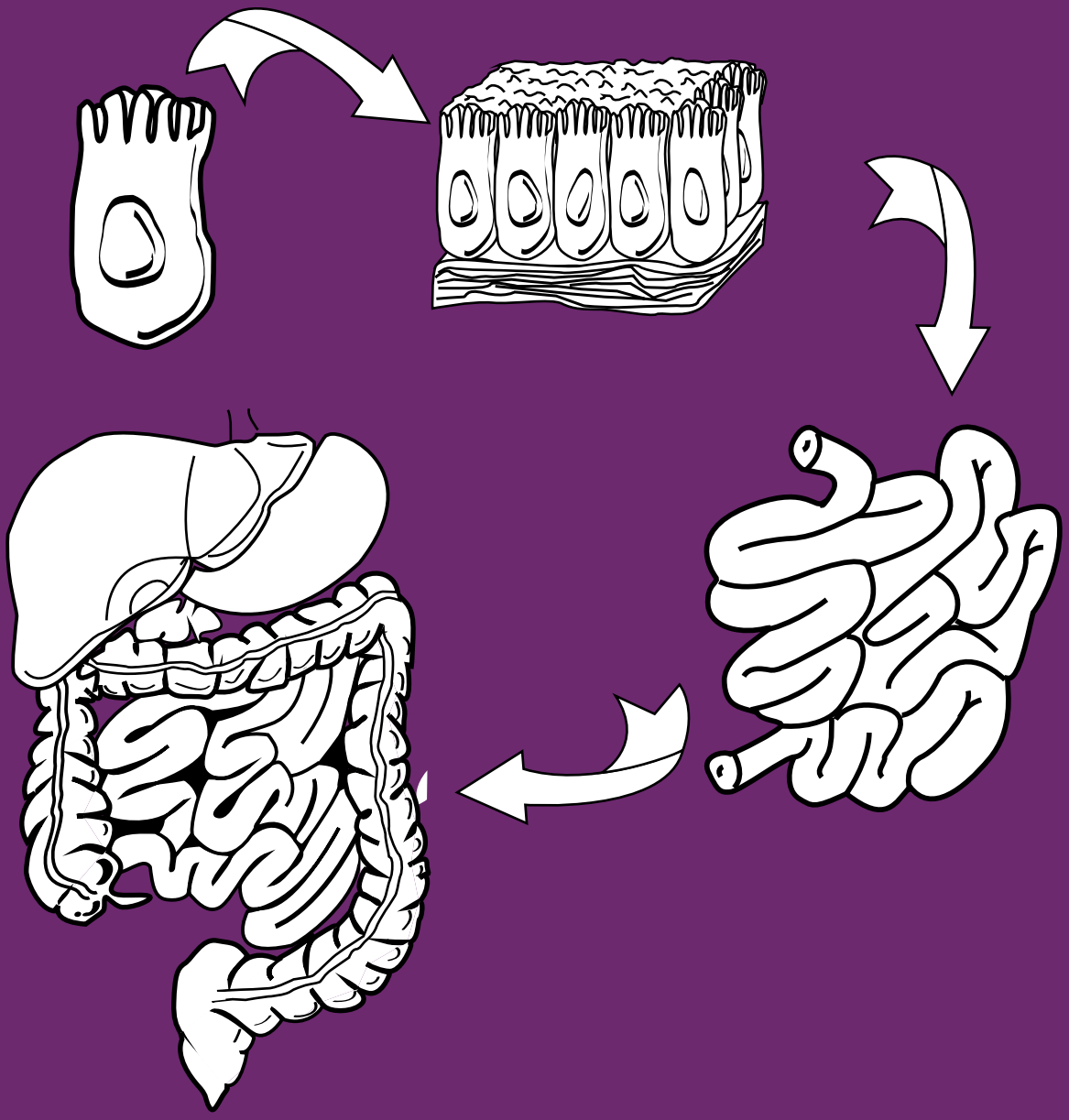
Year 11 General Human Biology
Unit 1 Workbook

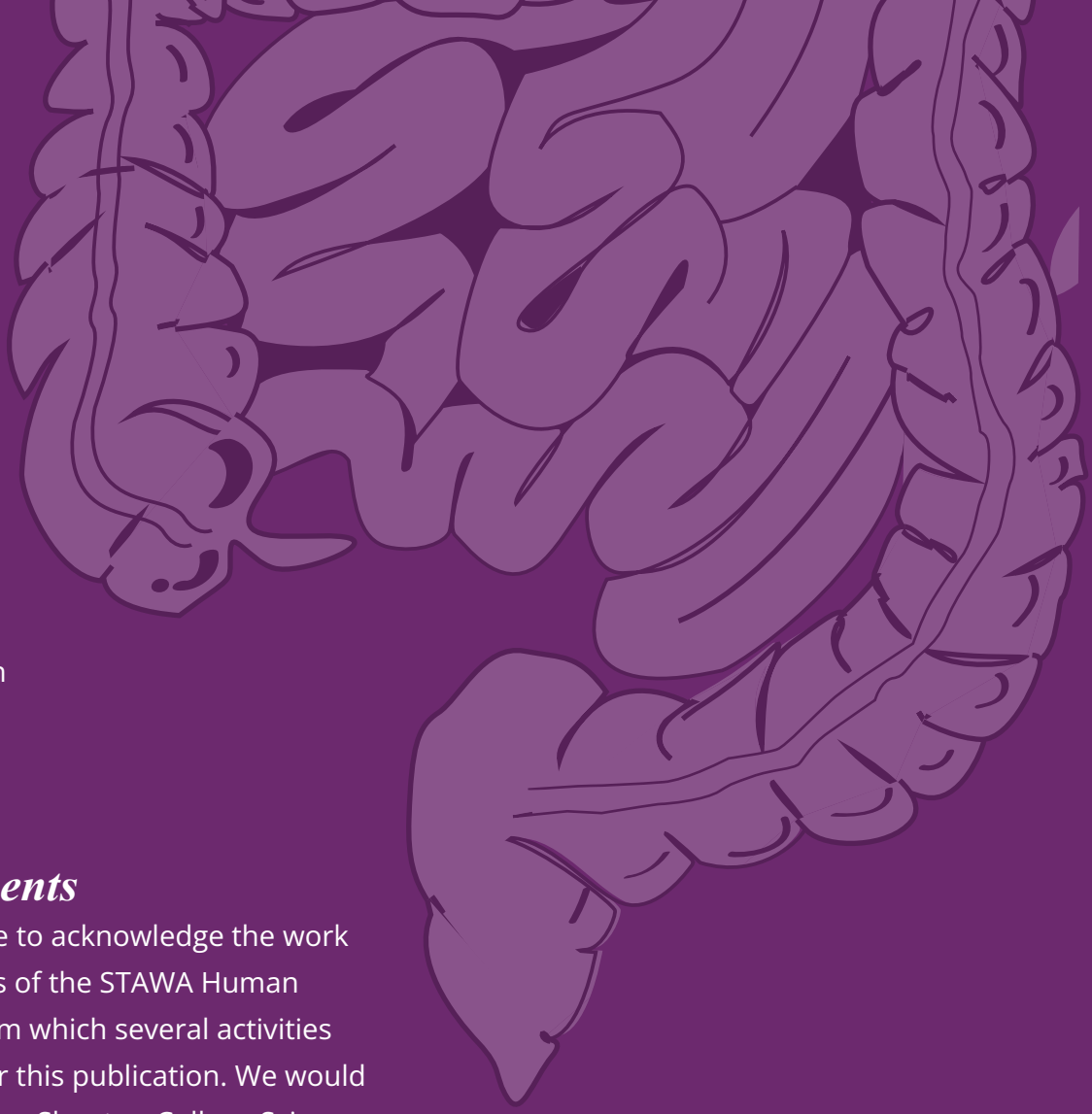


Healthy Body & Nutritional Choices

Student name: _____

Class: _____ **Teacher:** _____

STAWA
SCIENCE TEACHERS' ASSOCIATION OF WESTERN AUSTRALIA



Editor

Annabel Kanakis

Writers

Annabel Kanakis
Rebecca Cooke
Michelle Otway-Melvin
Shannon Fletcher
Zac Gomes
Fiona May

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 11 General Human Biology Unit 1 Workbook ISBN: 978-0-9925739-6-6

PO Box 1099, Osborne Park, WA 6916

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 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 *draw a circle*
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

Unit 1

Unit description

The focus for this unit is on the nutritional choices that we make for the optimal functioning of body cells.

Cells are the basic structural and functional units of the human body. Nutrients are required by cells to sustain life processes. The structures of the digestive system are designed to obtain nutrients which are essential for a functioning musculoskeletal system. Personal dietary decisions can affect the optimal functioning of body cells and quality of life.

Students investigate and model cell processes through practical activities. They explore the digestive and musculoskeletal systems through real and virtual dissections. Students analyse and evaluate various diets against the Australian Dietary Guidelines. They are encouraged to use information and communication technology to gather and interpret data, and communicate their findings in a variety of ways.

Unit content

Each unit includes the knowledge, understandings and skills described below.

Scientific Method

- Research a given topic and construct questions for investigation.
- Determine the appropriate methodology for investigations.
- Design scientific investigations, including the formulation of investigable questions and/or hypotheses, materials required, procedure to be followed to collect valid and reliable data, and identification of safety and ethical considerations.
- Conduct risk assessments to identify potential hazards and prevent potential incidents and injuries.
- Use equipment and techniques safely, competently and methodically for the collection of valid and reliable data, and use equipment with precision, accuracy and consistency.
- Represent qualitative and quantitative data in meaningful and useful ways, including the construction of appropriately labelled tables, process quantitative data using appropriate mathematical relationships and units, and draw appropriate graphs.
- Analyse data to identify and describe trends, patterns and relationships, including the use of appropriate mathematical techniques, and recognise errors and limitations in data.

- Draw conclusions consistent with the evidence and relevant to the question being investigated, identify further evidence that may be required, and recognise the limitations of conclusions.
- Evaluate the investigative procedure, including the relevance, accuracy, validity and reliability of data, and suggest improvements.
- Communicate information and ideas in a variety of ways using scientific conventions and terminology, including the selection and presentation of data and ideas to convey meaning to selected audiences in written, oral and multimedia formats.

Scientific literacy

- Distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas.
- Use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with the evidence and relevant to the question under investigation.
- Identify examples of where the application of scientific knowledge may have beneficial, harmful and/or unintended consequences.

CHAPTER 1

Introduction to Life Processes

Syllabus dot points

- All living things carry out the life processes of respiration, feeding, excretion, movement, reproduction, responding to stimuli and growth.
- The body has a hierarchical structural organization of cells, tissues, organs and systems.
- Body cells contain specialised structures with specific functions, including the nucleus, mitochondria, cytoplasm and cell membrane.

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 cells are the basic structural and functional unit of all living things, including humans.
2. The body has a hierarchical structural organisation of cells, tissues, organs and systems; the functions of the systems are related to life processes.
3. Understand the human body is organised into a structural hierarchy from cells to organ systems.
4. Understand that cells have structures that support their function.
5. Understand that cells are organised according to their structure and function to form tissues and organs that support the function of the human body.

Success criteria

- State the seven life processes.
- Describe the importance of the seven life processes.
- Describe each of the levels of organisation of the human body. This includes cells, tissues, organs and organ systems.
- Identify and label the organelles; the nucleus, mitochondria, cytoplasm and cell membrane.
- Sketch the basic structure of the cell membrane.
- Describe the function of the nucleus, mitochondria, cytoplasm and cell membrane.
- Write the word equation for cellular respiration and define the inputs and outputs.
- Describe cellular respiration.

Key terms

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

Key term	Definition
A.T.P	
Absorption	
Aerobic	
Anaerobic	
Cell Membrane	
Concentration Gradient	
Cytoplasm	
Diffusion	
Digestion	
Excretion	
Mitochondria	
Nucleus	
Organ	
Organ system	
Organelles	
Osmosis	

Key term	Definition
Respiration	
Selectively permeable	
Specialisation	
Tissue	

Life processes

Introduction

The world around us is made up of living and non-living things. Interactions between the living and non-living are essential to maintain the ecological balance on the Earth.

Living things are made up of cells and have a fixed lifespan. During their lifespan, they perform various functions for their existence on the Earth. These functions are called Life Processes. In contrast, non-living things do not perform life-sustaining functions.

There are several factors that scientists use to differentiate living from non-living things.
These factors are known as 'life processes'.

- Living things are made up of **cells**. Cells are the building blocks of all living things.
- They grow, reproduce and die.
- They require energy.
- They can adapt to changes in their environment and react to external stimuli such as cold, heat and pain.

From single celled organisms like bacteria to multicellular organisms like humans they all carry out the processes of **movement, reproduction, sensitivity, growth, respiration, excretion** and **nutrition**.

Some non-living things may be able to carry out some of these processes but not all. These are what distinguish living organisms from non-living.

Have you met MRS GREN?

The processes of life can be categorised into seven things. **MRS GREN** is a useful acronym that may be used to help remember each of these processes.

Movement

Animals do this by using a system of muscles and the skeleton, plants do this by growing towards the Sun. By changing shape or position allows the living things to collect food more efficiently.

Reproduction

Making more of the same species, using genetic information from a parent or parents. This allows populations to be maintained and for the next generation to survive.

Sensitivity

Responding to stimuli in the environment, such as light or temperature. This allows living things to survive and respond to their environment.

Growth
Describes how living things increase in size and allows them to mature.

Respiration
The release of energy from food. Without this living things would have no energy. *Note: breathing is NOT respiration.*

Excretion
The removal of wastes, such as CO_2, formed by cellular activities. Waste products that remain within a body or plant can be harmful.

Nutrition
Providing all the essential materials. Without a correct balance living things can become ill.

Checkpoint

All living things are made up of _____ which are the _____ of all living things.

All living things can be differentiated from non living things by several factors known as _____.

There are seven life processes that common to all living things. These are;

M _____

R _____

S _____

G _____

E _____

N _____

Activity: I'm alive, I think?

How do you know if something is alive or dead? This is an important question for emergency service people when they are called to help someone with a life-threatening condition. It is also important in understanding the needs of people to keep them alive in extreme conditions such as in deep sea, space, high altitude climbing or in areas of natural disasters.

All living things carry out life processes in order to keep the cells metabolising and supplying energy for body activities.

Activity purpose

- To collect evidence that indicates the operation of life processes in the human body.
- To recognise life processes in the living body and link them to specific body systems and functions.

Materials

- drinking straw
- 50ml beaker
- 10ml of limewater
- ruler
- cotton buds
- reflex hammer (if available)
- small lolly
- you may need internet sources to help with some questions

List the seven life processes:

Hint: Can you remember MRS GREN?

_____ _____

_____ _____

_____ _____

_____

Are you respiring?

Blow gently though a straw into a solution of limewater. (DO NOT suck liquid as this will cause illness)

Note the colour change: _____

State the cause of the limewater changing colour? _____

State the evidence that this test gives to indicate that you are respiring?

_____

_____

Have you ingested today?

What materials have you eaten today? *Feel free to have a lolly!*

_____

What evidence do you have that the body has digested (changed the food chemically) and absorbed it into the blood stream?

_____

Explain why there is there a need for food to be digested?

_____

Are you excreting?

Hopefully you have urinated today! State the colour of your urine. Where would the chemicals that made your urine the colour it is come from?

_____

_____

What is the difference between excretion and elimination? *(Use the internet to define these two words)*

Excretion: _____

Elimination: _____

Where, in the body, would you look for further evidence of excretion?

_____

Are you moving?

Sit on a chair with your legs crossed so that the foot of the crossed leg is off the floor. Try to sit as still as possible for 2 minutes.

State what happened to the cross-over leg? What causes this movement?

_____

_____

State any other movements that occur without you thinking about them?

_____

_____

State any evidence you have that there is movement of your internal organs?

_____

_____

Are you growing?

Using your ruler, estimate the length of your nails from the cuticle: _____

Nails are made of dead cells. How can the accumulation of dead cells (your nails) be used to indicate the life process of growth?

_____

State the evidence to indicate that nails ARE made of non-living material?

_____

Do you respond to stimuli?

Close your eyes and have someone gently touch your eye lashes with a cotton bud.
Sit on a table with your legs dangling over the edge. GENTLY tap the tendon beneath your kneecap, the side of your hand or with a reflex hammer.
Can you stop the reactions caused by the cotton bud or the tap on your tendon?

Did you have to think about the reaction to either stimulus?

_____

Reproduction

Reproduction can be asexual or sexual.

Human reproduction is **sexual** and involves male and female parents and sex cells, the egg and sperm.

Asexual reproduction doesn't occur in humans.

Mitosis isn't sexual reproduction. It is cell division for growth and repair.

Activity: Word match

Match the life process with the description and explanation. Use your highlighter or coloured pencils to make this easier.

Life Process	Description	Explanation
Excretion	Animals do this by using a system of muscles and the skeleton, plants do this by growing towards the sun	Allows living things to mature
Growth	How living things increase in size	Allows living things to survive and respond to their environment
Movement	Making more of the same species, using genetic information from a parent or parents	Changing shape or position allows the living thing to collect food more efficiently
Nutrition	Removing waste	Provides all the essential materials - without a correct balance living things can become ill
Reproduction	Responding to stimuli in the environment, such as light or temperature	This allows populations to be maintained and for the next generation to survive
Respiration	Taking in the correct materials for healthy life	Waste products left within a body or plant will be harmful
Sensitivity	The release of energy from food, in combination with oxygen	Without this living things would have no energy

Activity: Word search - life processes

Animal
Excretion
Food
Grass
Growth
Human
Jump
Movement
Nutrition
Oxygen
Plant
Reproduction
Respiration
Sensitivity
Sun

R	V	H	S	Q	P	A	N	D	N	I	L	A	M	Q	L	F	O
F	Z	W	T	S	E	N	S	I	T	I	V	I	T	Y	Z	A	M
S	G	N	W	F	O	O	D	J	Q	V	Y	Y	N	S	J	C	F
G	R	O	U	H	F	I	G	R	U	E	P	R	A	K	O	R	X
B	A	R	D	O	O	T	R	E	Y	W	U	F	L	J	Z	T	E
L	S	U	A	O	W	I	R	P	T	T	V	B	P	Y	J	V	Y
I	S	P	A	H	Y	R	E	R	D	A	J	R	B	U	Z	G	Y
C	B	S	U	Q	N	T	S	O	L	R	V	C	M	M	G	N	G
V	A	M	X	V	O	U	P	D	N	V	B	P	D	Z	N	W	Q
V	A	C	Y	O	I	N	I	U	Y	B	A	T	S	T	R	W	A
N	H	O	T	K	T	X	R	C	S	R	G	X	M	N	I	N	O
J	E	A	N	Q	E	A	A	T	G	Y	F	R	Y	T	I	R	D
G	M	Y	E	Q	R	N	T	I	A	G	K	K	O	M	H	O	W
G	B	F	M	N	C	V	I	O	G	D	L	X	A	W	Q	Y	G
K	Q	V	E	X	X	L	O	N	U	S	Y	L	E	B	T	O	R
A	A	A	V	F	E	F	N	V	Q	G	E	B	R	V	S	H	C
O	W	R	O	G	C	P	E	I	E	D	V	P	L	W	A	U	W
B	J	Y	M	L	P	X	Z	N	M	B	I	W	V	L	L	Y	Y

Cellular respiration

Mitochondria are organelles found in the cytoplasm of all of our cells. The role of the mitochondria is to make **energy** available for cellular activities and because of this, these organelles are often called the 'powerhouses' of the cell.

The chemical reaction that releases the energy stored in the food we eat, particularly the sugars (glucose), is called cellular respiration. It occurs in cell of the human body all the time. Heat is also a produced and 60% of the energy produced is lost as heat in this reaction.

$$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + \text{energy (ATP)}$$

There are two types of respiration: aerobic and anaerobic.

Aerobic respiration occurs in the mitochondria in the presence of oxygen. Glucose is completely broken down to carbon dioxide and water. It is the only reaction in the body that uses elemental oxygen. The first part of this reaction is called glycolysis where the glucose molecule is split into two pyruvate molecules. These are then metabolised into carbon dioxide and water releasing most of the available energy in glucose.

Anaerobic respiration occurs in the cytoplasm when oxygen is NOT available. Much less energy is released in anaerobic respiration.

Lactic acid produced during anaerobic respiration can build up in tissues can cause cramps or muscle stiffness the day after strenuous exercise.

Why does cellular respiration occur?

Respiration produces the energy needed for:

- heat production to maintain normal body temperature
- building complex molecules
- cell division
- movement of cell organelles
- movement of whole cells
- active transport
- transmission of nerve impulses

Checkpoint

Write the word equation for aerobic respiration.

_____

List three uses of the energy produced by cellular respiration.

1. _____

2. _____

3. _____

Cells

Introduction

Cells are the building blocks of all living things. In 1839 scientists Theodor Schwann and Matthias Schleiden formulated a set of principles based on discoveries about cells. This is known as 'The Cell Theory" and explains the relationships between cells and living things.

Modern cell theory states:

- All living organisms are composed of one or more cells.
- Cells are the basic structural and functional unit of plants and animals.
- All cells come from pre-existing cells.

Cells are the basic structural and functional unit of all living things. Cells are very small, vary in size and shape and most can only be seen with a microscope. There are more than 200 different types of specialised cells in the human body, that all have completely different functions within the body. Despite their function all cells have common structures.

Checkpoint

Name the scientists that were credited with modern cell theory?

_____

In what year did this occur? _____

Describe cell theory.

_____

_____

_____

_____

Recall the three principles of the cell theory?

1. _____

2. _____

3. _____

Name the important scientific instrument that is needed to be able to see cells?

_____

Inside cells

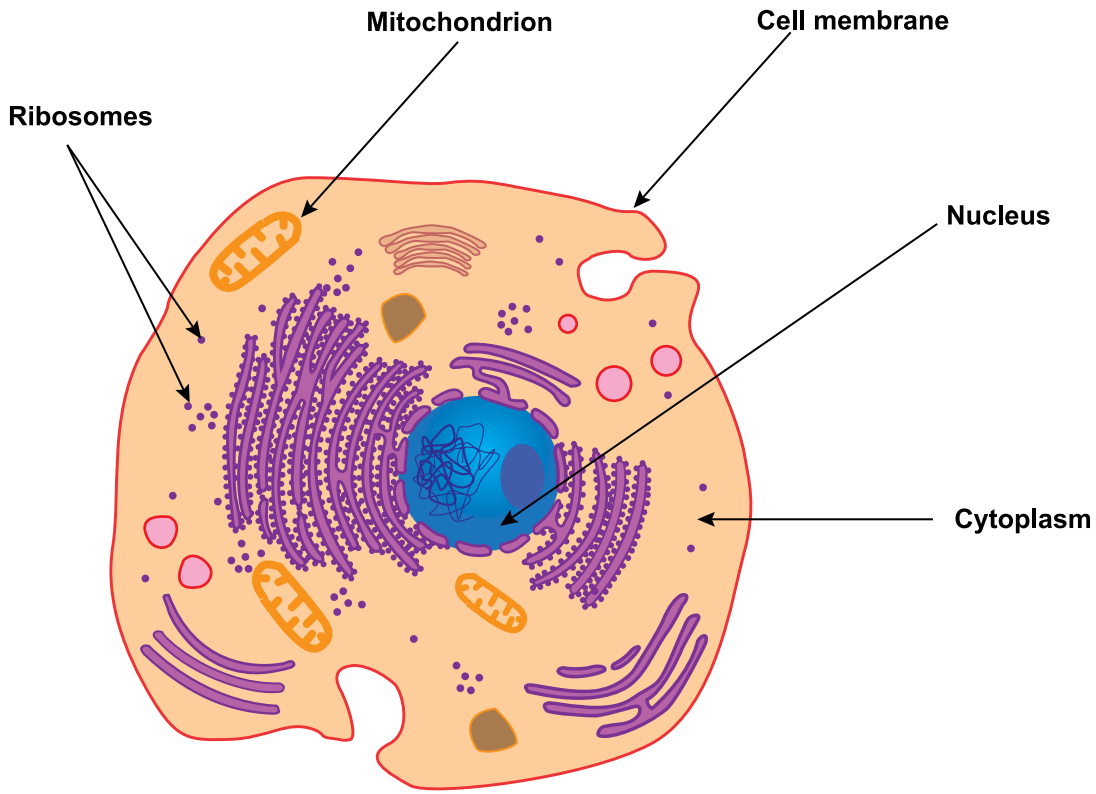
There are over 200 different types of cells in the human body. These cells vary in size, shape and function but most cells are have similar internal structures. Just as the human body contains organs, cells also contain 'mini organs' called **organelles**, specialised structures with specific functions, that work together to carry out the cell's role.

The contents of the cell are suspended in a material called **cytoplasm**. It fills all the space between the nucleus and the cell membrane. Cytoplasm contains 75% to 90% water.

The **nucleus** is found inside the cell and contains the cells genetic material. It controls all the activities of the cell, for example, it's chemical reactions, how it develops and how it reproduces.

Mitochondria are cylindrical shaped structures spread throughout the cell. Chemical reactions of cellular respiration occur in these structures and they are known as the 'powerhouse' of the cell. Mitochondria release energy required for cell activities.

Animal cell showing structures that are contained in most cells



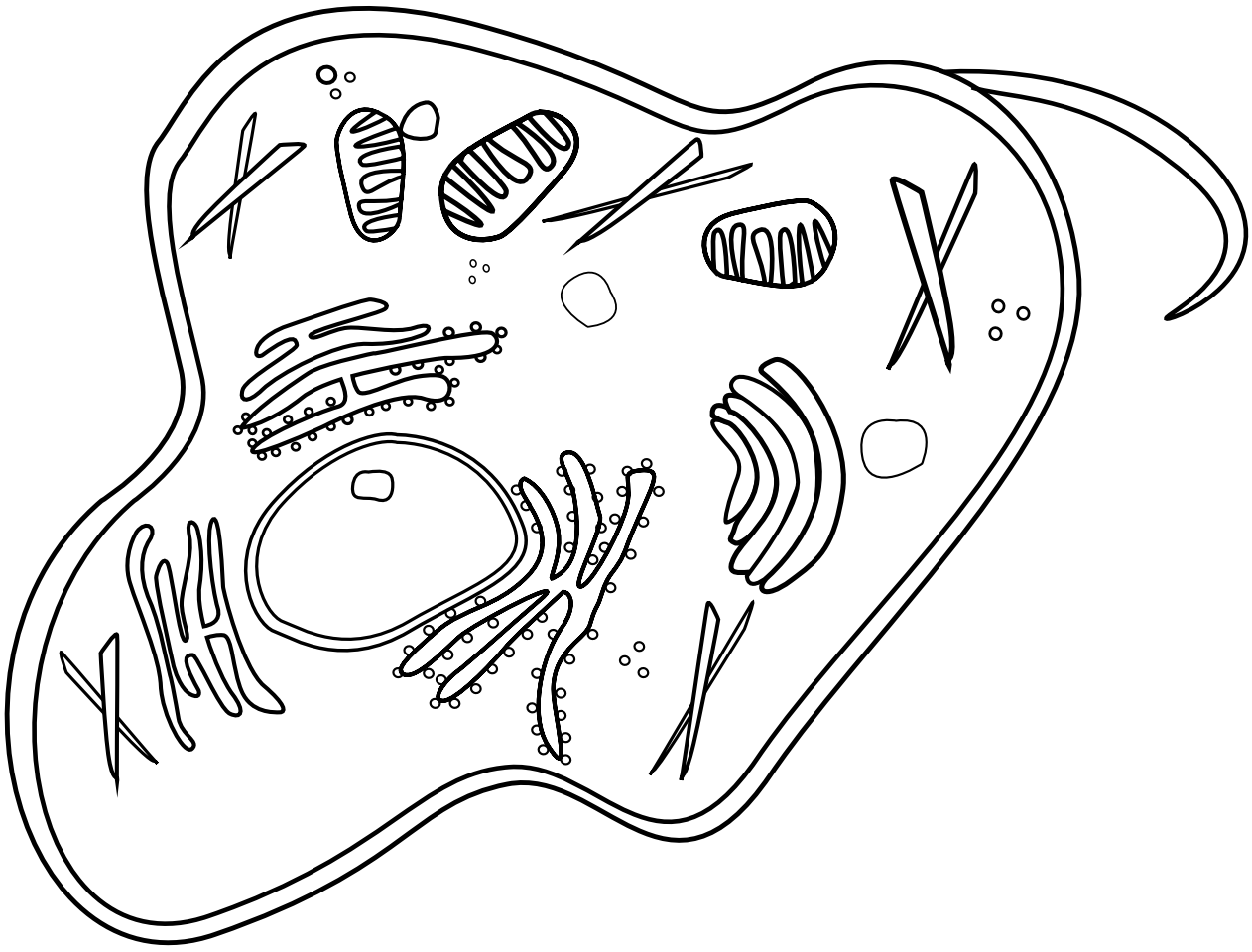
Checkpoint

Define the term organelle:

_____

Use the key below to colour each of the organelles in the diagram of an animal cell.

- ☐ Cell Membrane (green)
- ☐ Mitochondria (orange)
- ☐ Nucleus (blue)
- ☐ Cytoplasm (yellow)



Complete the table using the information above.

Structure	Location	Function
Cytoplasm		
Nucleus		
Mitochondria		

The cell membrane

The function of the cell membrane is to form a boundary to separate the environment inside the cell from the environment outside the cell. The cell membrane is what is known as **selectively permeable** which means it allows some substance to pass more easily into and out of the cell. It also provides structure to the cell and maintains its shape.

Checkpoint

Describe the main roles of the cell membrane:

_____

_____

_____

_____

_____

Activity: The cell membrane

There have been many different models of the cell membrane proposed to explain observations of cells in different environments and results of investigations. Cell membranes are too thin to observe them directly but it is possible to infer cell membrane structures from the reactions to different materials and different conditions.

Activity purpose

- To investigate the nature of the cell membrane by observing the effects of different solutions and conditions.
- To understand that the cell membrane is selectively permeable.

The effect of different solutions on cell membranes

Cells are usually surrounded by solutions, whether inside the body or in places where cells are in contact with the external environment. These solutions can change in composition and pH.

Time

Approximately 60 minutes with observations made after 24 hours for some treatments.

Materials

- 1 x safety glasses
- 50 x fresh beetroot pieces approximately (1 mm thick, 5 mm x 5 mm square)
- 10 x petri dishes
- ~ 30 mL of each of the following treatment solutions:
- pH 2, 4, 6, 8, and 10
- ethanol 1% and 20%
- detergent 1% and 5%
- distilled water
- 1 x sheet of white paper
- labels or marking pen
- coloured pencils or digital camera

Safety

- Wear safety glasses at all times
- Do not consume any solutions or other materials provided

Procedure

1. Label the petri dishes using the labels or marking pen with date, your group and the letters A-J.
2. Arrange the petri dishes on white paper.
3. Add enough of the treatment solution to the petri dish to a depth of 4-5 mm.
4. Very gently place 5 pieces of beetroot into each petri dish making sure they do not overlap and that all are covered by the treatment solution.
5. Cover the petri dishes with the lids.
6. Observe any immediate colour changes in the dishes and record the colour in the table below.
7. Rate the colour of the solution on a scale of 0 (no pink) - 5 (dark red). Use coloured pencils to show the shade indicated by the scales 0-5 OR use images from a digital camera to record the colour changes.
8. Observe the dishes again after about 1 hour and record the colour in the table below.
9. Observe the dishes again after about 24 hours and record the colour in the table below.
10. Answer the questions on the next page.

Results

Table: The effect of different treatments on cells

Petri dish	Treatment solution	Colour changes observed		
		Immediately	After 1 hour	After 24 hours
A	pH 2			
B	pH 4			
C	pH 6			
D	pH 8			
E	pH 10			
F	1% ethanol			
G	20% ethanol			
H	1% detergent			
I	5% detergent			
J	distilled water			

Space to stick digital pictures

Questions

Identify the treatment that caused the greatest colour change.

_____

State the ideal pH for the beetroot cell membrane. Explain why you chose this pH value?

_____

_____

Describe how detergent disrupts the cell membrane? State any observations that you made to support your answer.

_____

_____

Suggest why distilled water caused a change to the cell membrane?

_____

_____

Types of cells in the human body

Cells vary in size (see diagram below). All the cells as shown below are drawn to the same scale. The largest cell, an egg cell, would be just visible to the naked eye; all the other cells are microscopic.

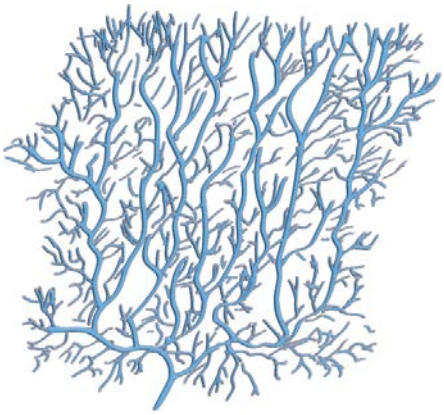
Red blood cells

Sperm

Bone cell

Fat storage cell

Egg



Nerve cell in brain

Cells lining intestine

Smooth muscle cell

Body organisation

Introduction

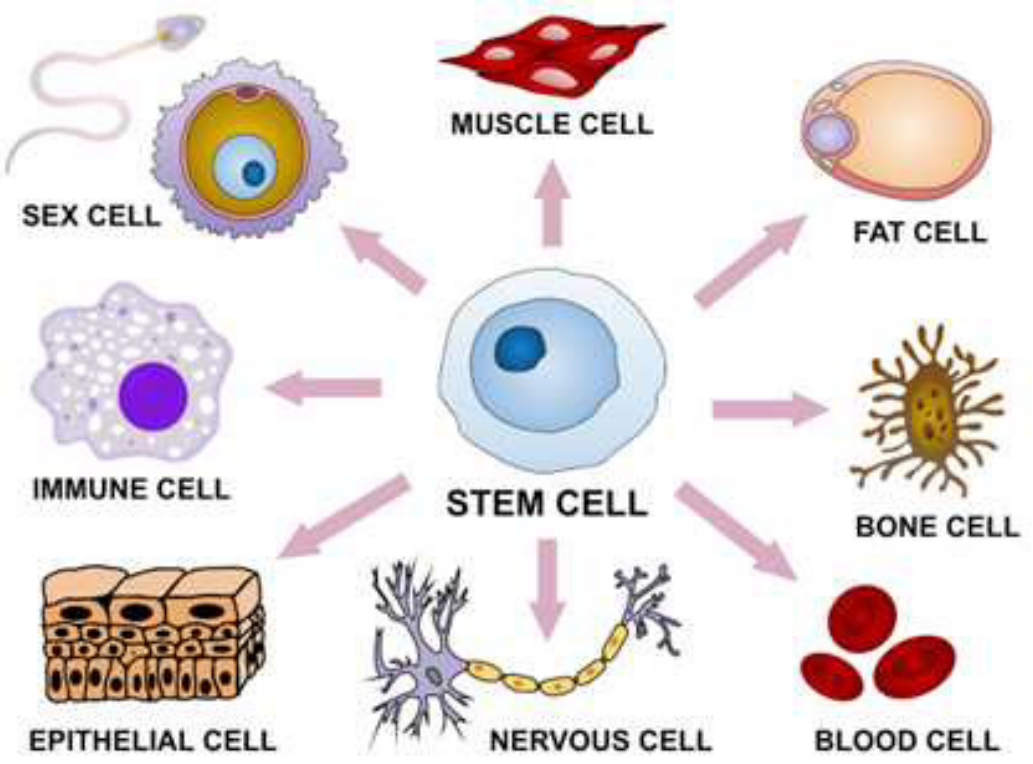
The human body contains over 75 billion cells. These cells are not randomly located but organised in a particular way that allows each one to contribute to the functioning of the whole body.

Each human develops from one cell, a fertilised egg cell. That cell divides repeatedly. The new cells called **stem cells**, become **specialised** for their particular function through the process of **differentiation**. Differentiation occurs when stem cells develops into the type of cell it is programmed to become.

The body is organised by a structural hierarchy of cells, tissues, organs and organ systems that work together to perform the life processes (MRS GREN).

Cells are the lowest level of organisation forming the basic building block of all living things. There are over 200 different cell types in the human body. For example, muscle cells are able to shorten in length; red blood cells are able to transport oxygen; nerve cells send messages etc.

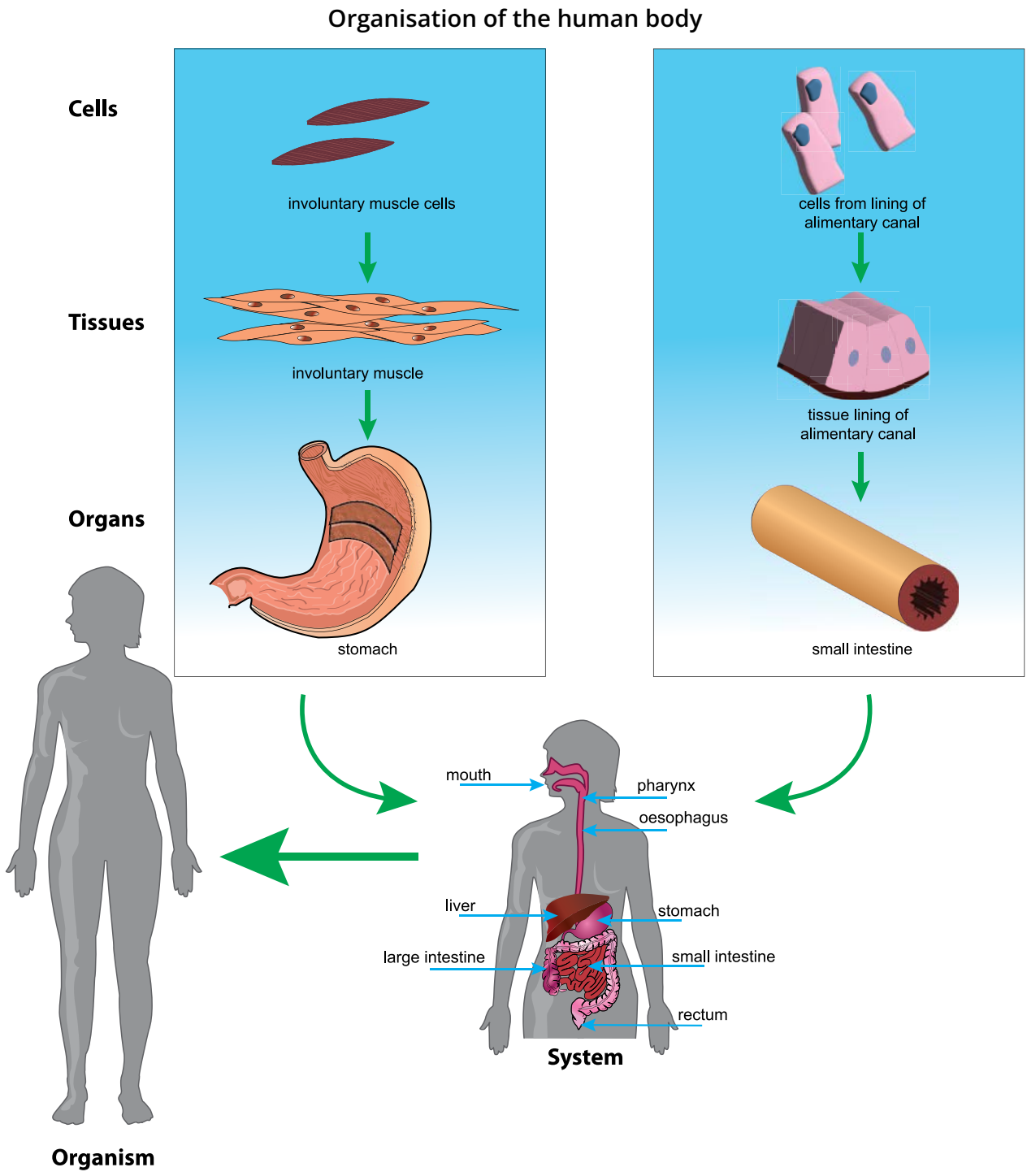
Tissues are the second structural level. Tissue is made up of cells with similar properties that carry out a common purpose. Tissue is grouped into four main types: epithelial, connective, nervous and muscle. Groups of nerve cells make up nervous tissue, groups of bone tissue cells form bone and groups of muscle cells make up muscle tissue.



The third level of organisation are **organs**. An organ is normally made up of two or more tissues that work together to carry out a common function. The stomach is an organ with lining tissue on the inside and muscular tissue in the wall; the heart is an organ made up of muscular tissue and nervous tissue.

The highest level of organisation is the **organ system**. An organ system is a group of organs that work together for a common purpose. For example, the role of the respiratory system is to supply the blood with oxygen and to remove carbon dioxide from the blood. Some of the structures that make up the digestive system are illustrated below.

The body systems are all integrated into the one living thing, the **organism**.



Checkpoint

Finish the sentences below using the word list: system, living things, organ, tissue.

A cell is the building block for all _____

A group of cells that all work together to do a special job is called a _____

Many tissues working together makes up an _____. An example of this is the stomach.

A lot of different organs working together make up a _____. The respiratory system is an example of this.

Tissue

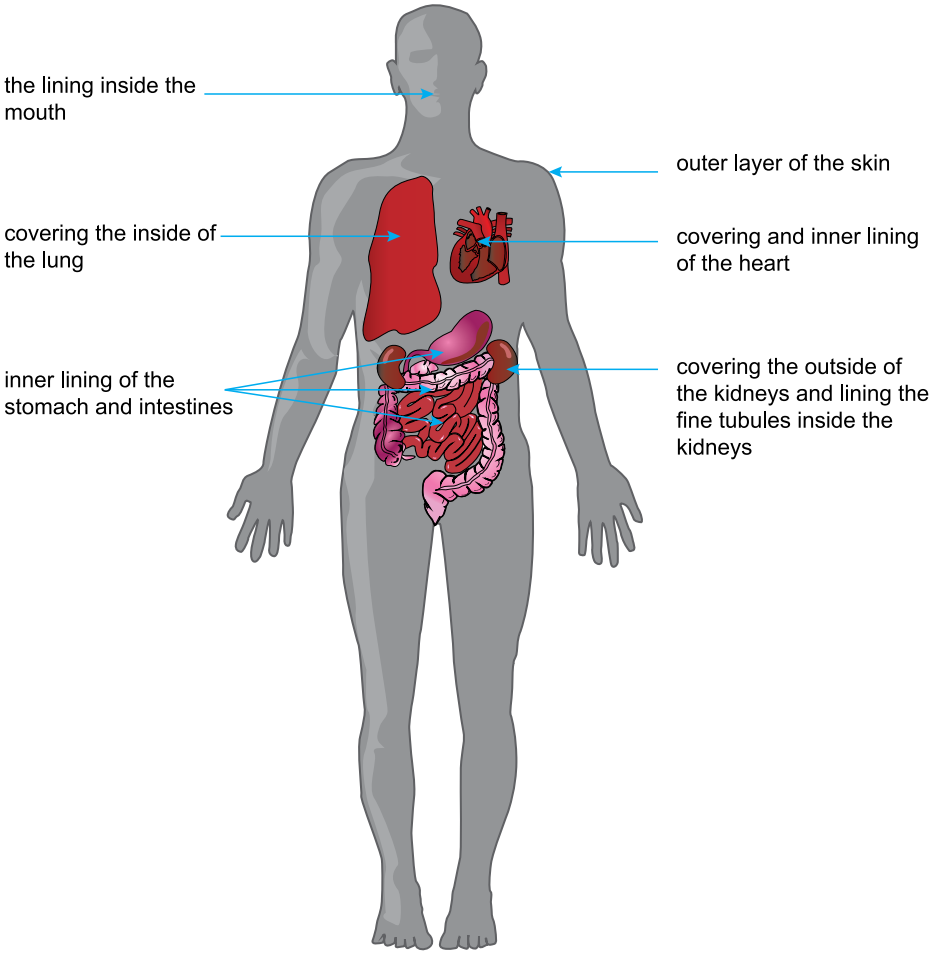
Tissue is a group of cells that are similar in structure and that work together to carry out a particular task. The structure of the tissue and the function that it performs can be used to classify it into one of four basic types. These four basic types of tissue are epithelial tissue, connective tissue, muscular tissue and nervous tissue.

Epithelial tissue

Epithelial tissue is made up of cells that form a surface over other organs. The skin's outer layer, the **epidermis**, is an example of epithelial tissue. Organs like the heart, kidneys, intestines, liver and lungs are covered with epithelial tissue. It also lines the inside of organs, so the inner layer of the heart, stomach, intestines and other hollow organs is made up of **epithelium**.

All blood vessels are lined with epithelium.

Where epithelial tissue is located in the human body

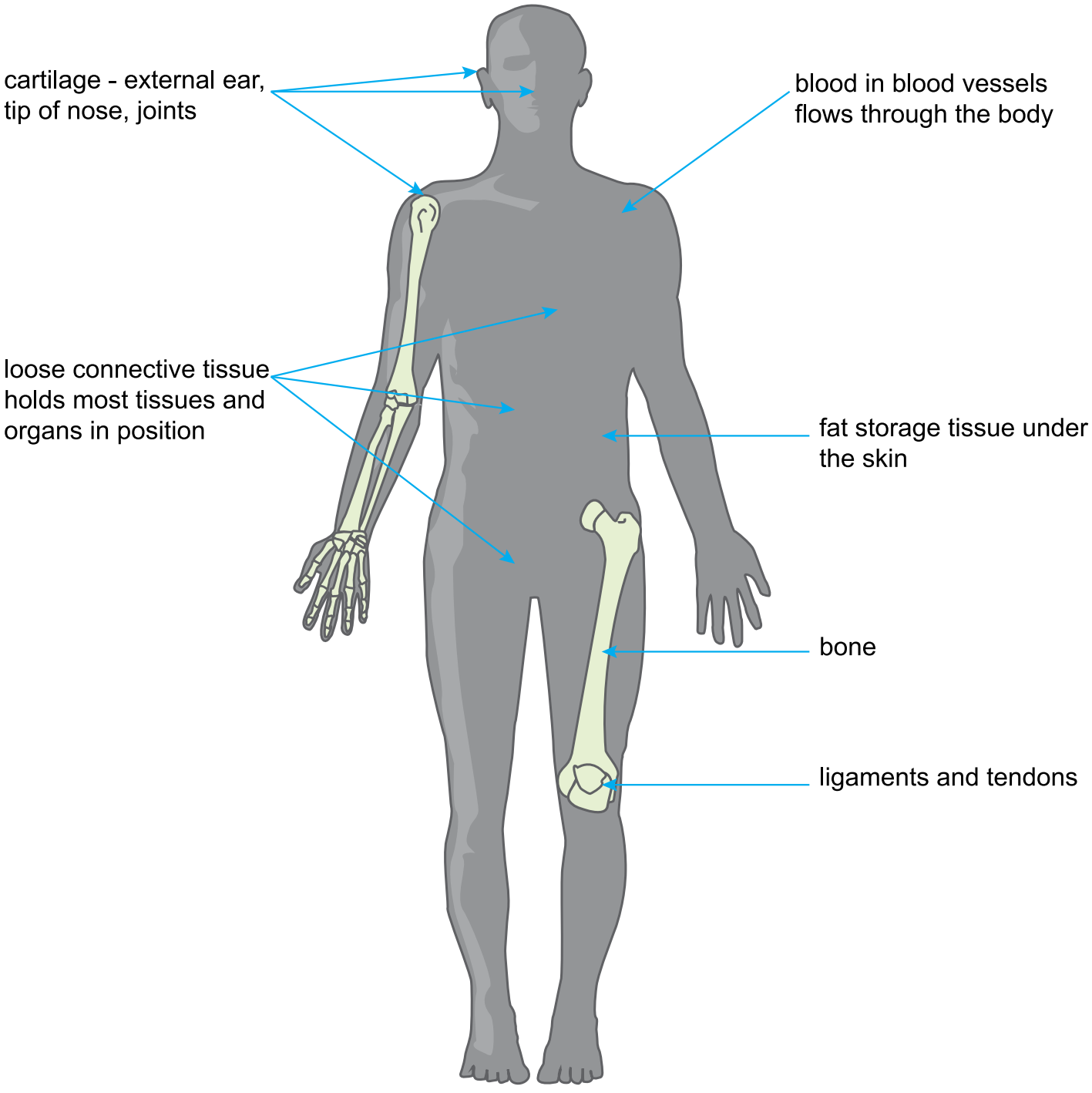


Epithelial tissue consists of cells that are very closely packed together and form a smooth surface. They may vary in shape from thin and flat to column or cube shaped. The cells that line the inside the mouth, cheek cells, are an example of thin, flat epithelial cells.

Connective tissue

Connective tissue supports and holds together other tissues in the body. Connective tissue is unlike epithelial tissue in that the cells are not close together, they are separated from each other by large amounts of material called **matrix**. Matrix is a non-cellular material that consists of inorganic salts and collagen. Connective tissue includes bone, cartilage, tendons, ligaments and fat storage tissue. Blood is also classified as a connective tissue. The matrix of blood is the liquid in which the blood cells are suspended.

Where connective tissue is found in the human body



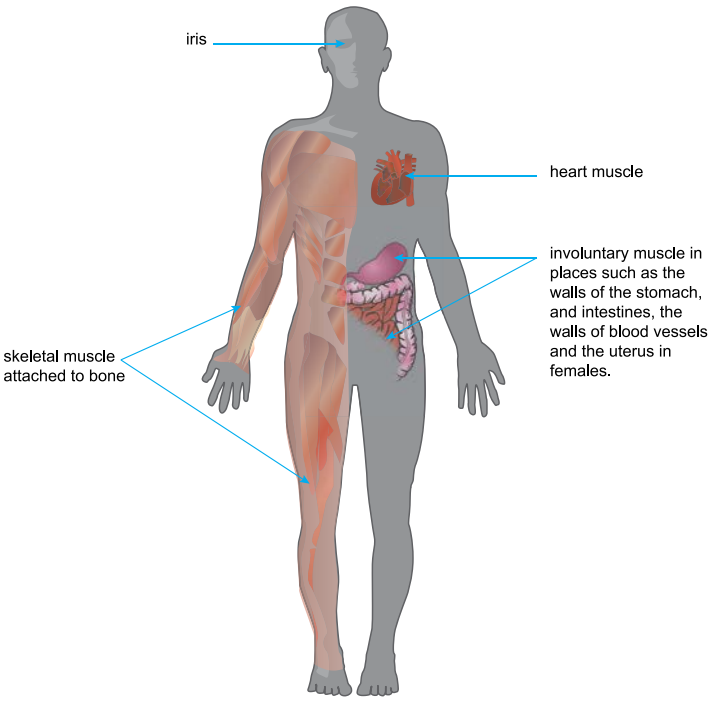
Muscle tissue

The cells of **muscle tissue** are long and thin and are arranged in bundles of muscle fibres. They respond when stimulated and contract becoming shorter and fatter.

There are three different types of muscle tissue.

1. **Skeletal muscle** tissue makes up the muscles that are attached to bones. These are the muscles that you can feel in your arms and legs. Skeletal muscle is considered voluntary muscle as we have control over when we move particular muscles as necessary.
2. **Involuntary muscle**, also known as **smooth muscle tissue** is made up of cells that we cannot control voluntarily. This type of muscle is found in the walls of the stomach and intestines, in the walls of blood vessels, in the iris of the eye, in the uterus and in many other organs.
3. **Cardiac muscle** tissue is only found in the heart. When heart muscle contracts it pumps the blood. Heart muscle cannot be voluntarily controlled.

Where muscle tissue is found in the human body

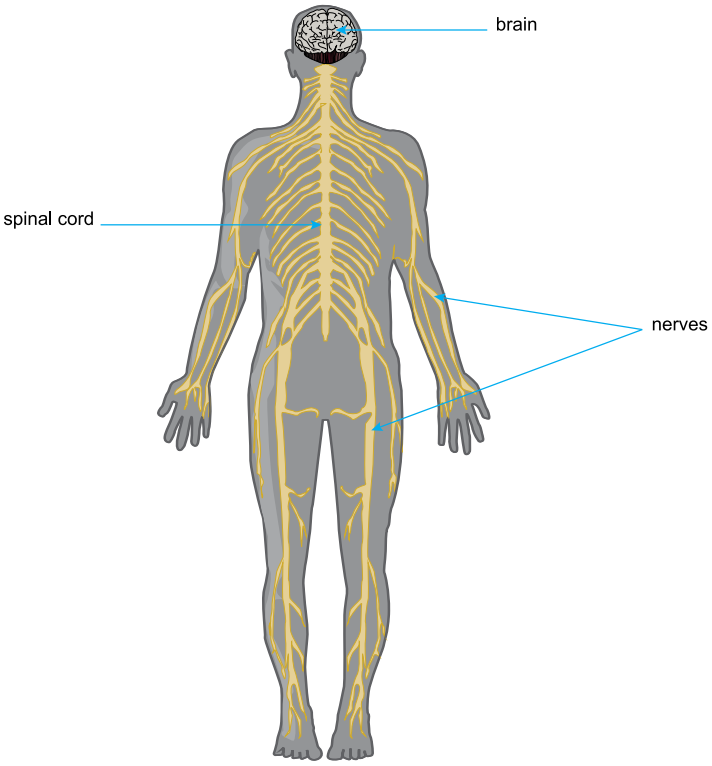


Nervous tissue

Nervous tissue is made up of specialised nerve cells that are called **neurons**. Neurons have long projections from the body of the cell. When a neuron is stimulated electrical messages can be carried along these projections from one neuron to another sending messages to and from the brain.

Nervous tissue is found in the brain, the spinal cord and in the nerves.

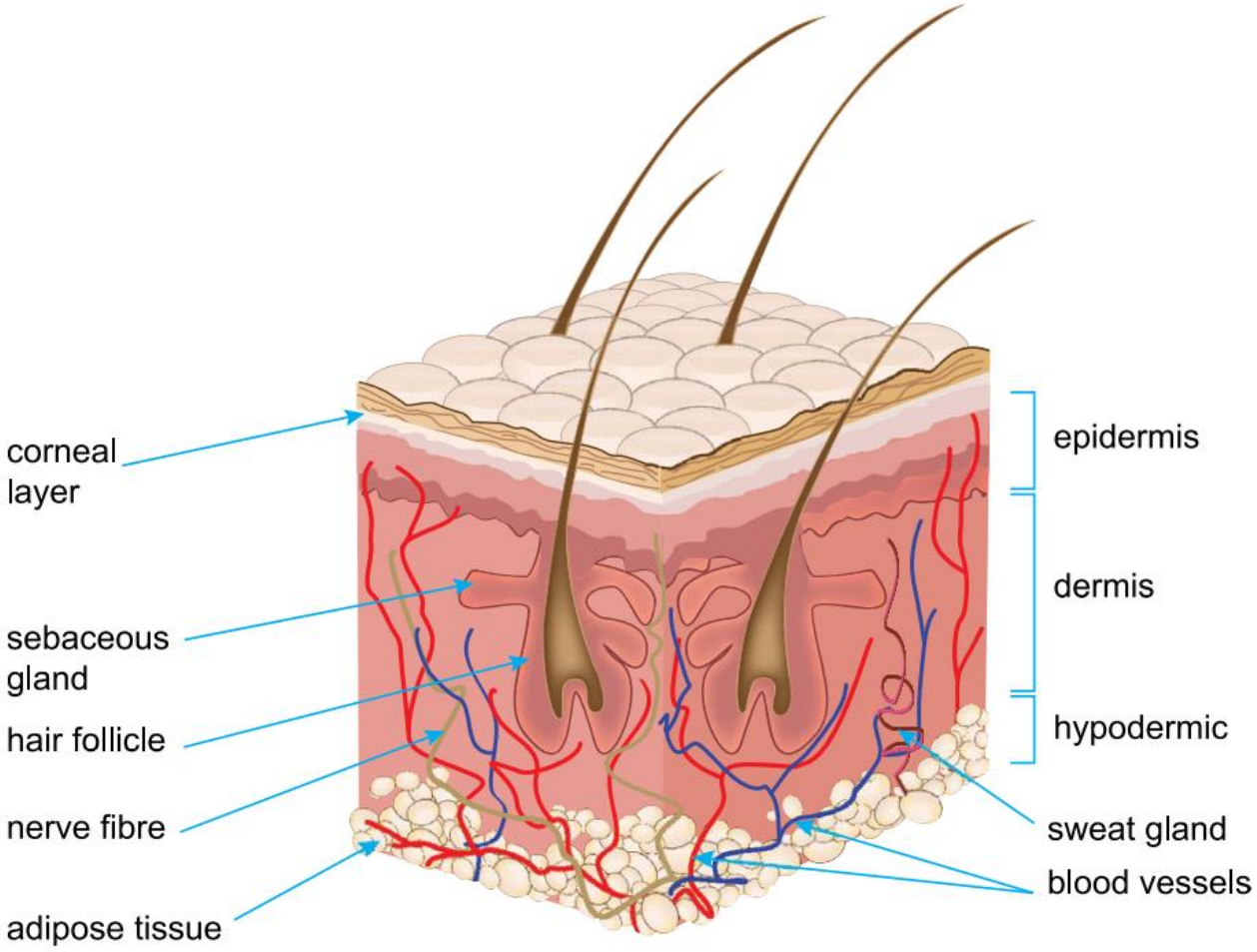
Where nervous tissue is found in the human body



Organs

Organs are formed when two or more types of tissue work together to carry out a particular task. The stomach, heart, lungs and kidneys are all examples of organs, and most organs have a recognisable shape. The skin is the body's largest organ containing epithelium, connective, and nerve tissue.

Structure of Human Skin



Organ systems

Organs do not work independently of each other and are grouped together into organ systems. These are also called body systems and carry out specialised functions in the human body.

Some organs like the pancreas form a part of both the digestive and endocrine system as it produces digestive enzymes to breakdown food and also the hormone insulin to regulate blood sugar levels.

The major body systems are listed below.

Body system	Main function
Respiratory	Intake of oxygen and removal of carbon dioxide
Circulatory	Transport of nutrients, oxygen and wastes to and from the cells
Digestive	Intake, breakdown and absorption of food
Excretion	Removal of wastes
Musco-skeletal	Movement, support and protection of body parts
Reproduction	Production of new individuals
Nervous	Detection of changes in the environment and coordination of body activities
Endocrine	Regulation and coordination of many body functions
Immune	Protection against infection by micro-organisms

Organism

The body systems all work together in a coordinated way for humans to carry out the processes of life. For example, cellular respiration requires glucose which is broken down by organs in our digestive system and oxygen that is delivered to our cells through the respiratory system, the circulatory system then pumps the blood containing the oxygen and glucose throughout our bodies so our cells can produce the energy we need.

Checkpoint

In the space below draw a simple flow diagram to show the four levels of organisation of the human body:

C _____ → T _____ → O _____ → O _____ S _____

Define each of the following terms:

Word	Definition
Cells	
Tissue	
Organ	
Organ System	

For each of the following tissues, list two places in the body in which you would find this type of tissue.

Epithelial tissue (Lining tissue)	**Connective tissue** (Supportive tissue)	**Muscle tissue** (Contracting tissue)	**Nervous tissue** (Carries messages)
1.	1.	1.	1.
2.	2.	2.	2.

Use the diagram below to name the organs and then list to the organ system they belong to.

pancreas, heart, liver, stomach, brain, gall bladder, lungs, intestines

Nervous system

_____

Respiratory system

_____

Digestive system

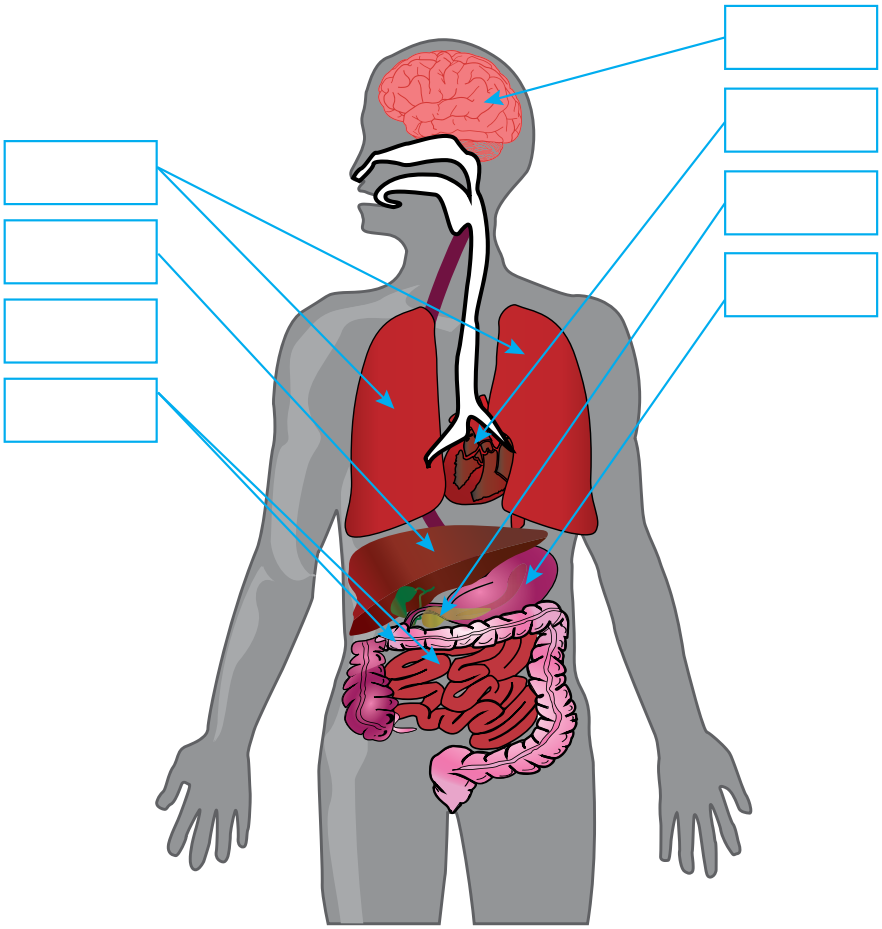
_____

Excretory system

_____

Circulatory system

_____



Extras for experts

Describe the similarities and differences between skeletal and cardiac muscle tissue.

List all the tissue types that may be present in your finger. For each tissue explain how it contributes to the function of your finger.

Explain why skin is an organ not a tissue. Think!

Choose three organ systems and list all the organs that make up that system.

Organ system	Organs

Organ system	Organs

Activity: Observing tissues

Humans are multicellular organisms. The thousands of millions of cells in your body organise themselves into collections of cells with common structures and functions. People call such collections tissues.

Histologists normally classify human tissues into one of the following types:

- epithelial tissue
- connective tissue
- muscle tissue
- nervous tissue

Each tissue type has cells with characteristic features depending on its function in the body. The organs of your body are always composed of a variety of tissues.

The most common way to study tissues to is observe sections of the tissues under a microscopic. Histology is the study of the microscopic structure and function of tissues.

Activity purpose

- To observe and draw tissues viewed under a microscope.
- To use equipment (the microscope) safely and responsibly.
- To recognise that organs consist of a two or more tissues.

Time

Approximately 60 minutes

Identifying tissues

Materials

- monocular microscope
- a selection of prepared microscope slides, labelled A-H, containing a selection of examples of each tissue type
- lead pencil
- coloured pencils

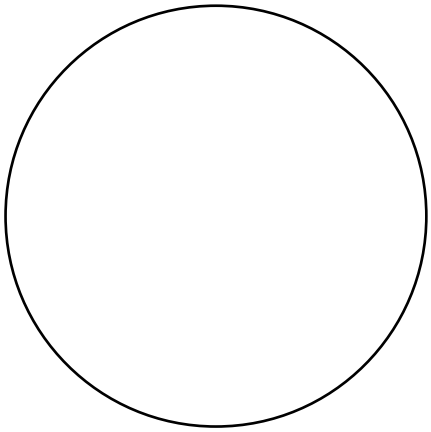
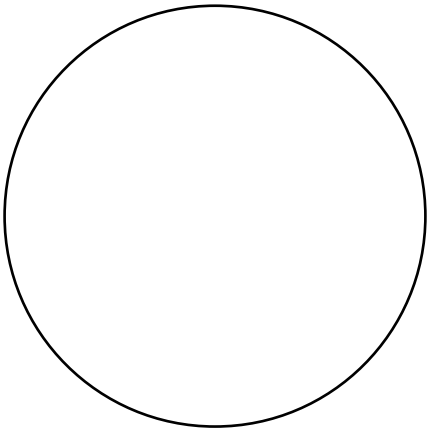
Note: the name of the tissue type on each slide is shown. Students are not required to identify tissue types.

Procedure

1. Microscopes containing slides of human tissues have been set up around the room. The tissue you are required to observe is in the field of view. Try not to move the slide.
2. Visit each microscope in turn, under the direction of your teacher.
   - In the table below, draw a diagram of what you observe in the field of view. Your diagram should be drawn in lead pencil and coloured pencils can be used to colour the cells. Use the same or similar colour to that on the slide.
3. Label any parts of the cell you can identify, such as the cell membrane and the nucleus.

Results

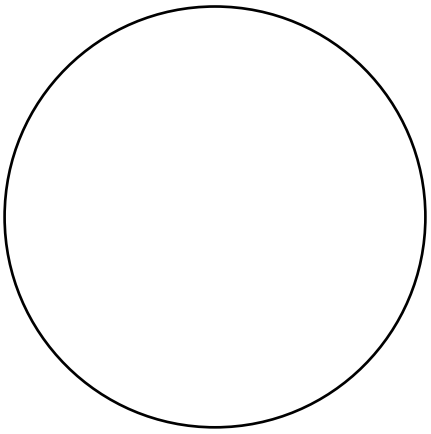
Table: Human tissues

Slide	Tissue drawing
A	Tissue type: _____  Magnification = _____
B	Tissue type: _____  Magnification = _____

Slide	Tissue drawing

C

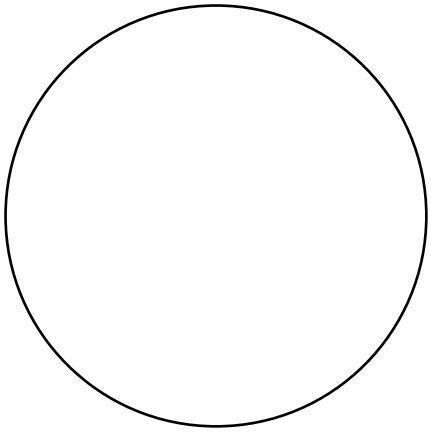
Tissue type: _____



Magnification = _____

D

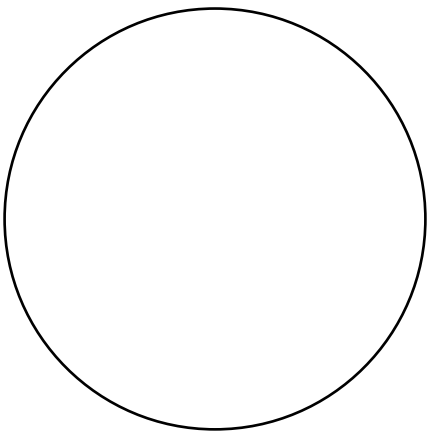
Tissue type: _____



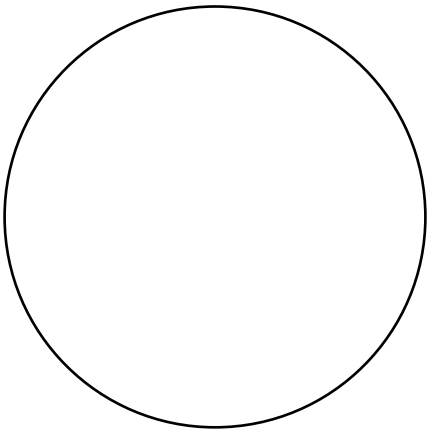
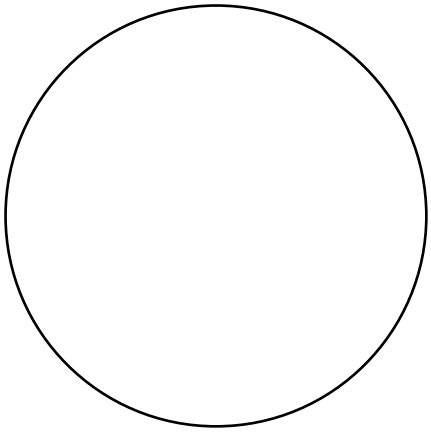
Magnification = _____

E

Tissue type: _____



Magnification = _____

Slide	Tissue drawing
F	Tissue type: _____  Magnification = _____
G	Tissue type: _____  Magnification = _____

If you are interested in finding out more about any of the tissues, use the following virtual slide resources to help:

- https://histology.medicine.umich.edu/full-slide-listful
- https://www.histology.leeds.ac.uk/tissue_types/index.php

Review questions

Describe the structural organisation of the human body.

_____

_____

_____

_____

_____

Use the terms below to complete the table.

provides movement, stomach, framework for body, brain, Intestines, takes in and breaks up food, circulates blood through body, lungs, sexual organs, provides O_2 to body and removes CO_2, muscles, reproduction, spinal cord, coordinates all thoughts and actions, heart

System	Main organ(s)	Function
Skeletal		
Muscular		
Circulatory		
Respiratory		
Digestive		
Reproductive		
Nervous		

Chapter review

- Describe the processes carried out by all living things.
- Explain why is reproduction essential for the continuation of the species.
- Explain why living cells undergo cellular respiration.
- Define the term organelle.
- State the purpose of cytoplasm in the cell.
- Summarise the roles of the four main organelles of the cell.
- Name the organelle known as the powerhouse of the cell.
- Describe the function of the cell membrane.
- Name the substances needed for cellular respiration.
- Name the substances produced by cellular respiration.
- Recall three activities in the body that require energy.
- Describe the purpose of a microscope.

Extras for experts

- Cells contain many organelles. Make a list of the important organelles and their functions, for example ribosomes.
- Some cells contain microvilli. How do these structures help the exchange of materials?
- Would you expect the cells of a large mammal like an elephant to be larger than those of a small mammal like a mouse? Explain your answer.

CHAPTER 2

Digestive System

Syllabus dot points

- Nutrients (carbohydrates, proteins, lipids, vitamins, minerals and water) are compounds in foods essential to life and health that provide energy, the building blocks for repair and growth, and substances necessary to regulate chemical processes.
- The structure of the digestive system facilitates the breakdown of food to compounds that can be readily absorbed into the blood for use by cells.
- Mechanical digestion, including the teeth and peristalsis, is required to reduce the size of food pieces and to increase the surface area on which chemical digestion can act.
- Chemical digestion involves the use of enzymes (amylase, protease and lipase) to chemically break down food for absorption; enzymes have optimal pH and temperature ranges.
- Absorption from the small and large intestine involves the transport of materials (diffusion, osmosis and active transport) into the blood and lymph.
- Materials eliminated from the digestive system include indigestible contents, excess materials and some metabolic wastes.
- The function of the digestive system can be compromised by diseases and conditions that reduce the efficiency of digestion or absorption of food.

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 nutrients are essential for various functions in the body.
2. Understand how the structure of the digestive system assists with the breakdown of foods into compounds that can be absorbed and used by cells.
3. Understand that mechanical digestion assists to reduce the size of food particles increasing the surface area and enabling effective chemical digestion.
4. Understand and explain the function of the enzymes amylase, protease, and lipase in the breakdown of food by chemical digestion.
5. Understand that metabolic waste, indigestible and excess materials are eliminated from the digestive system.
6. Understand that diseases and disorders can affect the condition and efficiency of the digestive system to absorb nutrients for the body.

Success criteria

- Describe the sources of the nutrients carbohydrates, proteins, lipids, vitamins, minerals and water.
- Describe the functions of the nutrients including the provision of energy, the building blocks for repair and growth, and substances necessary to regulate chemical processes.

- Describe the structure and function of the alimentary canal.
- List the accessory organs of the digestive system and explain their functions.
- Label diagrams of the digestive system.
- Identify the difference and similarities between mechanical digestion and chemical digestion.
- Describe the role of teeth and peristalsis in mechanical digestion.
- List three major enzymes in the digestive system and identify the smaller compounds they break different food types into.
- Explain the process of elimination and identify what compounds the digestive system eliminates from the breakdown of food.
- Describe some common diseases that occur in the digestive system.
- Describe the consequences of disease on efficiency of digestion and the absorption of nutrients.
- Describe how diarrhoea reduces the absorption of food.
- Identify possible causes of diarrhoea.
- Explain what constipation is and how to reduce it.
- Identify possible causes of constipation.

Key terms

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

Key term	Definition
Accessory organs	
Alimentary canal	
Carbohydrates	
Chemical digestion	
Constipation	
Diarrhoea	
Digestion	
Elimination	
Enzyme	

Key term	Definition
Fats (lipids)	
Mechanical digestion	
Minerals	
Peristalsis	
Protein	
Surface area	
Villi	
Vitamins	

The digestive system

All living things need nutrients to provide cells with the nutrients to make organic tissue and provide

chemical energy to carry out life processes. Nutrients in food are often too large to be absorbed by the cells. The process by which food is broken down into smaller nutrient molecules is called digestion.

The digestive system is responsible for the process of digestion. It consists of the **alimentary canal** – a series of organs from the mouth to the anus through which food passes – and **accessory organs** – organs that produce and secrete chemicals into the alimentary canal that aid in digestion.

Nutrients

All living things need nutrients to provide cells with energy, repair and growth of tissues, and are necessary to regulate chemical processes. Essential nutrients include carbohydrates, proteins, lipids (fats), vitamins, minerals and water.

Carbohydrates

Carbohydrates are broken down to simple sugars such as glucose. Glucose is used up immediately in the body, and what is not used is converted to glycogen and stored for later use. Your brain is made up of nerve cells called neurons. These neurons require energy to function and help your brain regulate and maintain your body. The energy used by your brain is in the form of glucose which is a carbohydrate. When a runner crosses the finish line after a long race, it is the carbohydrate glycogen used as energy that helped them finish the race. Your body will use carbohydrates and fats as energy to maintain body functions.

Sources of carbohydrates

Carbohydrates are one of the three main macronutrients required by the body, and they are a major source of energy. They are found in a variety of foods, including:

1. Grains: Grains are a rich source of carbohydrates. Examples include wheat, rice, oats, barley, and corn. These can be consumed in various forms like bread, pasta, cereals, and flour.
2. Fruits: Fruits such as bananas, apples, oranges, berries, and grapes contain carbohydrates in the form of natural sugars, mainly fructose.
3. Vegetables: Vegetables like potatoes, sweet potatoes, carrots, and peas contain carbohydrates. However, most vegetables also provide dietary fibre, vitamins, and minerals.
4. Legumes: Legumes, including lentils, chickpeas, kidney beans, black beans, and green peas, are

high in carbohydrates and are also an excellent source of protein and fibre.

5. Milk and dairy products: Milk and dairy products like yogurt and cheese contain lactose, a type of carbohydrate. However, some milk products, like cream and butter, have lower carbohydrate content.
6. Sugar and sugary foods: Refined sugar, honey, maple syrup, and molasses are concentrated sources of carbohydrates. Foods and beverages such as lollies, cakes, cookies, sodas, and sweetened drinks contain added sugars, which are simple carbohydrates.
7. Processed and packaged foods: Foods such as bread, pastries, crackers, and packaged snacks often contain refined grains and added sugars, making them high in carbohydrates.

It's important to note that carbohydrates are divided into two main categories: simple carbohydrates (found in fruits, milk, and sugary foods) and complex carbohydrates (found in whole grains, legumes, and vegetables). While simple carbohydrates are easily digested and provide quick energy, complex carbohydrates take longer to break down and provide sustained energy due to the presence of dietary fibre.

Uses of carbohydrates

The main role of carbohydrates in the body is to supply the cells with energy. Starch supplies most of the energy the body needs. Starch is broken down into glucose and is transported through the circulatory system to all body cells. The excess glucose is sent to the liver where it is stored as glycogen. If there is still excess glucose in the body, the liver converts it into fat. The fat will then move to fatty tissue and be stored.

Checkpoint

Name three sources of starch and three sources of simple sugars.

Describe the function of carbohydrates in the body.

_____

_____

Extra research:

Words ending in “ose” are usually sugars. Identify the foods the following sugars are found in:

Fructose _____

Lactose _____

Dextrose _____

Maltose _____

Sucrose _____

Proteins in the body

Proteins are large molecules that are essential for the structures of the body tissues. They are made of smaller units called amino acids. An example of a protein is haemoglobin, which is a large protein found in red blood cells. It helps to carry oxygen towards body cells and collects carbon dioxide to take to the lungs.

Sources of protein in food

Protein is an essential macronutrient required by the human body for growth, development, repair, and maintenance of cells, tissues, and organs. It can be found in a wide variety of foods, both from animal and plant sources. Below are some common sources of protein in food:

1. Meat: Animal meats like beef, chicken, pork, lamb, and game meats are well-known sources of protein. They typically contain high-quality, complete proteins that contain all essential amino acids required by the body.
2. Poultry and Eggs: Chicken, turkey, duck, and other birds are excellent sources of lean protein. Eggs, particularly the egg whites, are also rich in protein and are a common source for those who prefer a vegetarian diet.
3. Seafood: Fish and other seafood, such as salmon, tuna, cod, shrimp, and shellfish, are rich sources of protein. Additionally, they provide omega-3 fatty acids, which have numerous health benefits.

4. Dairy Products: Products like milk, cheese, yogurt, and cottage cheese are known for their protein content. Dairy is particularly rich in casein and whey protein, which are complete proteins.
5. Legumes and Pulses: Beans, lentils, chickpeas, peas, and other legumes are great plant-based sources of protein. They are also rich in dietary fiber and various vitamins and minerals.
6. Soy Products: Foods derived from soybeans, such as tofu, tempeh, edamame, and soy milk, are complete protein sources and are commonly consumed by vegetarians and vegans.
7. Nuts and Seeds: Almonds, peanuts, cashews, walnuts, chia seeds, flaxseeds, and other nuts and seeds contain protein. They are also a good source of healthy fats and provide additional nutrients.
8. Grains: Though not as protein-dense as animal-based sources, certain grains like quinoa, amaranth, and buckwheat contain more protein compared to other grains like rice and wheat.
9. Vegetables: While most vegetables do not contain significant levels of protein, green leafy vegetables like spinach, kale, and broccoli contain a decent amount of protein, along with other beneficial nutrients.
10. Protein Supplements: Protein powders, shakes, and bars are commonly used to supplement protein intake, especially by athletes, bodybuilders, or those with increased protein needs.

It is important to note that the protein content may vary among different sources, and a well-balanced diet consisting of a variety of protein sources is ideal to obtain all necessary amino acids and nutrients.

Functions of proteins in the body

Proteins form the building blocks for muscles, blood, and skin. Collagen is a protein that makes tendons, ligaments and scars that have knitted damaged tissue together. Proteins are also used to replace skin cells as they have a short life span. Muscle grows by making new proteins and with regular exercise they reproduce faster to grow muscle tissue.

Proteins are also used in the immune system, when the body detects an invading antigen, it constructs a large protein used to fight the invading infection called an antibody. Without proteins the body would not be able to resist infections.

Checkpoint

List five sources of protein from food.

_____

_____

_____

Describe the function of protein in the body.

_____

_____

_____

Extra research:

The malnutrition diseases Kwashiorkor and Marasmus develop in children, and are a concern for people living in developing countries. These conditions occur due to severe malnutrition. Research the following diseases.

	Name of disease: Kwashiorkor	Name of disease: Marasmus
Causes		
Symptoms		

Create a list of foods rich in protein and identify the daily intake for each food. Compare these with your intake of protein.

List of food rich in protein	Daily intake for a teenager

List of food rich in protein	Daily intake for a teenager

Describe the effects of a high protein diet.

_____

_____

_____

Whey protein has been popular with athletes. Identify the source of whey protein and its effectiveness for athletes.

_____

_____

Debate the risks and benefits associated with taking protein supplements.

_____

_____

_____

Fats (lipids)

Fats and oils, also called lipids and are important to a healthy body. There are different types of fats some that are healthier than others. **Unsaturated fats** are healthier than **saturated fats**, as saturated fats raise the low density (LDL) cholesterol in the blood increasing the risk of plaque forming in the veins and arteries. Examples of unsaturated fats include olive oil, peanut oil, almonds, pumpkin seeds. Examples of saturated fats include fatty meat, butter, cream, palm oil and cocoa butter. By eating less saturated fats the chance of heart disease is lowered. Food manufacturers may include saturated fats into their products to improve shelf life and texture of the product.

Trans fats, or trans-fatty acids, are a form of unsaturated fat. They come in both natural and artificial forms and are the most harmful and can increase the risk of heart disease and cancer. They occur in many processed food products. Reading the nutritional information panel will help to identify the amount of saturated fats being eaten.

Functions of fats in the body

- Used in formation of cell membranes and hormones
- As a source of energy storage
- Protect vital organs in the body
- Helps keep your body warm
- Fats help your body absorb some nutrients

Place the foods from the list in the correct column in the table below.

butter, prawns, coconut oil, avocado, pear, olives, chips, croissant

Saturated fats	Unsaturated fats	Trans fats

Checkpoint

Explain the differences between unsaturated, saturated and trans fats.

The body has two types of cholesterol, so what does it mean if a person has high cholesterol?

Explain how to reduce unhealthy cholesterol.

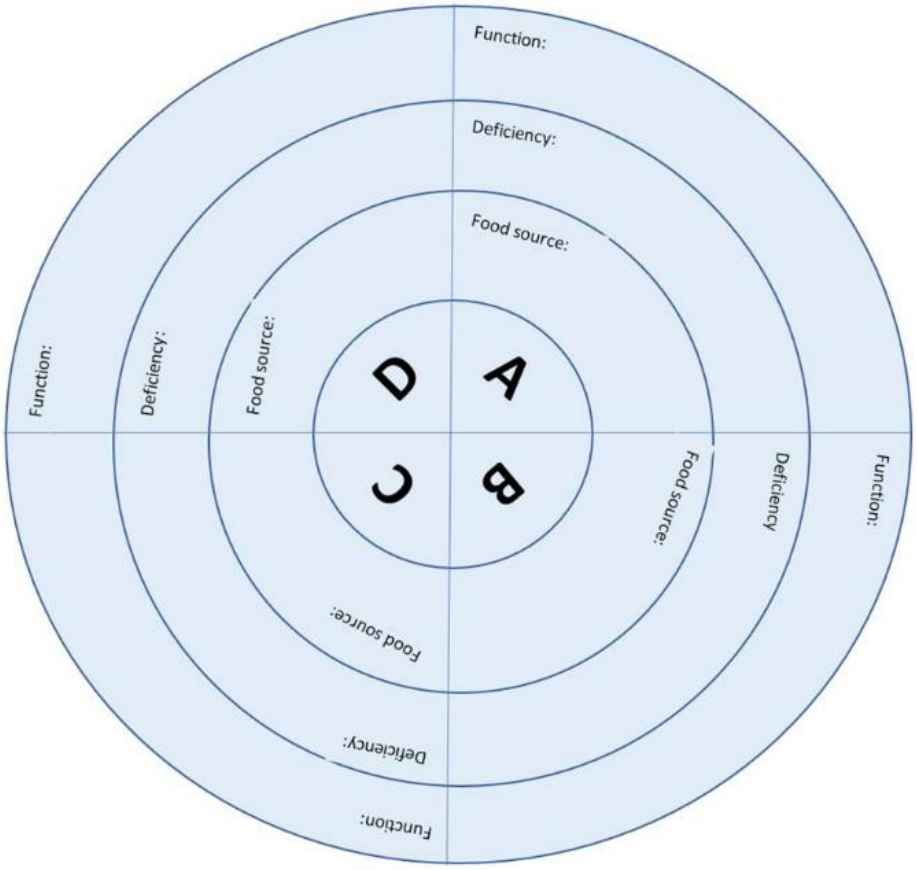
Essential vitamins

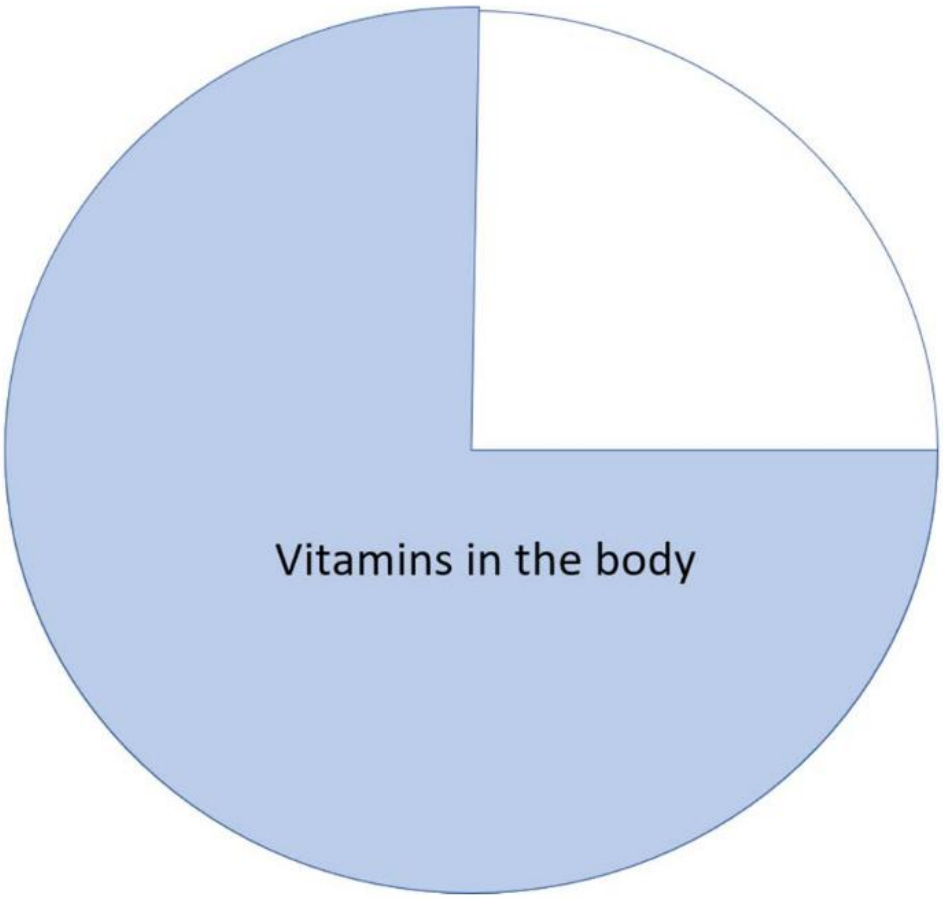
In the early 1900's Szent-Gyorgyi's discovered vitamin C. Since then a range of different vitamins and minerals have been discovered leading to better understanding of our bodys' needs and how nutrition plays an important role in our body's health.

Vitamins are not needed in large amounts. If they are not taken in from a healthy diet, symptoms of deficiency are produced. The table below shows water soluble vitamins, their functions, deficiencies and what foods can be eaten to take in that vitamin.

Vitamin	Function	Deficiency	Food source
Vitamin A	Promotes vision, helps to make other proteins in the body, supports reproduction and growth.	Night blindness, total blindness.	Liver, fish liver oils, milk, butter, eggs
Vitamin B	Vitamin B group consists of thiamine, riboflavin, niacin, biotin, pantothenic acid, vitamin B6 and vitamin B12. A general the function of this group of vitamins is to assist metabolic pathways (help with chemical reactions in the body).	Major deficiency leads to pellagra and beriberi.	Whole grain breads, vegetables, fruits, meat, fish, eggs, nuts, milk, legumes
Vitamin C	Has many functions, such as maintaining blood vessels.	A deficiency leads to bleeding gums.	Capsicum, oranges
Vitamin D	Vitamin D is fundamental for a healthy skeletal system as it is essential for bone growth.	Deficiency include rickets. The bones of children fail to calcify causing abnormal skeletal systems. Bone density reduces causing osteoporo-sis, making bones vulnerable to breaking. A deficiency can also retard bone growth.	Skin expo-sure to sun-light, fatty fish like salmon, herring, and mackerel.

Fill in the missing information in the vitamin wheel below, join the two circles with a split pin.





This page is intentionally blank.

Minerals

Minerals are **essential nutrients** needed for the body. Vitamins are organic and can easily be broken down in the body. Minerals, however, are inorganic and are not easily broken down or changed into anything else. When preparing food, it is important to be careful not to destroy minerals in the cooking process. Minerals are also needed in smaller amounts than vitamins.

The role of iron in the body

Iron is an essential nutrient in the body. It is important in making ATP (adenosine triphosphate) energy in the body. Iron is also found in the protein haemoglobin in the red blood cell and myoglobin in the muscle cell. They help the cell to carry oxygen to body cells.

After iron is eaten, it is transferred to the bone marrow where the body makes red blood cells. If there is extra iron the body will store the iron in the liver, bone marrow or spleen.

Iron deficiency is common and widespread:

- Females are more affected by an iron deficiency due to losing blood during menstruation.
- In pregnancy, the need for more iron to support a larger blood volume is needed.
- Children who are growing rapidly and receive little iron from their milk diets.

Iron deficiency can lead to iron deficiency anaemia where the body has low haemoglobin stores. The person will feel tired, weak, have little resistance to the cold and may get headaches.

Foods that contain iron

Tinned oysters, beef liver, parsley, tomato juice and broccoli.

Some foods are fortified with iron, like some breakfast cereals. Iron absorption can be increased. For example, if toasted bread fortified with iron is eaten with a glass of orange juice the vitamin C in the orange juice improves the iron absorption from the toasted bread.

The table below shows how much iron you gain from eating a serve of food.

Food	Serve size	Amount of iron (mg)
Beef mince burger	1 patty (77g)	2
Chicken	1 cup diced (140g)	1.8
Tuna	½ small can (56g)	0.9
Oatmeal	½ cup cooked (93g)	3
Spinach	1 cup (30g)	0.8

Checkpoint

What is the recommended daily intake of iron (RDI) of a teenager? Compare it with your actual intake of iron over a week. *Hint: use label information of the food you eat over a week.*

Calculate your average iron intake per day. Does this amount match the recommended daily intake?

Explain the symptoms a person would experience if they had an iron deficiency and identify two possible causes for this deficiency.

List sources of iron obtained from animals and non-animal sources. Compare the amount of iron obtained from animal and non- animal sources.

Calcium

Calcium is found in large quantities in the body, it assists with the development of a healthy skeleton. A child needs more calcium as they develop their skeletal system, older people require calcium to help prevent bone loss. Calcium supports the structure of our teeth and bones. Calcium is also stored in the bones to help the body if the blood calcium levels drop. Calcium is regulated in the body by vitamin D. If the bodys' level of calcium is too high vitamin D will activate a reduction in calcium blood levels maintaining homeostasis.

Foods that contain calcium

Broccoli, sardines with bones, milk, plain yoghurt, cheddar cheese, tofu (soybean curd) and bok choy (Chinese cabbage).

One cup of milk on average is equivalent to 300 milligrams of calcium. Teenagers may need from 1000 to 1300 milligrams of calcium a day. That is equal to 3 to 4 cups of milk a day.

If you order a hot chocolate at a cafe, you have a choice of many different types of milk. Have you ever wondered which milk contains the most calcium and where that calcium comes from?

Too little and too much calcium

Calcium from supplements can be useful for people who have a calcium deficiency and are not getting enough calcium from their food. Too much calcium in the body can have negative effects like the formation of kidney stones.

If a child does not get enough calcium in their body during their growing years, their bones don't reach maturity with the necessary bone mass and density. This causes long term problems in adult life as bone density is reduced leading to conditions like osteoporosis (reduced bone density leading to bones breaking easily).

Checkpoint

In the table below research different milks and calculate the amount of calcium gained from each product.

Number the milks researched from the highest calcium amount to the lowest calcium amount (1-7).

Type of milk	Amount of calcium per 100ml	Calcium (highest to lowest)
Cow - full cream milk		
Cow - high low milk		
Oat milk		
Rice milk		
Soy milk		
Cashew nut milk		
Almond milk		

Give a reason for why the milk with the highest calcium amount is so high.

_____

Should the milks listed above be used for children under 3 years old, give a reason for your answer.

_____

_____

Explain what it means if milk is fortified.

_____

_____

Explain the long-term complications that can develop with a diet low in calcium.

_____

_____

Explain the consequences of a high calcium diet over an extended period.

_____

_____

Some people are lactose intolerant and may struggle to drink milk. Suggest ways they may obtain the recommended amount of calcium daily.

_____

_____

_____

Water

Water is the most important nutrient for the body, about 60% of the body is made up of water. Water is taken into the body through drinking and through eating fruits, vegetables, and meats. Water is also made in our body during the process of metabolism (chemical reactions in the body). The body loses water through excretion. The amount of water loss will depend on the environmental temperature. If it is a hot day, you will produce sweat and excrete more fluid than if it is cold frosty day.

Function of water in the body

- carries nutrients through the body
- removes wastes from the body
- acts as a solvent – dissolving minerals and vitamins
- acts as a lubricant in joints and around the eyes
- maintains blood volume

How much water is needed per day is dependent on several factors like the environmental temperature, humidity, activities so daily water requirement is usually shown in a portion amount.

Checkpoint

Use the link to the Australian Government – Nutrition Reference Values https://www.nrv.gov.au/ and identify your recommended daily intake of water. Compare this to your actual daily intake of water.

_____

_____

Identify the factors that will require the body to take in more water than usual.

_____

_____

_____

_____

We all enjoy soft drinks, but have you looked closely at what is inside that drink?

Research the amount of sugar found in each of the following drinks.

Type of soft drink (600ml)	Draw a teaspoon for each 5mg of sugar found in the soft drink	Total tsp of sugar
Coke		
Orange juice		
Sports drink		
Iced coffee		
Water		

Using the table above, list the drinks containing the most sugar to the least amount of sugar.

_____

Identify the drinks that you are more likely to drink and reflect on your choice, do you feel that your choice of soft drink will benefit your body?

_____

_____

Visual: Place the correlating amount of sugar into separate plastic bags to see how much sugar is visibly in each of the above drinks.

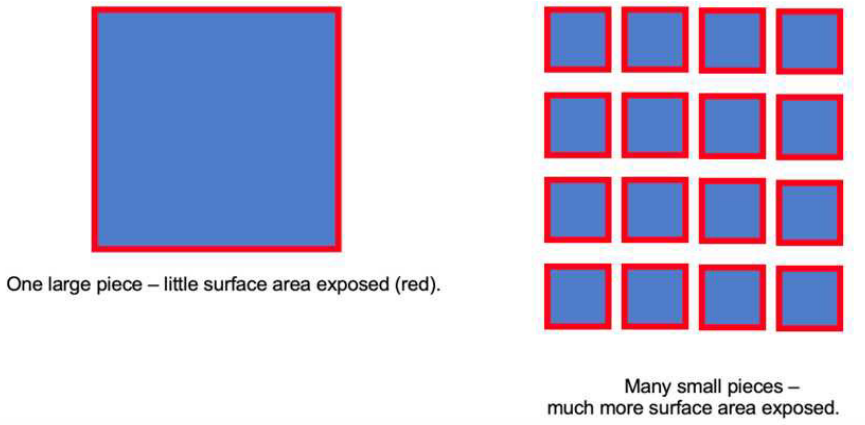
Types of digestion

Before food can be absorbed into the blood stream it must be broken down into simpler molecules small enough for cells to absorb. Mechanical and chemical digestion breaks large food molecules like carbohydrates, proteins, and lipids, into smaller compounds.

Mechanical digestion is the breakdown of food into smaller pieces. The purpose of mechanical digestion is to increase the surface area of the food to which chemicals can attach. This decreases the time taken for chemical digestion to occur.

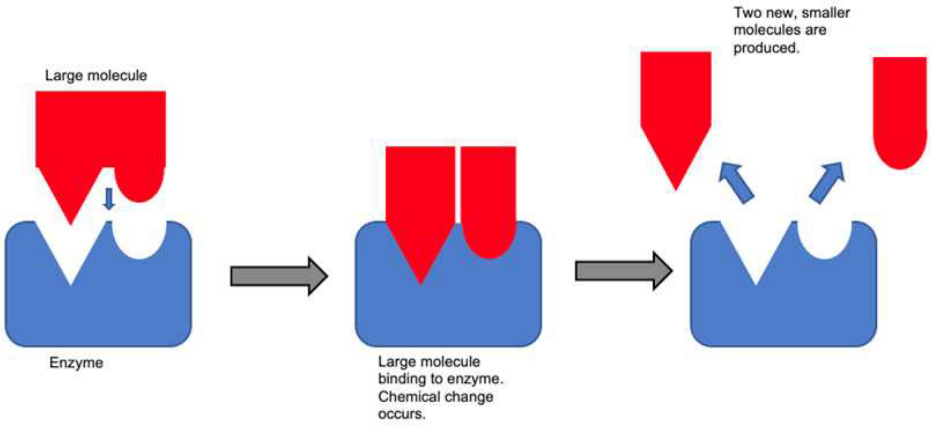
Mechanical digestion is a physical process. That is, the food particles get smaller, but no new molecules are formed. There are several organs in the digestive system that perform mechanical digestion – the mouth, stomach, and small intestine

Figure 1: Mechanical digestion



Chemical digestion is the breakdown of large molecules into smaller, simpler molecules that can be easily absorbed into the bloodstream. Chemical digestion uses **enzymes** – proteins that speed up chemical reactions. Figure 2 below depicts how enzymes work.

Figure 2: Enzyme action



Examples of enzymes used in chemical digestion include:

- Amylase, which breaks down carbohydrates into monosaccharides,
- Protease, which breaks down proteins into amino acids, and
- Lipase, which breaks down lipids (fats) into fatty acids and glycerol.

Checkpoint

Mechanical digestion is the breakdown of:

_____

The purpose of mechanical digestion is to:

_____

Mechanical digestion aids chemical digestion by:

_____

Assume the large square in Figure 1 has a surface area of 16 cm^2 and the smaller squares have a combined surface area of 64 cm^2. Calculate how many times more surface area the smaller squares have compared to the large square.

_____

_____

Define **chemical digestion**:

_____

_____

Explain why chemical digestion is necessary:

_____

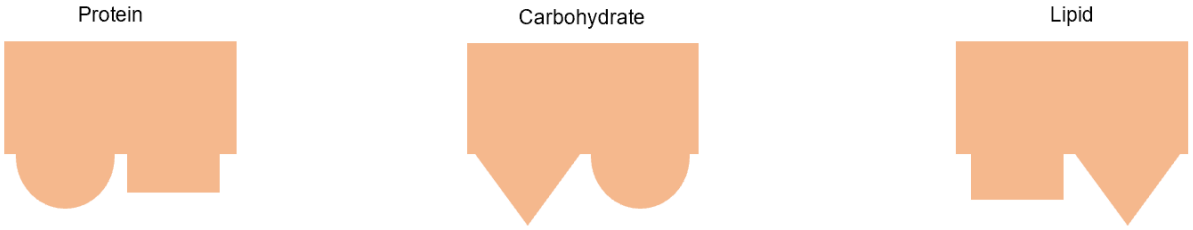
_____

_____

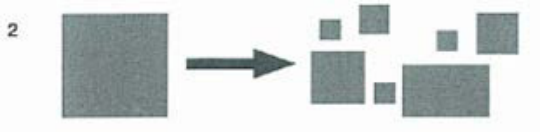
Use the correct symbol below to create a diagram similar to Figure 2 to represent the action of amylase:

_____

_____



The following five diagrams represent digestion. Propose which type of digestion each represents. Explain your decision in each case.

Diagrams	Type of digestion (tick)	Why it represents that type of digestion
1 	☐ Mechanical ☐ Chemical	
2 	☐ Mechanical ☐ Chemical	
3 	☐ Mechanical ☐ Chemical	
4 	☐ Mechanical ☐ Chemical	
5 	☐ Mechanical ☐ Chemical	

Activity: Enzymes

Enzymes are chemical helpers that we find throughout our bodies, including the digestive system. They operate inside our cells to help speed up reactions. In the digestive system, enzymes help to chemically breakdown food into simpler molecules.

Enzymes can also be found in everyday foods and materials. For example, some washing powders have enzymes in them to help breakdown dirt on your clothes. Pineapple also contains enzymes that work to breakdown protein.

Activity purpose

- To observe how enzymes chemically change substances.

Part A: Enzymes in pineapple

Jelly contains protein. This protein is in the form of the gelatin, which is what makes the jelly set firm when put in the fridge. Pineapple contains protein-digesting enzymes.

Materials

- 1 x safety glasses
- two petri dishes filled with jelly – one with nothing on top, and the other with piece of pineapple on top

Safety

- Safety glasses must be worn at all times.

Time

15 minutes

Procedure

1. Observe the two petri dishes and record your observations below.

Results

	Petri dish 1	Petri dish 2
Contains	Jelly only	Jelly and pineapple
Observations		

Explain your observations made in Petri dish 1.

_____

_____

Explain your observations made in Petri dish 2.

_____

_____

Part B: Factors affecting enzyme activity

Effect of temperature on the action of an enzyme.

Materials

- 1 x safety glasses
- water baths at various temperatures (e.g. 0°C, 20°C, 40°C, 60°C and 80°C)
- Starch solution
- Amylase enzyme
- 10 test tubes
- Iodine
- Pipettes – disposable
- Spotting tile
- Timer

Safety

- Safety glasses must be worn at all times.
- Be careful of hot surfaces and equipment.

Time

60 minutes

Procedure

1. Set up water baths at various temperatures (e.g. 0°C, 20°C, 40°C, 60°C and 80°C).
2. Add starch solution to 5 test tubes.
3. Add amylase solution to another 5 test tubes.
4. Place one starch and one amylase test tube into each water bath for 5 minutes - to allow the enzyme and substrate to reach the desired temperature.
5. Place 1 drop of iodine into each dimple on a spotting tile.
6. Add the amylase to the starch in the 0°C water bath.
7. Start the timer.
8. Every minute remove a sample of the starch-amylase solution and add it to a drop of iodine on the spotting tile.
9. Repeat step 8 until the iodine no longer changes colour - meaning that there is no starch present, in other words the amylase has broken all starch down.
10. Repeat steps 6-9 for each of the temperatures.
11. Record results.
12. Draw a graph to show the time taken for starch to be digested at different temperatures.

Practical 1.4 - Effect of temperature on the action of an enzyme - Enzymes and digestion (CCEA) - GCSE Biology (Single Science) Revision - CCEA - BBC Bitesize; citation

Results

Describe the trend in the results.

State three variables that you controlled during this experiment.

Write a conclusion for this experiment.

_____

_____

_____

At which temperature is enzyme activity optimal in the human body? Explain why.

_____

_____

_____

_____

Now watch this video to find out how pH affects enzyme activity.
pH and Enzyme Activity - YouTube

This video summarises the effects of temperature and pH on enzyme activity.
GCSE Biology - Enzymes - How Temperature and pH Affect Rate of Reaction - YouTube

Activity: Testing for nutrients in food

Your diet contains chemicals from six basic nutrient groups: carbohydrates, proteins, lipids, vitamins, minerals and water. These groups are needed in varying amounts in different people and are present in varying amounts in different foods.

Today we are going to carry out some simple tests to see what nutrients are present in a variety of foods that we consume in our regular diets.

Proteins contain the elements of carbon, hydrogen, oxygen and nitrogen. The proteins that we eat are digested into amino acids. Cells inside our bodies use these amino acids to produce new proteins that we need. Muscle cells contain a lot of protein.

Fat contains the elements carbon, hydrogen and oxygen. The fats that we eat are digested into fatty acids and another substance called glycerol. The body uses these to make different types of fat. Cell membranes contain a lot of fat.

Carbohydrates also contain carbon, hydrogen and oxygen but in different proportions to fats. Carbohydrates are digested into small sugars. Glucose is the main sugar that is produced and this is used in respiration. If more carbohydrates are eaten that can be respired, the extra is turned into fat and stored.

The word equation for respiration is:

glucose + oxygen + $\longrightarrow$ water + carbon dioxide (+ energy)

It can be shown that food is used in respiration by using radioactive markers. One type of carbon is slightly radioactive. Rats fed on glucose containing this sort of carbon are found to breather out radioactive carbon dioxide!

Activity purpose

- To test for nutrients in food.

Materials

- Food testing tile
- Test tubes
- Mortar and pestle
- Iodine solution
- Benedict's solution

- Biuret solution
- Brown paper
- Pipettes
- Bunsen burner, heat proof mat, matches
- Safety glasses
- Tongs
- Distilled water
- Food samples

Also see each set of instructions that follow.

Safety

- Safety glasses must be worn at all times.
- Any chemicals that get on the skin should be washed off immediately with cold water.
- Do not consume any foods or chemicals.

Time

60 minutes

Procedure

1. Each food sample will need to be turned into a paste/liquid. To do this place the food item into the mortar and pestle and grind, adding a little bit of distilled water to help it become a paste/liquid.
   **If the food sample is already in liquid form you DO NOT need to do this!*
2. Use the following procedures to test each food for the specific nutrient.

The test for starch (a carbohydrate)

Testing for glucose

Apparatus

- Bunsen burner
- Boiling Tube
- Tripod
- Pipette
- Heatproof mat
- Benedict's solution
- Pestle and mortar
- Food sample(s)
- Gauze
- Eye protection

Warning

Wear eye protection!

Method

1. Using a pestle and mortar, mash a small sample of food with an equal volume of water.
2. Pour the mashed food into a boiling tube.
3. Add 10 drops of Benedict's solution.
4. Place the boiling tube into a beaker of water. Heat the baker until it boils.
5. Green, yellow, and red colours indicate the presence of glucose

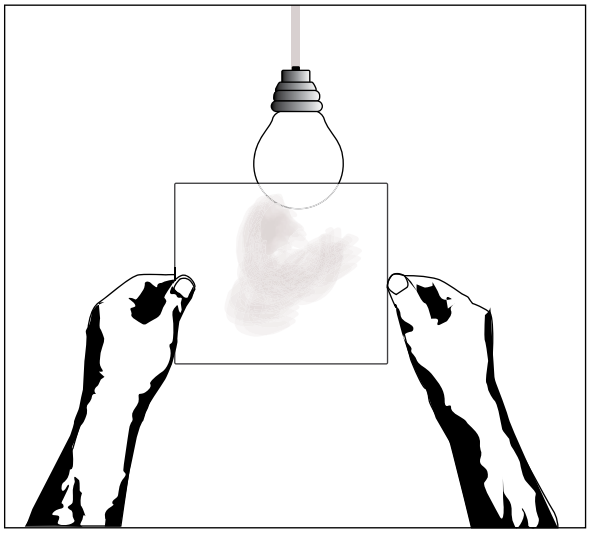
The test for fat

Apparatus

- Food Samples
- Piece of plain paper

Method

1. Take a sample of your food and rub it into the paper for 20 seconds.
2. Carefully remove the food from the paper.
3. Hold the paper up to the light. If you can see a greasy mark, fat is present.



The test for protein

Using biuret solution

Apparatus

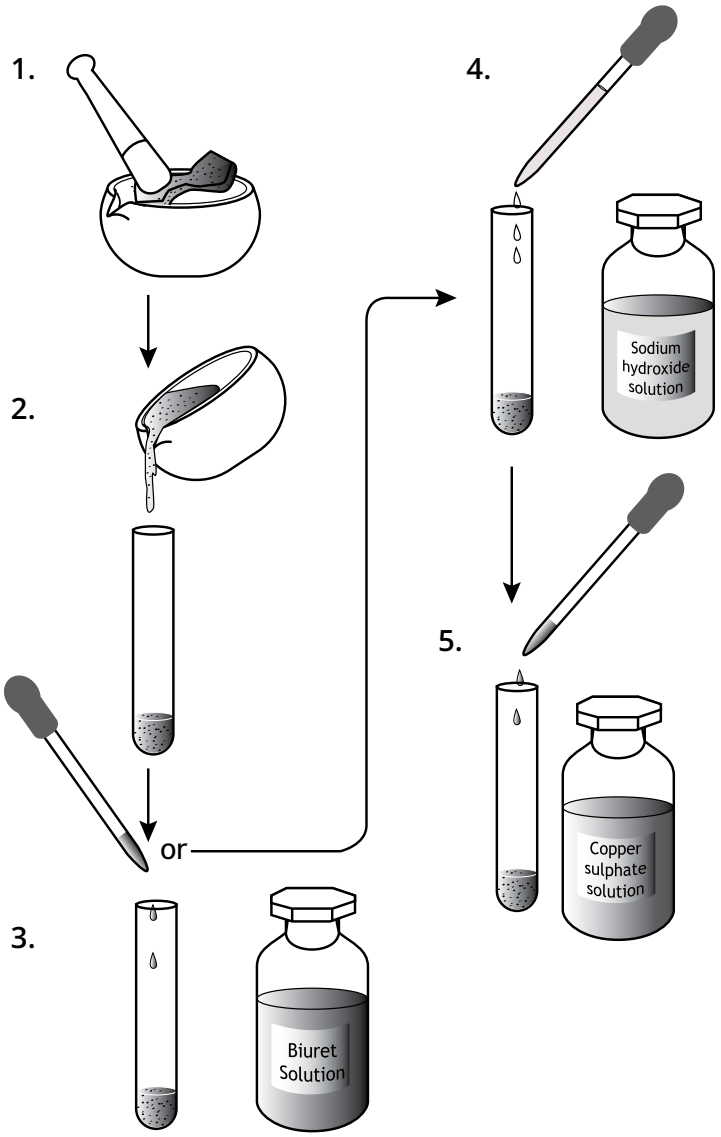
- Food samples
- Test tubes and stoppers
- Water
- Pipette
- Pestle and mortar
- Eye protection
- Biuret solution, or sodium hydroxide solution (0.4M)
- Copper sulphate solution (0.1M)

Warning

Biuret solution and sodium hydroxide can both hurt your skin. Wear eye protection!

Method

1. Using a pestle and mortar, mash a small sample of food with an equal volume of water.
2. Pour the mashed food into a test tube.
3. If you do not have biuret solution then go to step 4. Otherwise add 10 drops of biuret solution and go to step 6.
4. Add an equal volume of dilute sodium hydroxide solution.
5. Now add 10 drops of copper sulphate solution.
6. Wait for a couple of minutes.
7. If a purple colour appears, there is protein in the food.



Results

Record your observations in the table below.

Food	Sugar test (benedicts)	Starch test (iodine)	Protein test (biuret)	Fats test (brown paper)

If you had to choose one of the food samples to take on a 3 day bush walk which would you pick. Give reasons for your choice.

_____

_____

_____

Which of the food samples would you recommend people only eat in moderation. Give reasons for your choice.

_____

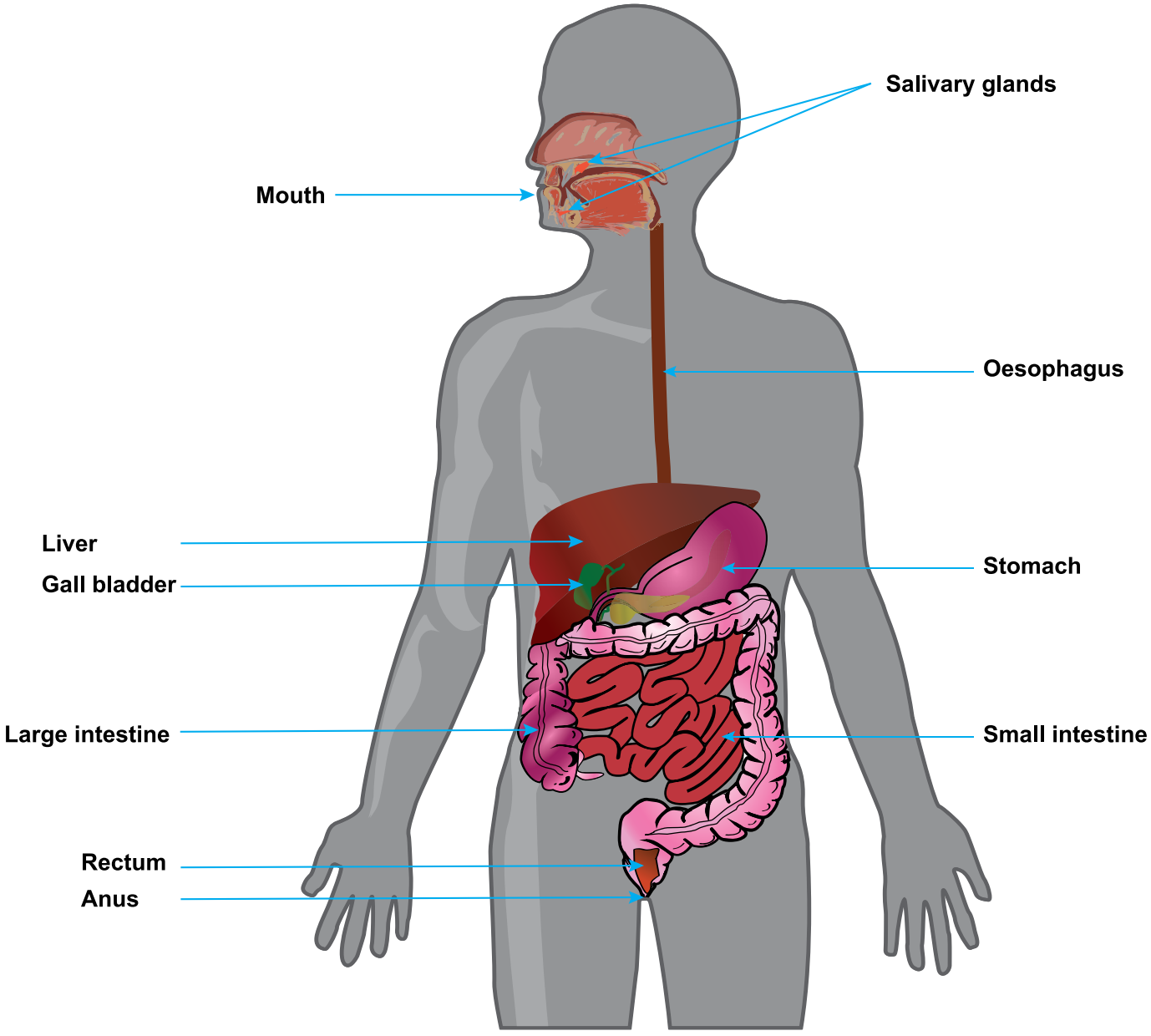
_____

_____

Organs of the digestive system

The digestive system is an organ system that ingests food and breaks it down into smaller nutrients that can be absorbed by the body. It is made up of the alimentary canal and accessory organs. The **alimentary canal**, also known as the gastrointestinal tract, is a series of organs through which food travels from the mouth to the anus. Food does not pass through **accessory organs**. However, these organs produce and secrete chemicals necessary for digestion into the alimentary canal.

Organs of the digestive system



Mouth and salivary glands

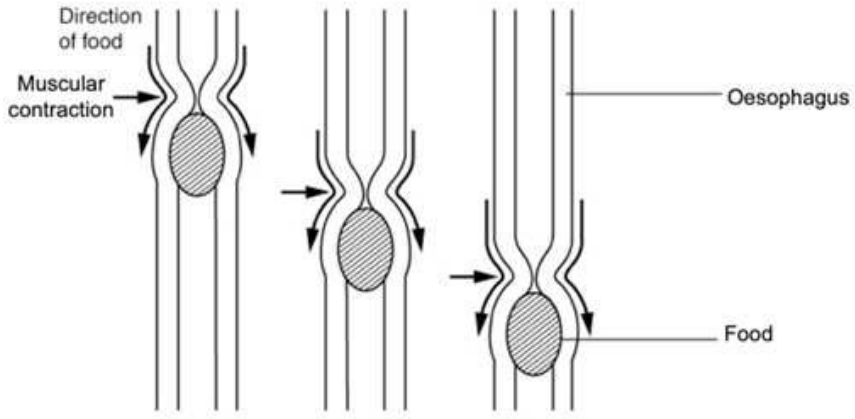
Food is taken through the mouth and digestion starts with the teeth, using mechanical digestion they start to break down the food. Salivary glands around the mouth produce and secrete saliva. Saliva has many functions; it lubricates the food allowing it to form into a soft ball shape called a bolus. It also contains an enzyme called amylase that begins the chemical digestion of carbohydrates in the mouth. Once the food is chewed into small enough pieces, the tongue shapes the broken down food into a soft ball shape and pushes it to the back of the mouth to be swallowed.

Oesophagus

Once the food is swallowed, it enters the oesophagus. This is a muscular tube that extends from the mouth to the stomach. Food moves through the oesophagus through a wave-like motion of muscular contractions called **peristalsis**. Peristalsis ensures food moves along the alimentary canal in one direction from the mouth to the stomach.

The image right shows the peristaltic movement of a bolus (soft ball of food) through the oesophagus.

Peristaltic movement of a bolus



Stomach

The bolus enters the stomach from the oesophagus. The stomach is responsible for most of the breakdown of food into smaller pieces. This is achieved through waves of muscular contractions in various directions called churning. Churning separates the food and mixes it with digestive juices until it forms a semi-liquid.

The stomach also contains hydrochloric acid that activates the enzyme protease so that the chemical digestion of protein can begin. The acid also protects the body by killing many of the pathogens present in food. The stomach wall is lined with a thick layer of mucus to protect itself from the acid and protease (otherwise the stomach would digest itself!).

Checkpoint

Name the part of the mouth that mechanically digests food. Describe how it does this.

Name the enzyme present in saliva and outline its role in chemical digestion.

Name and describe the process that transports broken-down food from the mouth to the stomach.

Circle the correct term (*text in italics*) to complete the following statements:

- The process of moving food through the oesophagus is called *peristalsis / swallowing*. This is performed by waves of muscular contractions *down / up and down* the oesophagus.
- The food then enters the stomach. Most of the *mechanical / chemical* digestion occurs here.
- The stomach mechanically digests food through waves of muscular contractions in *many / one* directions is called churning. Churning breaks apart food and mixes it with stomach *acid / juices*.
- It also chemically digests protein through the action of *lipase / protease / amylase* present in the stomach juice.

Outline one similarity and one difference between peristalsis and churning.

Small intestine, pancreas, liver and gall bladder

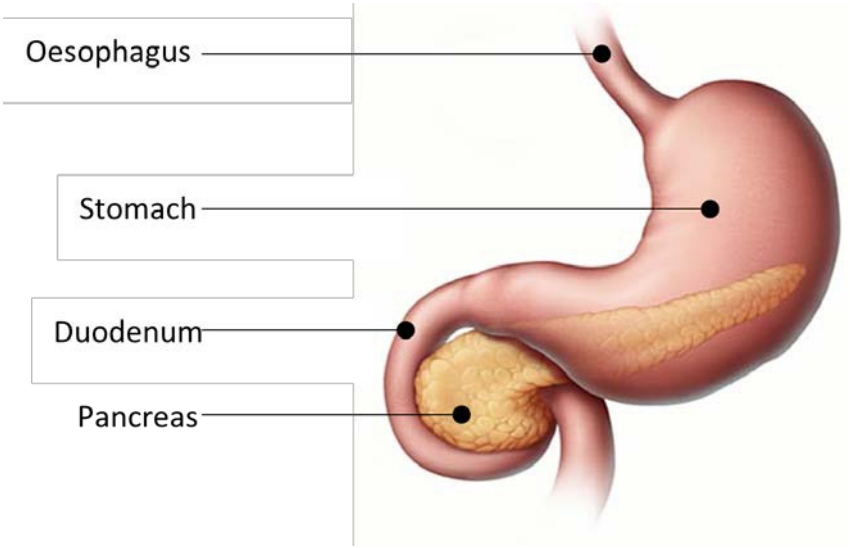
After 6-8 hours, the stomach pushes the semi-liquid food into the small intestine. The small intestine is a long muscular tube in which final digestion of food and most of the absorption of nutrients occurs.

As the food enters the small intestine from the stomach, three more accessory structures release chemicals into the small intestine to assist with digesting the food

The pancreas secretes a juice that neutralises the stomach acid. The juice also contains amylase, protease, and lipase to complete chemical digestion of the large nutrient molecules into their smaller building blocks. Amylase chemically digests the carbohydrates in the chyme, protease chemically digests the proteins, and lipase chemically digests the lipids (fats).

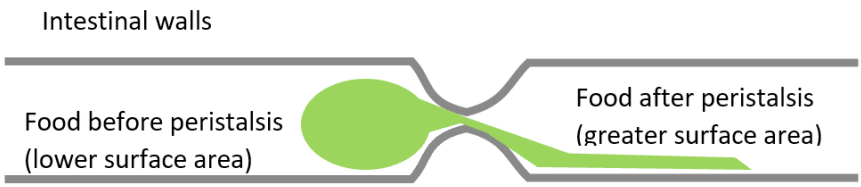
The image below shows the different structures of the stomach and surrounding organs.

Stomach and surrounding organs



The liver produces a brown liquid called bile, which is stored in the gall bladder. When chyme enters the small intestine, the gall bladder secretes bile into the small intestine as well. Bile emulsifies lipids – it separates them into smaller droplets. This is a form of mechanical digestion, as it increases the surface area for lipase to attach to lipids. The food is pushed along the length of the small intestine through the peristaltic movement. Peristalsis also mechanically digests food as it flattens the food, exposing more surface area to the bile and enzymes.

The image right demonstrates peristaltic movement in the small intestine.



Once the carbohydrates, proteins and lipids are broken down into their smaller nutrient molecules, these building blocks – along with vitamins and minerals – are absorbed into the bloodstream through the wall of the small intestine. The intestinal walls are lined with microscopic, finger-like projections called villi (singular: villus).

The image below shows the lining of the small intestine wall that is covered with villi to assist with absorption.

Villi in the small intestine

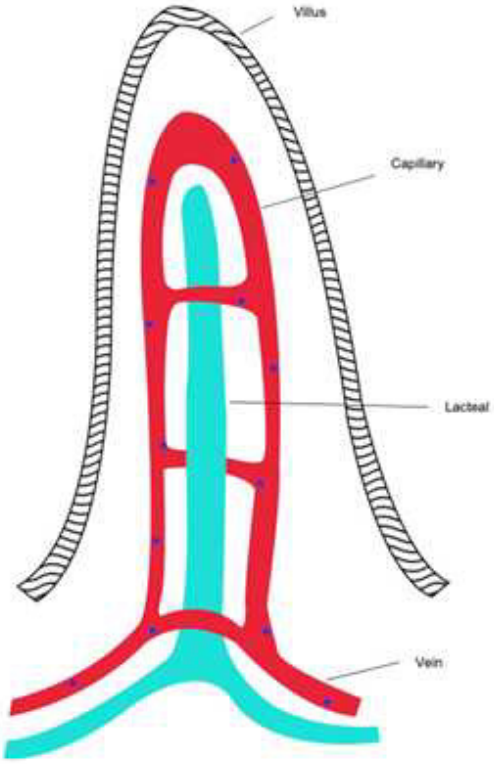
To increase the rate of absorption, villi:

- are one cell thick – this gives a short distance for nutrients to travel to the blood.
- are surrounded by capillaries into which nutrients are absorbed and carried to where they are needed by the cells.
- contain a lacteal, a lymphatic vessel that absorbs fatty acids and glycerol.

After the nutrients are absorbed, the indigestible material remaining in the small intestine moves into the large intestine.

The image right shows the structure of a villi in the small intestine.

Cross-section of a villus



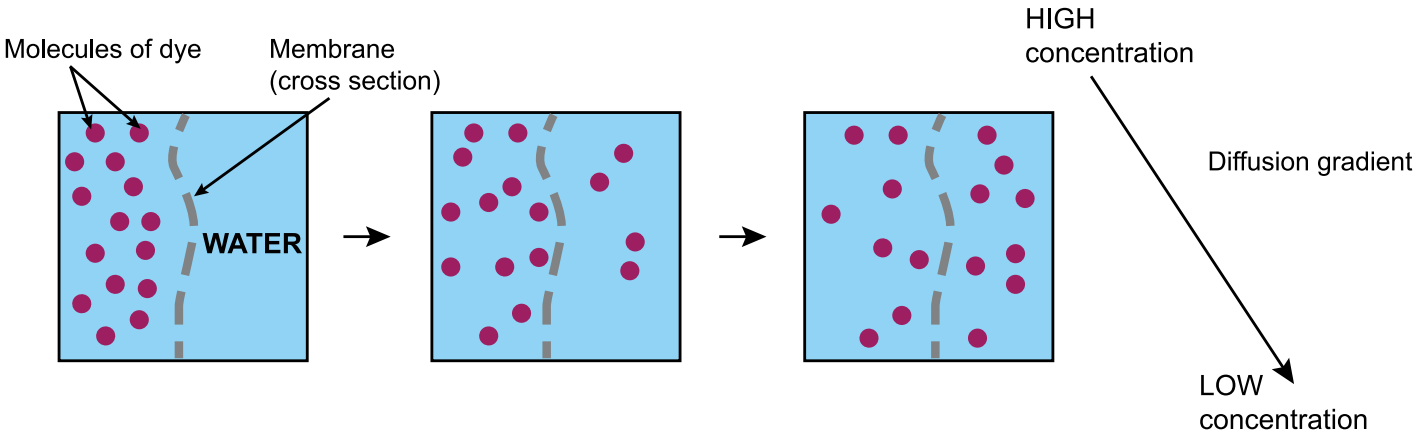
Types of transport of materials across membranes

As all cells are living things they must let certain materials enter and leave the cell to function properly. Nutrients are gained from the environment around the cell and will move across the cell membrane into the cell. Oxygen, water, glucose, amino acids, and other materials (e.g. vitamins and minerals) are all examples of substances that move into the cell. Waste materials, like carbon dioxide and urea, must be moved out of the cell to maintain cell function.

There are two main ways materials move across a cell membrane. These are by **passive** or **active** processes.

All molecules in a solution move around as they have **kinetic energy**.

As there are many molecules, all travelling in random directions, there are millions of collisions every second. This results in the molecules in a solution spreading out to take up the available space. This process is called diffusion.



Passive transport processes do not require any extra energy. This is because substances move down the concentration gradient. Substances are moving from an area of high concentration to low concentration.

Active transport processes do require extra energy. This is because substances move up or against the concentration gradient. Substances are moving from an area of low concentration to high concentration.

Checkpoint

Fill in the blanks.

Transport across the cell membrane can be _____ .

_____ require energy, because substances move _____ the concentration gradient, from areas of _____ concentration to areas of _____ concentration.

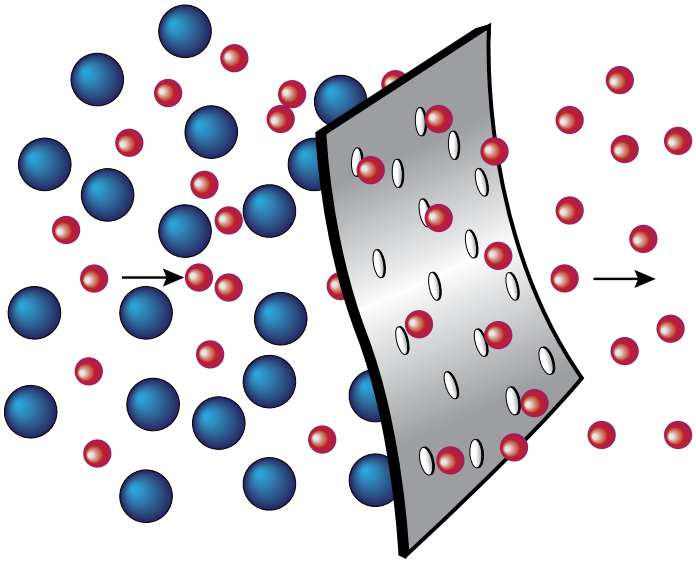
_____ require energy, because substances move _____ the concentration gradient, from areas of _____ concentration to areas of _____ concentration.

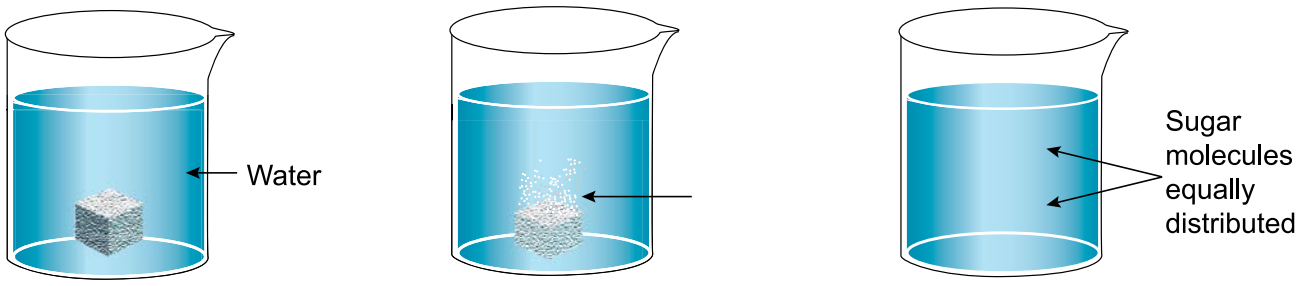
Passive processes

The cell membrane controls how materials move into or out of a cell. How does it do this?

The cell membrane is what we call selectively permeable. This means that it allows some substances to easily move across it, but not others.

For example, when a sugar cube is put in a glass of water, it will dissolve and the sugar molecules will spread slowly throughout the water as a result of random movement until the sugar molecules are evenly spread out in the glass of water.





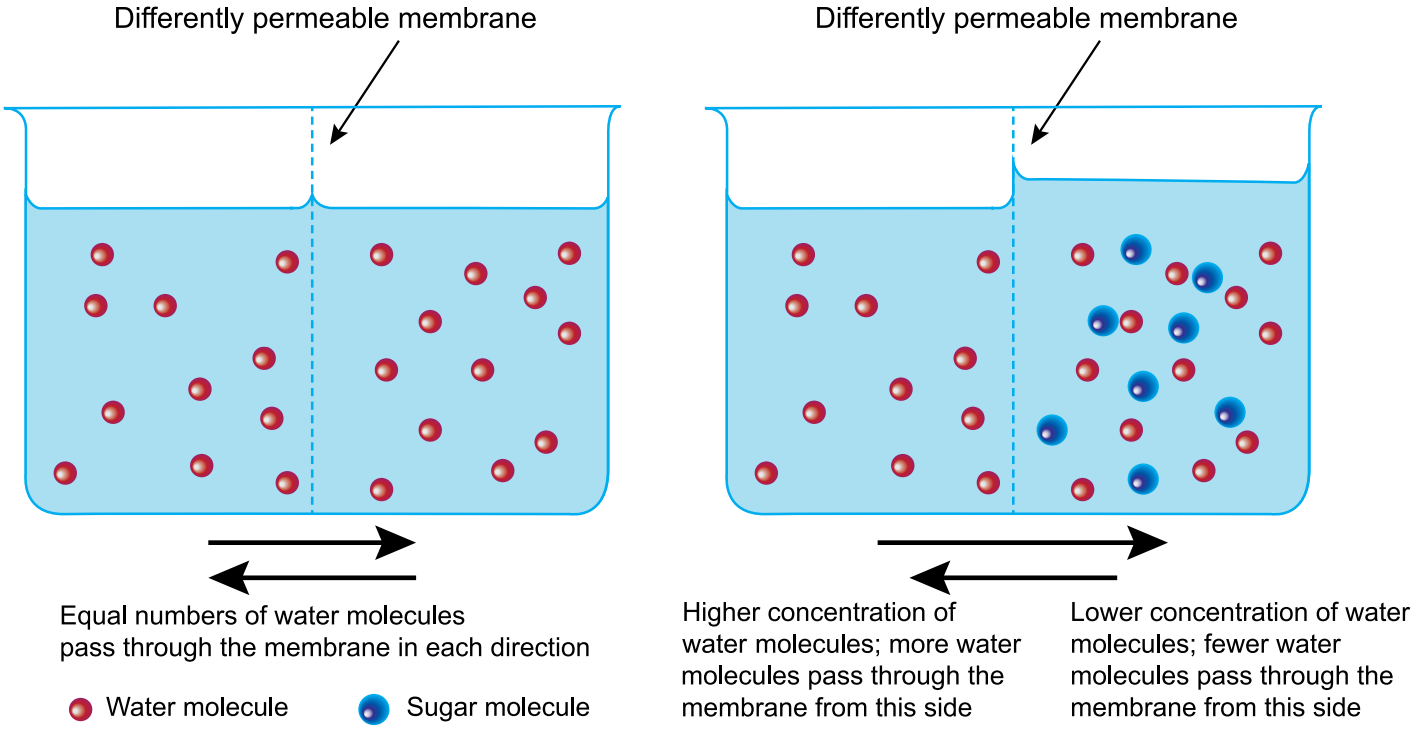
a) Sugar cube when placed in water b) Sugar cube slowly dissolves c) Sugar cube completely dissolves

Diffusion is the movement of a substance from and area of high concentration to an area of low concentration so that the molecules become evenly spread out. For example, as oxygen is used up

inside the cell, molecules of oxygen diffuse into the cell from the higher concentration of oxygen outside. As carbon dioxide is produced in the cell, the concentration of carbon dioxide becomes higher than outside and carbon dioxide diffuses out.

Cell membranes are **selectively permeable** and small molecules like oxygen and water can move through easily but larger molecules like glucose or proteins are not able to pass through easily.

Osmosis is a special type of diffusion involving the movement of **water.** Water moves across a selectively permeable membrane from a 'more watery' area to a 'less watery' area. The selectively permeable membrane allows water through but holds back large molecules like sugars and proteins. It acts as if it has tiny holes in it that are too small for the larger molecules to pass through, as can be seen in the diagram below.



Active processes

Active transport involves the movement of substances across a cell membrane from a lower to a higher concentration, which is the opposite direction from that in which diffusion would occur. This type of transport is described as active because the cell must supply **energy** for the process to occur.

Endocytosis

Some substances such as large molecules like white blood cells are too big to be moved through the membrane. A cell may surround some outside material with a fold of the cell membrane. The membrane folds to form a **vesicle**, a liquid filled sac. This process requires the cell to expend energy to form the vesicle and is an **active process**.

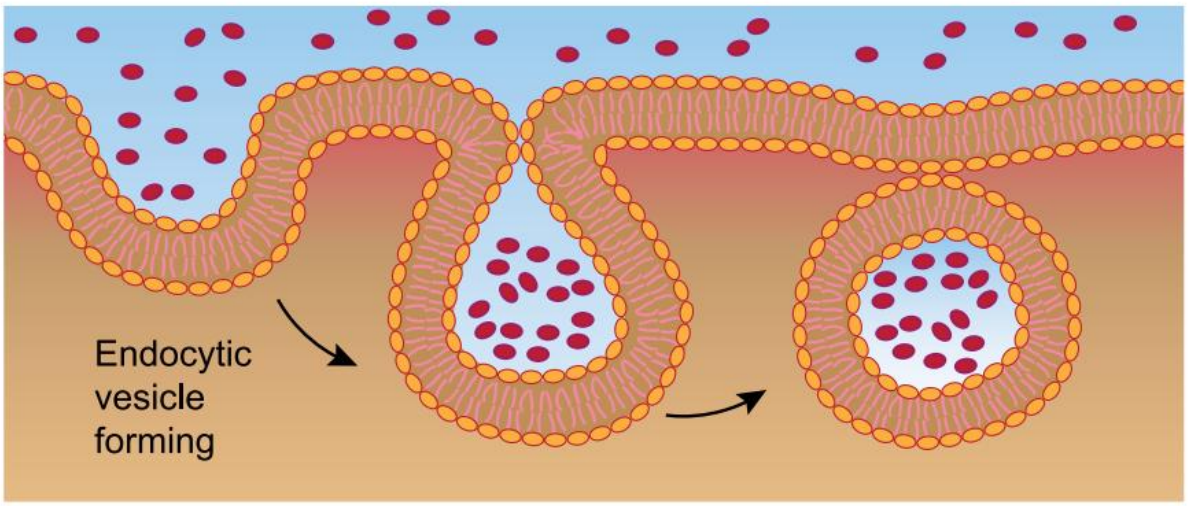
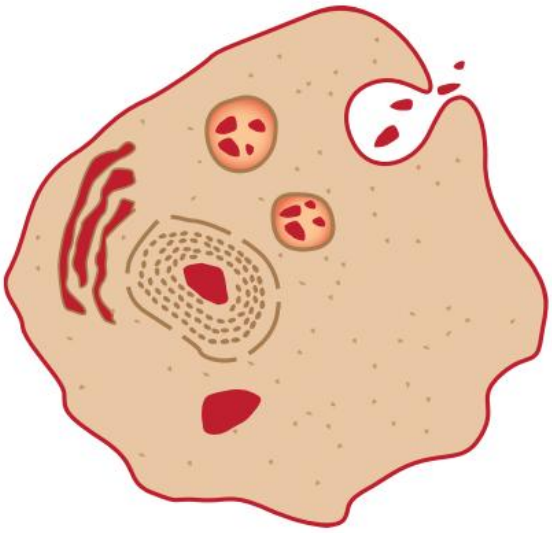
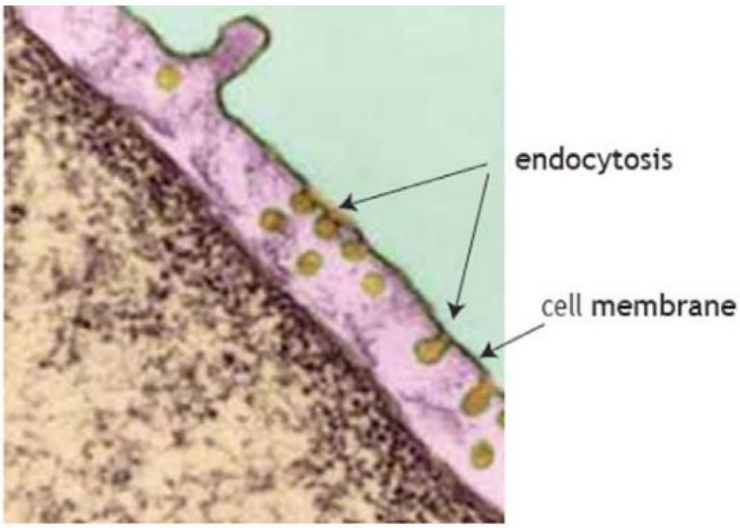


Diagram showing the process



Electron micrograph showing endocytosis



Checkpoint

Summarise how each of the following transport processes move materials across the cell membrane.

Diffusion _____

_____

_____

Osmosis _____

_____

_____

Active Transport _____

_____

_____

Endocytosis _____

_____

_____

Activity: Exchange of materials

A cell must have a means of obtaining its needs from its surroundings and remove its wastes to continue to function. In the activity you will investigate two of the processes, diffusion and osmosis.

Activity purpose

- To observe how materials move into and out of the cell.

Part A: Diffusion

Materials

- 1 x safety glasses
- 1 x gas jar
- 1 x 20 cm piece dialysis tubing
- 1 x 10 mL measuring cylinder
- distilled water
- concentrated ammonia solution
- 1 x dropper bottle universal indicator

Safety

- Safety glasses must be worn at all times.
- Do not inhale fumes from ammonia solution it may cause illness.

Procedure

1. Pour distilled water into the gas jar until it is about ¾ full, then add 1 mL of concentrated ammonia solution.
2. Tie a knot in one end of the dialysis tubing.
3. Wet the tubing with water so you can easily open the end of the tubing.
4. Fill the tube with water to within 5 cm of its open end.
5. Add universal indicator drop by drop to the tube contents until it has a recognisable colour.
6. Tie a knot in the open end of the tubing.
7. Wash the resulting 'sausage' in water to remove any chemicals that may be stuck the outside.
8. Immerse the tubing containing the universal indicator solution to the ammonified water.

Results

Record any changes you observed in the contents of the jar and tubing.

Name the material that represents the cell.

Name the material that represents the cell membrane.

Name the material that represents the liquid in which the cell lives.

Questions

Explain the change in the universal indicator.

Explain how this colour change in the tube occurred.

Suggest a reason for the universal indicator not moving out of the dialysis tubing.

Part B: Osmosis

Materials

- 4 x de-shelled fresh eggs*
- 250 g table salt
- 200 mL distilled water
- 200 mL 0.1 M salt (NaCl) solution
- 4 x 250 mL beakers labelled A, B, C and D
- balance
- paper towel
- digital camera (optional)

**Eggs can be de-shelled by leaving them in vinegar overnight. Make sure the whole egg is immersed to remove all of the shell. The skin-like membrane will hold the egg together.*

Procedure

The experiment requires eggs to be treated in a different ways under controlled conditions. Accurate recording of the mass of each egg at the start of the experiment and then its mass at the end of the experiment is very important. Handle the eggs very carefully as things could get messy, egg membranes are easily broken.

1. Weigh each egg and record its mass in the table column 1.
2. Egg A - place some of salt crystals in the base of Beaker A making a hollow in the middle. Place the egg into the hollow and cover it with more salt. Make sure none of the egg is showing above the salt.
3. Egg B - gently place the egg in Beaker B and cover with distilled water.
4. Egg C - gently place the egg in Beaker C and cover with 0.1 M salt solution.
5. Egg D - carefully wrap the egg in plastic wrap and place in Beaker D.
6. Cover each beaker tightly with plastic wrap.
7. Leave eggs overnight in a location where they will not be disturbed.

The Next Day:

1. Remove the eggs CAREFULLY from each treatment. Gently wash off the excess salt from the egg in beaker A and dab the eggs with paper towel to remove excess water.
2. Re-weigh each of the eggs and record its mass in the column 2.
3. Calculate the amount of water lost or gained by finding the mass difference between column 1 and column 2.
4. Record the difference in the column 3.
5. Calculate the percentage water loss/gain using the following formula and write your answers in column 4.

Percentage weight change formula

$$\text{percentage change} = \frac{\text{mass column 3}}{\text{mass column 1}} \times 100$$

Results

Record observations of any visible changes that have occurred to the eggs in the Table below. Digital photos may be useful for the collection of extra supporting data.

Complete the table: Observations of eggs in different treatments.

Treatment	1. Starting mass of egg (g)	2. End mass of egg (g)	3. Amount of water lost / gained (+/-g)	4. Percentage mass change +/-(%)
A. Egg in salt crystals Observations:				
B. Egg in distilled water Observations:				
C. Egg in 0.1M salt solution Observations:				
D. Egg in plastic wrap Observations:				

Questions

Why was the original mass of the eggs recorded?

_____

Provide a reason for Egg D being included in the experiment.

_____

Describe the changes that occurred to the salt that was packed around Egg A.

State which substance moved, and explain its movement in the treatment of Egg A. Include evidence from your results to justify your answer.

State which substance moved, and explain its movement in the treatment of Egg B. Include evidence from your results to justify your answer.

State which substance moved, and explain its movement in the treatment of Egg C. Include evidence from your results to justify your answer.

State which substance moved, and explain its movement in the treatment of Egg D. What evidence do you have for your answer?

Which treatment showed the greatest percentage change in weight? Explain why.

Why was the percentage change calculated for each egg?

Compare the percentage change of eggs in similar treatments from the other groups. Explain any differences between the results.

State the type of membrane that surrounds the egg. List the materials that can pass across this membrane.

Predict what would happen if Egg B was placed into the salt crystals in Beaker A. Explain your answer.

Use a diagram to show the movement of materials across the membrane of the egg.

Summary

In the Part A experiment the substance which moved was ammonia. In a living cell what kinds of materials would enter or leave? List as many as you can.

_____

_____

_____

_____

Our kidneys use osmosis to remove excess fluid from our blood. Describe another example in the human body where osmosis takes place.

_____

_____

_____

_____

Conditions affecting the digestive system

The function of a healthy digestive system is to break down food into smaller nutrients and molecules and to absorb as many nutrients as possible. However, complications to this system may have unwanted side effects like diarrhoea and constipation.

Diarrhoea

Diarrhoea is the condition in which the faeces is eliminated frequently and in liquid form. It is often caused by pathogens such as bacteria or viruses. An example of a common bacterial infection is *salmonella* present in raw chicken. When a pathogen is present, the body recognises the threat and increases the rate of peristalsis through the intestines. This reduces the time available for absorption of nutrients and water to occur. Diarrhoea can also be caused by food intolerances (e.g. gluten or lactose), bowel cancer, and irritable bowel syndrome (IBS).

Constipation

Constipation is a condition in which eliminating faeces is often difficult and painful, and the faeces is usually hard or dry. Constipation occurs when the rate of peristalsis through the intestines is reduced. This increases the time available for water to be absorbed from the excess material.

Constipation can be caused by a lack of insoluble fibre in the diet. The insoluble fibre is called cellulose, a carbohydrate found in plants for which humans have no enzyme to break down. Thus, it remains in the intestines and stimulates peristalsis. Constipation can also be caused by a lack of exercise, insufficient water intake or tumours in the large intestine that obstruct the faecal matter.

Checkpoint

Describe diarrhoea.

_____

_____

Explain why the rate of peristalsis increased when a person has diarrhoea.

_____

_____

_____

List four possible causes of diarrhoea:

1. _____

2. _____

3. _____

4. _____

Describe constipation.

_____

_____

Explain why a reduced rate of peristalsis results in constipation.

_____

_____

_____

Explain how a diet high in vegetables can prevent constipation.

_____

_____

_____

A common digestive problem suffered by many people in our society is gluten intolerance and coeliac disease.

Find out what types of food and drinks have gluten in them.

_____

_____

_____

_____

_____

_____

Describe the symptoms suffered by someone who has gluten intolerance who has eaten food containing gluten.

Activity: Digestion

Activity purpose

- To simulate the digestive process.

Safety

- Safety glasses and gloves must be worn.
- Take care when handling sharp objects and chemicals.

Time

60 minutes.

Materials

Per group of 3

- 1 slice of bread
- plastic knife
- cutting board
- small ziplock plastic bag
- 25 mL 0.1 M Hydrochloric acid (HCl)
- 50 mL 0.1 M Sodium bicarbonate ($NaHCO_3$)
- 1 mL pepsin solution (a type of protease)
- 1 mL trypsin solution (a type of protease)
- 1 mL amylase solution
- gauze square
- filter funnel
- funnel stand
- 200 mL beaker
- light microscope
- 2 plain slides and cover slips
- 2 small sticky labels

Procedure

1. Chop the carrot with the knife on the chopping board. Keep all the pieces together.
2. Use the flat blade of the knife to squash the chopped carrots.
3. Scrape the carrots from the board into the ziplock bag.

4. Pour the 25 mL of HCl into the ziplock bag.
5. Add 1 mL pepsin solution to the bag.
6. Seal the bag carefully so it doesn't leak.
7. Massage the bag for 3 minutes to mix the acid and pepsin with the carrot.
8. Carefully open the bag and pour in the 50 mL of $NaHCO_3$.
9. Add 1 mL trypsin and 1 mL amylase.
10. Seal the bag carefully so it doesn't leak.
11. Massage the bag for 5 minutes to mix the alkali and enzymes with the carrot.
12. Set up the filter apparatus with 3 layers of gauze in the funnel. Make sure it is two layers of gauze material NOT three pieces of gauze.
13. Gently pour the contents of the ziplock bag into the gauze in the funnel. **BE CAREFUL** not to let the content overflow the gauze.
14. Take a sample of the filtrate from the beaker and place it on a microscope slide.
15. Label this Slide A.
16. Take a sample from the material left in the gauze (residue) and place it onto another microscope slide.
17. Label this Slide B.
18. View the slides under the light microscope at medium and high power.
19. CLEAN UP AND PUT THINGS AWAY.

Questions

What do the following steps in the procedure represent in the digestive system?

1. Chopping and squashing the carrot.
2. Scraping carrot from the board into the bag.
3. Adding HCl and pepsin to the bag.
4. Massaging the bag for a few minutes.
5. Adding the alkali, trypsin and amylase.
6. Filtering the contents of the bag.

_____

_____

Describe the change in the appearance of the carrot during the procedure.

_____

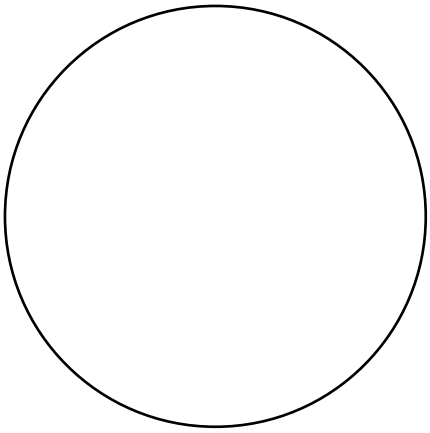
_____

_____

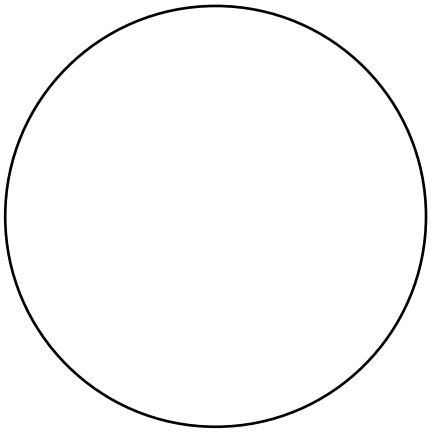
_____

Draw diagrams of the microscopic view of the filtrate and residue of the carrot.

Slide A: Filtrate



Slide B: Residue



What was the main difference between the filtrate and the residue?

_____

_____

_____

_____

In the body, what would happen to the 'residue'?

_____

_____

_____

_____

Activity: Digestive system model

Use the following website to construct a model digestive system.

https://gizmos.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=1050

Activity purpose

- Design and create an abdominal model that shows as many organs of the digestive system as possible.

Safety

- Take care when handling sharp objects.

Procedure

Your model must be:

- be three-dimensional.
- contain as many organs of the digestive system as possible.
- have every organ clearly visible and labelled.
- have organs that are detachable and interactive (Challenge!)

You may have a "torso" model in your classroom, in which the organs can be removed to show what's underneath. You can aim to produce something similar if you wish. However, your model does not need to be that accurate. Here are some ideas on how to create your model:

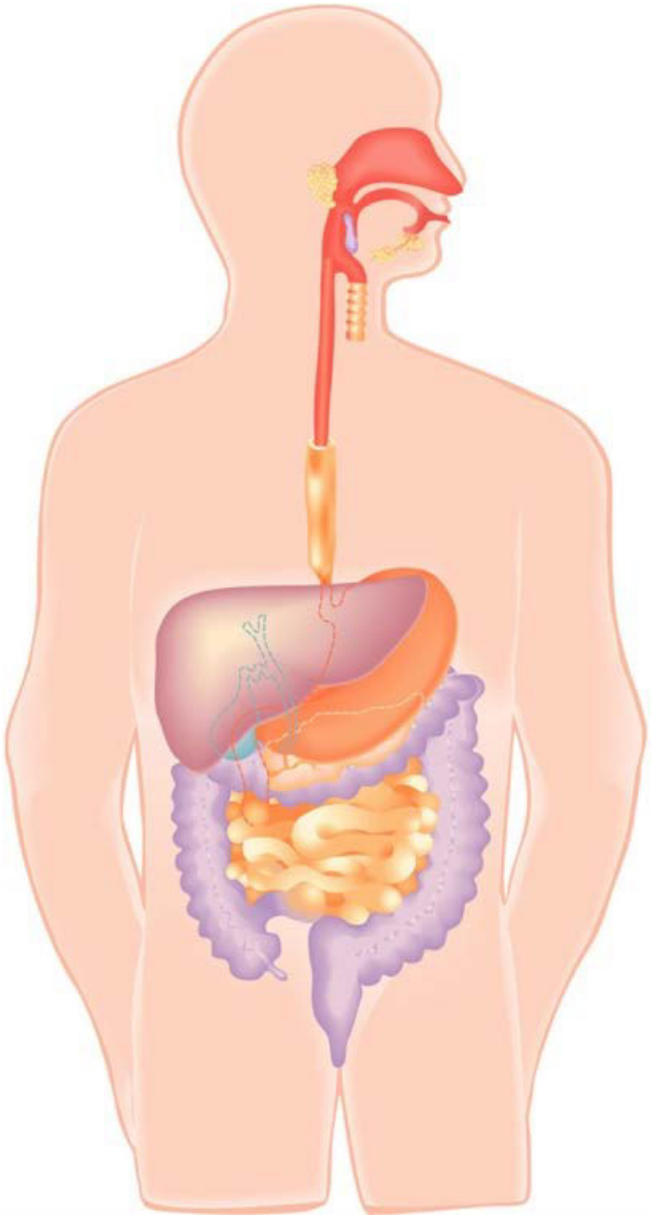
- Use stiff transparent film to create "layers" for the various organs. Each organ or organ system can be "peeled" away to reveal what's underneath.
- Use plasticine to create the organs. Colour code each organ system with different colour plasticine.
- Use various household items to create your organs, such as cardboard tube for oesophagus or a balloon for the stomach.

Be imaginative!

All models must be accompanied by a bibliography that is given in the correct format.

Your teacher may also want you to explain your model.

Be prepared to give an outline of what each organ system does. It is also possible that you might be asked to give some examples of how an organ's structure relates to its function, so be prepared to give some examples. e.g. the pancreas produces digestive juices. It has a duct (tube) running down its middle which collects and transports these juices to the small intestine i.e. its structure is related to its function.



Chapter review

Fill in the blanks:

Our body needs to break down the food that we eat so that _____

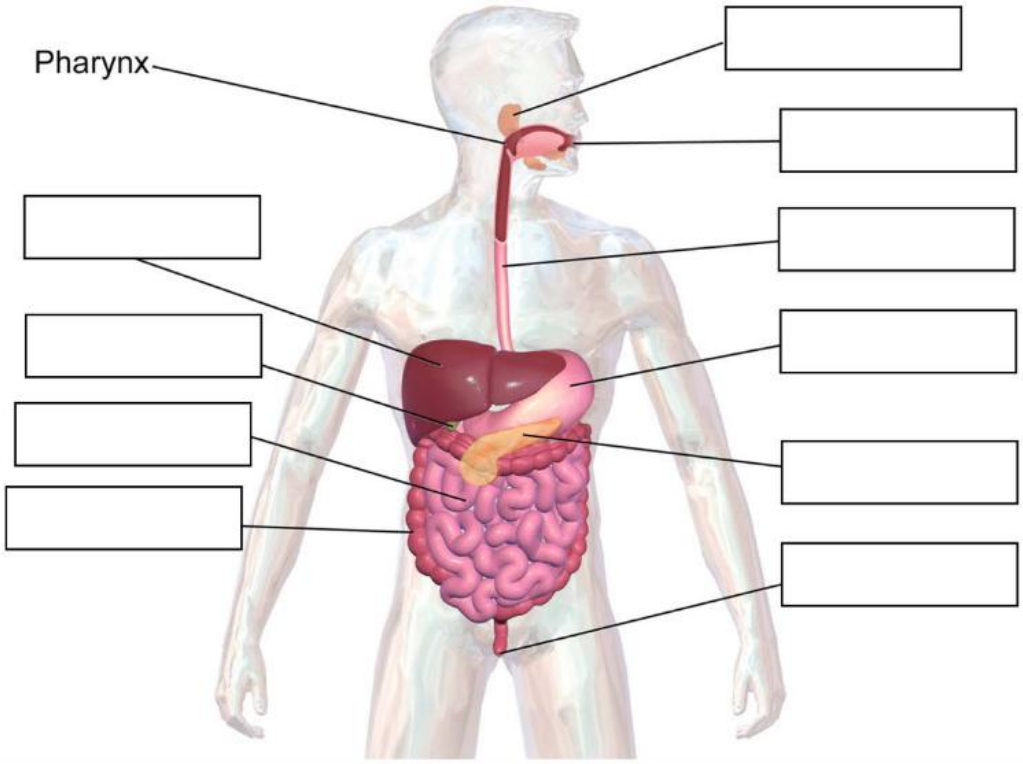
_____.

The two processes that break food down are called _____ _____ , which is the breakdown of food into smaller pieces, and _____ _____ , which uses proteins called _____ to break food into their smaller nutrient 'building blocks'.

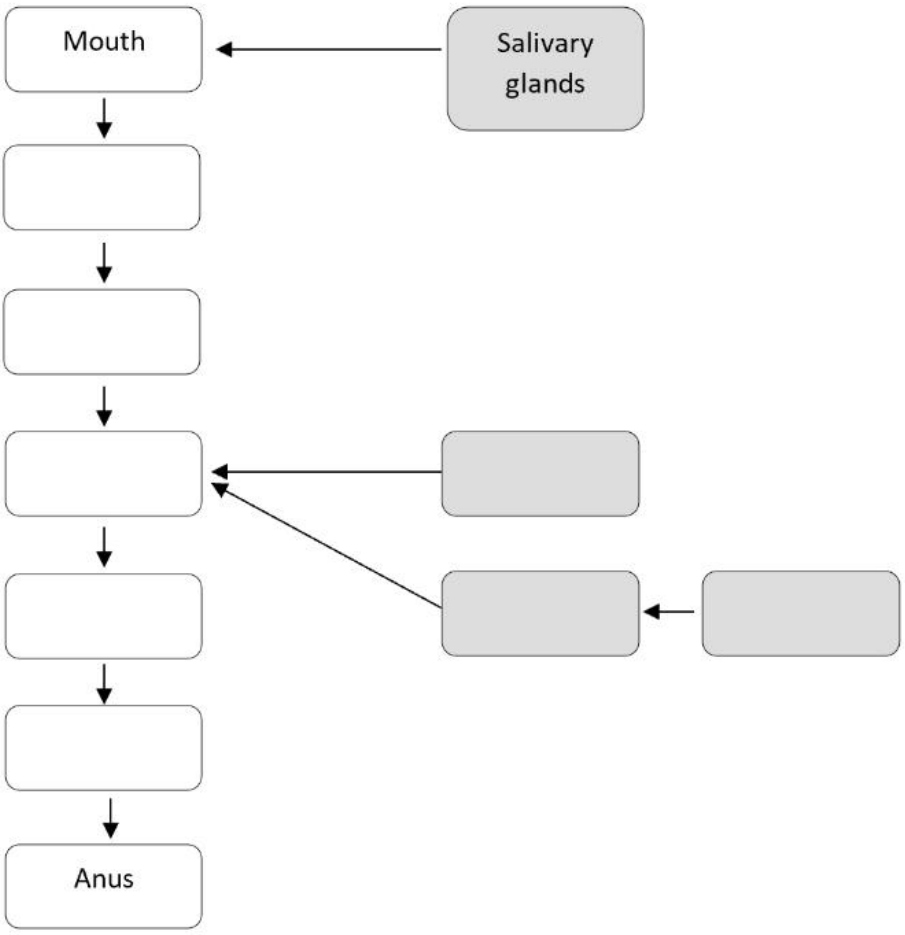
Complete the table below to summarise mechanical and chemical digestion.

Organ	Mechanical digestion	Chemical digestion
Mouth		_____ breaks down _____ into _____
	Churning separates food	_____ breaks down _____ into _____
	Peristalsis _____ _____ _____ Bile _____ _____ _____	Amylase breaks down carbohydrates into monosaccharides _____ breaks down _____ into _____ _____ breaks down _____ into _____

Label the diagram of the digestive system below.



Complete the flow chart below that summarises the path of food through the alimentary canal and the secretions from accessory organs.



Extras for experts

Research the major nutrients (carbohydrate, protein or lipids) in the foods below. Then predict the enzyme(s) listed in this section that would be activated when eating:

Potato chips

_____

Lean meat

_____

Ice-cream

_____

Egg on toasted bread (two nutrients)

_____

_____

For each scenario below, predict the most likely digestive condition that will result.

Write 'D' for diarrhoea and 'C' for constipation.

A child refuses to eat their vegetables for a week. _____

Alcohol irritating the lining of the intestines. _____

Medication that reduces the movements of involuntary muscles. _____

Chronic dehydration – the water levels of the body are often lower than normal. _____

CHAPTER 3
Musculoskeletal System

Syllabus dot points

- The support and movement of the body is facilitated by the five functions of the skeletal system (support, movement, protection, production of blood cells, storage of minerals) and the macroscopic structure of long bones.
- The location and structure of joints in the skeleton (fixed, slightly movable, freely movable) allow for a range of movement.
- Skeletal muscles work in groups around joints to bring about flexion and extension.
- Damage to muscles, bones and joints could be due to movements beyond the capabilities of the musculoskeletal system.

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. Understand that the skeletal system has five main functions.
3. Identify the location and function of joints in the skeletal system and explain the type of movement they provide for the body.
4. Understand that skeletal muscles work with other muscles in various ways to bring about desired actions at joints.
5. Understand that various activities such as sport can cause injury to muscles, bones and joints.

Success criteria

- Describe the functions of the skeletal system.
- Explain the macroscopic structure of long bones.
- Describe the five functions of the skeletal system.
- 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 how the structure of a long bone provides strength for the skeletal system.
- Give examples of antagonist pairs of muscles and describe how they work together to allow movement.
- Describe flexion and extension as movements brought about by muscles moving bones at the joints.
- State some examples of damage to muscles, bones and joints and how to manage the symptoms.

Key terms

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

Key term	Definition
Abduction	
Adduction	
Agonist	
Antagonist	
Antagonistic pairs	
Ball and socket joint	
Belly	
Bone marrow	
Cartilage	
Circumduction	
Compact bone	
Diaphysis	
Dislocation	
Epiphysis	
Extension	
Fixator	

Key term	Definition
Flexion	
Fracture	
Gliding joint	
Hinge joint	
Immovable	
Insertion	
Joint	
Ligament	
Medullary cavity	
Moveable	
Origin	
Periosteum	
Red bone marrow	
Saddle Joint	
Skeletal muscles	
Slightly moveable	
Spongy bone	

Key term	Definition
Sprain	
Synergist	
Synovial joint	
Tendons	
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.

_____

_____

_____

_____

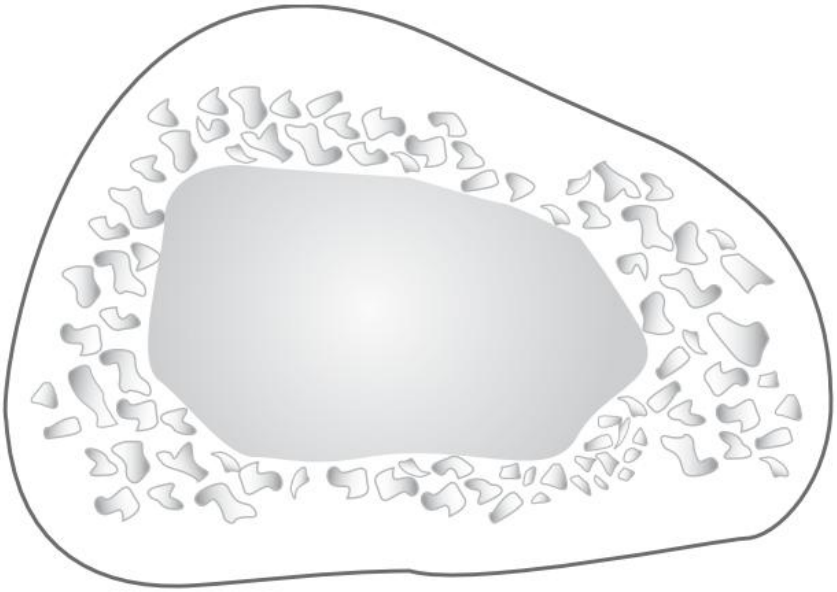
Compare the strength of compact and spongy bone based on their structure.

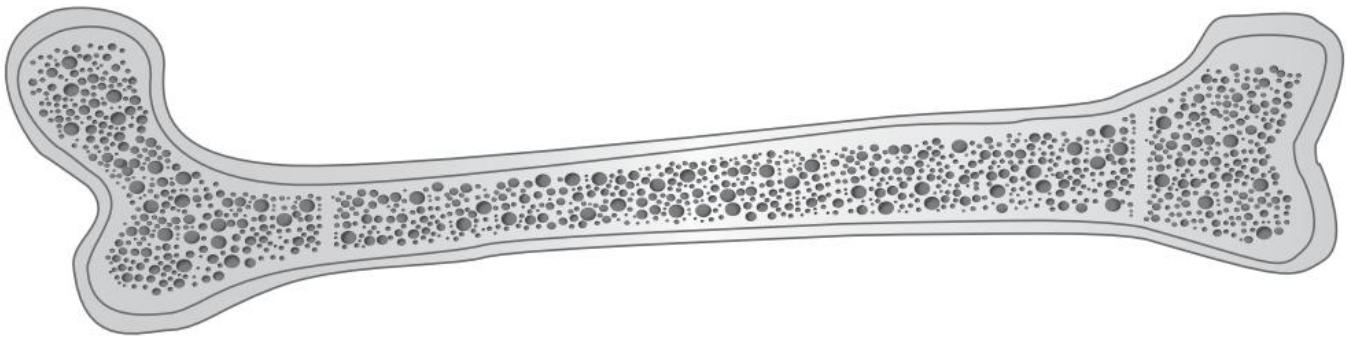
_____

_____

_____

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.

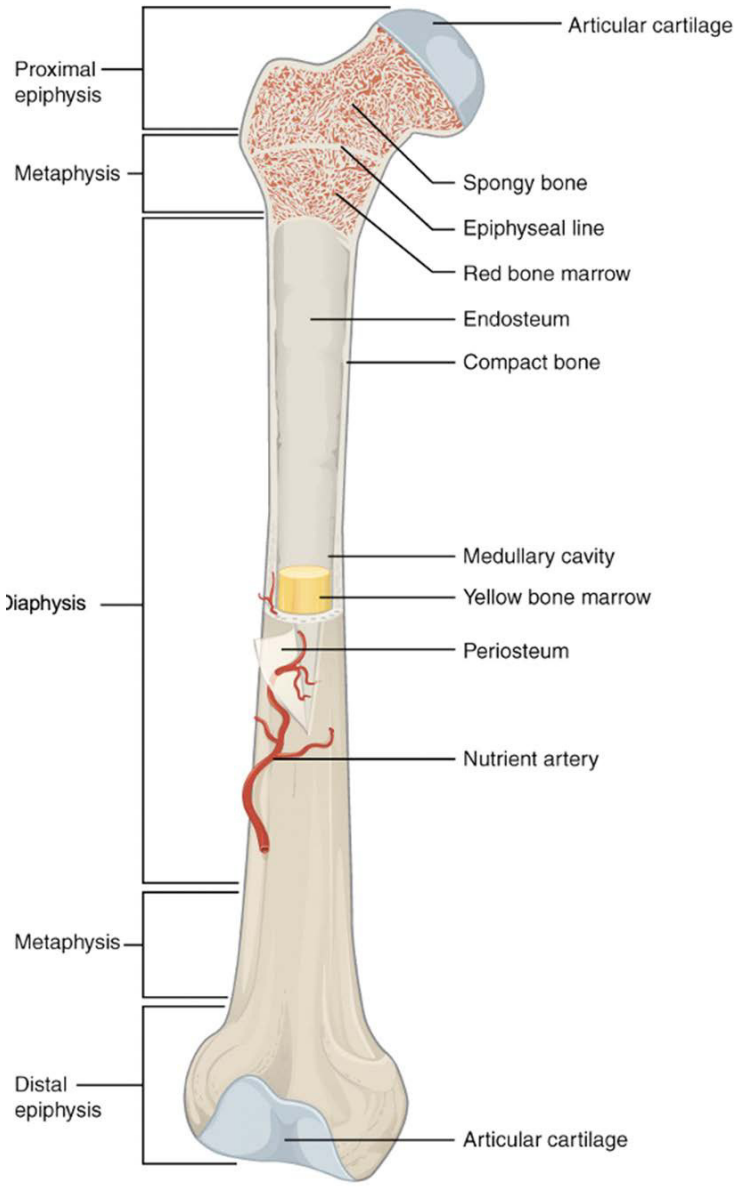




A long bone is made up of an outer layer called the **periosteum**. This layer protects the bone and supports blood vessels entering the bone. The shape of the long bone consists of a long shaft and two ends. The two ends are called **epiphysis** and are filled with red bone marrow. Covering the epiphyses 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.

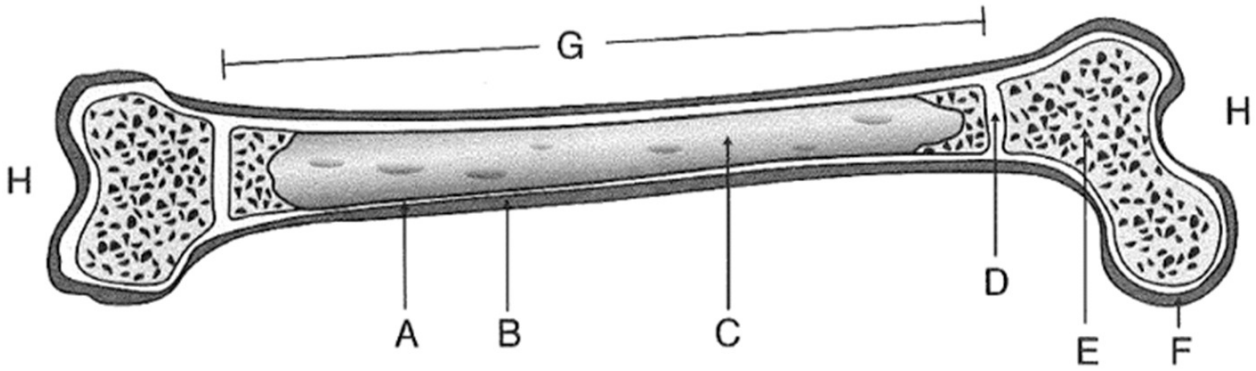
Identify the position of articular cartilage in the bone and explain its function.

_____

_____

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.

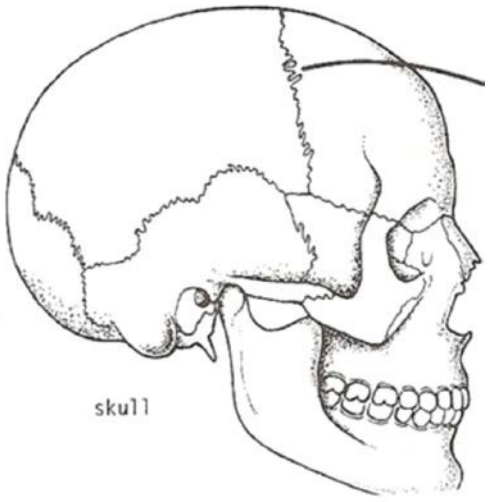
Types of joints

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

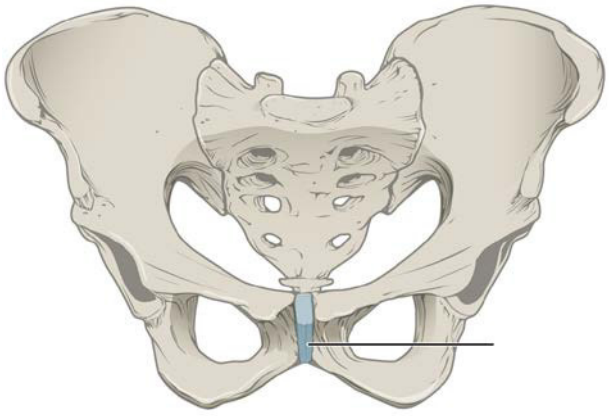
Collagen connects two or more bones that are in close contact with each other. These joints are usually immovable. For example, the cranium has sections of bone and where they join is called sutures.

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

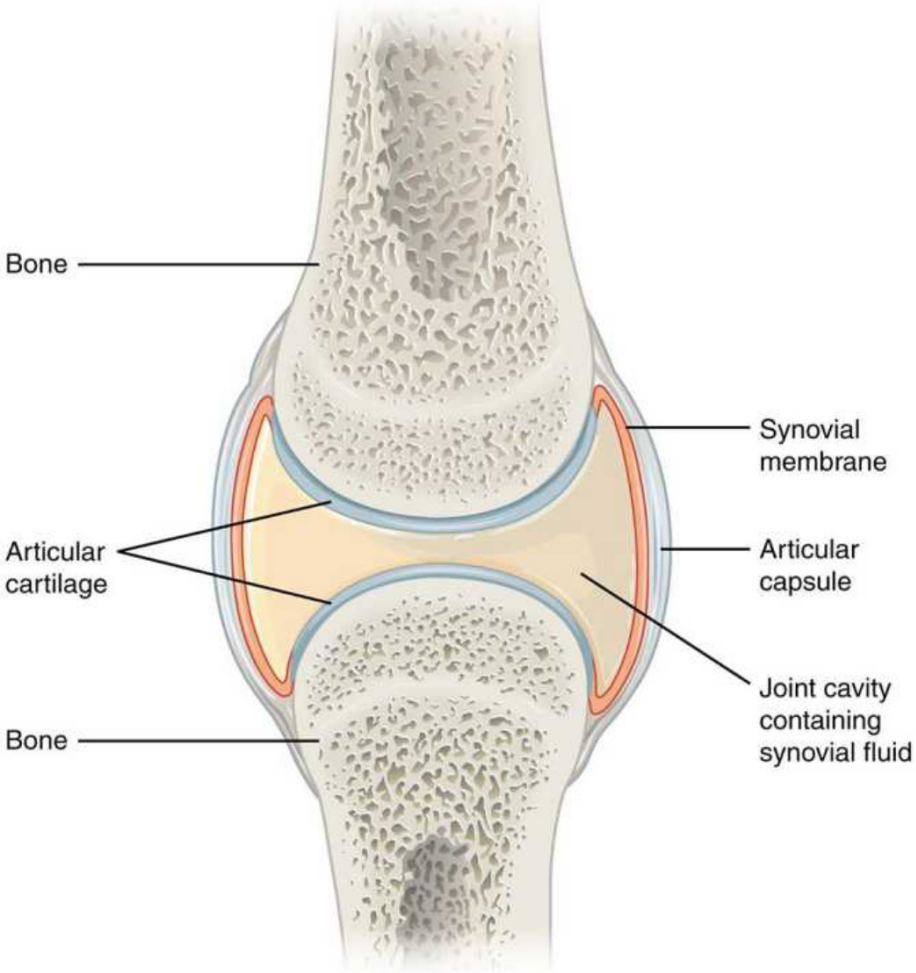
Cartilage joins two or more bones together allowing for slight limited movement. An example of this type of joint are the discs between the vertebrae and the symphysis pubis, the cartilage that joins the pelvic bones, shown in the diagram below. There must be some flexibility in these joints. For example, 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		

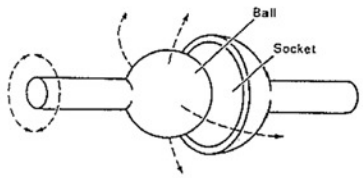
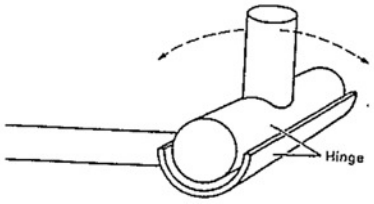
Types of synovial joints

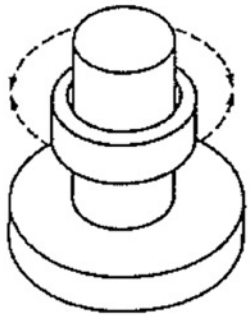
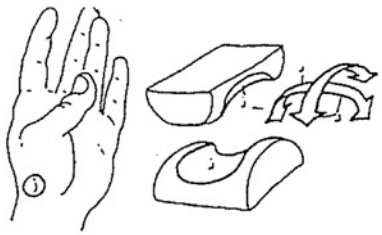
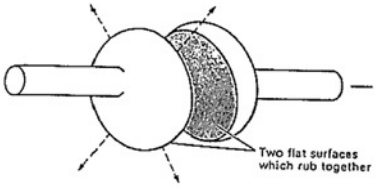
Synovial joints are further classified into six types of joints according to the movement they permit.

- **Ball and socket joint: t**he 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

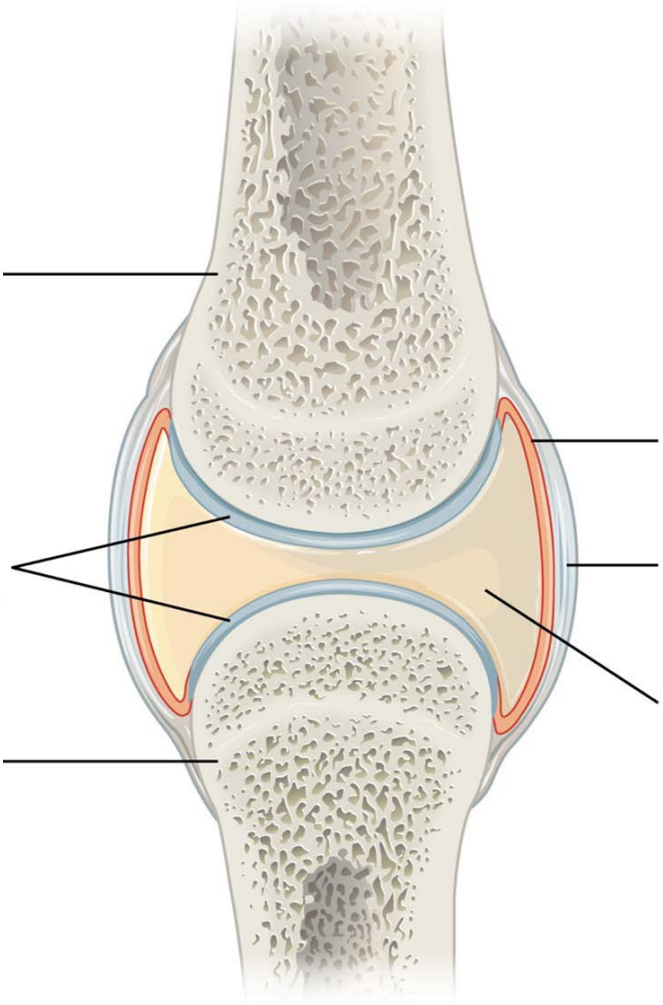
Synovial joints may contain different structures like:

- Cartilage forms a type of pad called a **meniscus**. This occurs in the knee only. The cartilage is fibrous yet smooth and slippery to enables 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 stablise 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 ulnar) and the upper arm bone (humerus). **Extension** is when the angle of the joint is increased by straightening the joint.

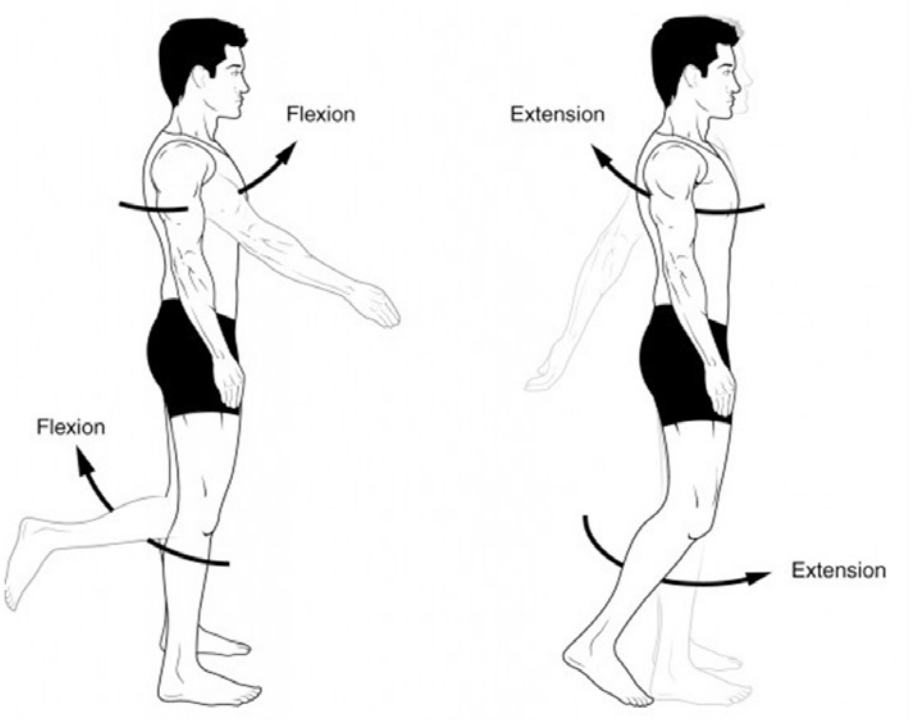
Abduction is moving the limb away from the centre line of the body. For example, moving the arm out sidewards from the body. Think of abduction as 'taking away'.

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

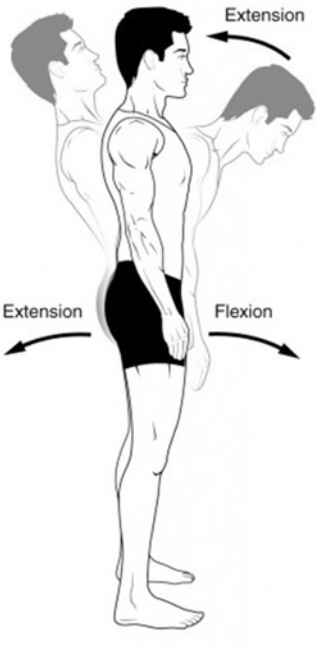
Rotation is the movement of a joint around its axis. For example, turning the head from side to side.

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.

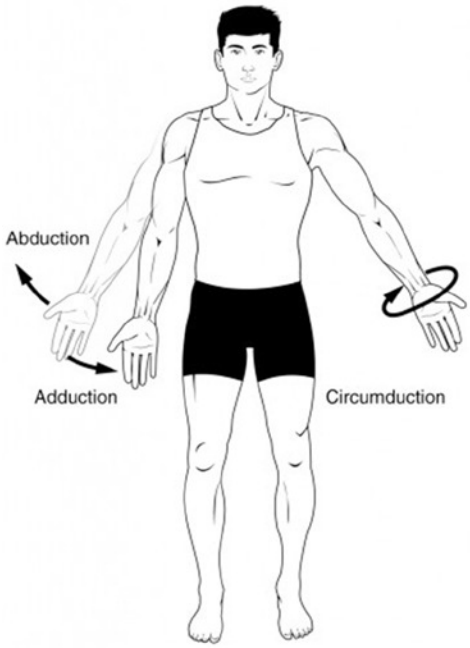
The following diagrams show the different types of body movement that utilises joints, ligaments, muscles, and tendons.



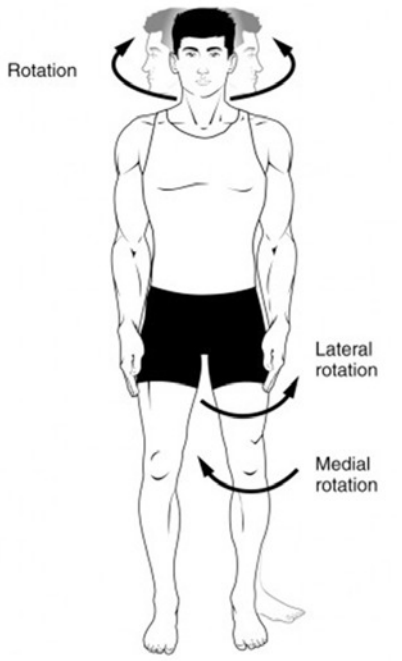
(a) and (b) Angular movements: flexion and extension at the shoulder and knees



(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 follows 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.

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

1. 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)

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.

References

- Martini, F., Welch, K., Newsome, M., Martini, F., Tranel, L., & Mills, A. (1995). *Fundamentals of Anatomy and Physiology*. Prentice Hall - Pages 185, 188, 189, 191, 192, 196, 197, 198, 200, 203, 205, 248, 270, 277, 291
- U.S. National Library of Medicine. (n.d.). *Red Blood Cell Production - Health Video: Medlineplus medical encyclopedia*. MedlinePlus. Retrieved April 24, 2022, from https://tinyurl.com/3vxxvchc
- Nursing times, skeletal system 1: the anatomy and physiology of bones https://www.nursingtimes.net/clinical-archive/orthopaedics/skeletal-system-1-the-anatomy-and-physiology-of-bones-27-01-2020/
- Contributor, N. T. (2021, August 16). *Skeletal system 1: The anatomy and physiology of bones*. Nursing Times. Retrieved April 25, 2022, from https://www.nursingtimes.net/clinical-archive/orthopaedics/skeletal-system-1-the-anatomy-and-physiology-of-bones-27-01-2020/
- Lumen Learning, L. (n.d.). Anatomy and physiology. Lumen. Retrieved April 25, 2022, from https://courses.lumenlearning.com/nemcc-ap/chapter/bone-classification/

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.

_____

_____

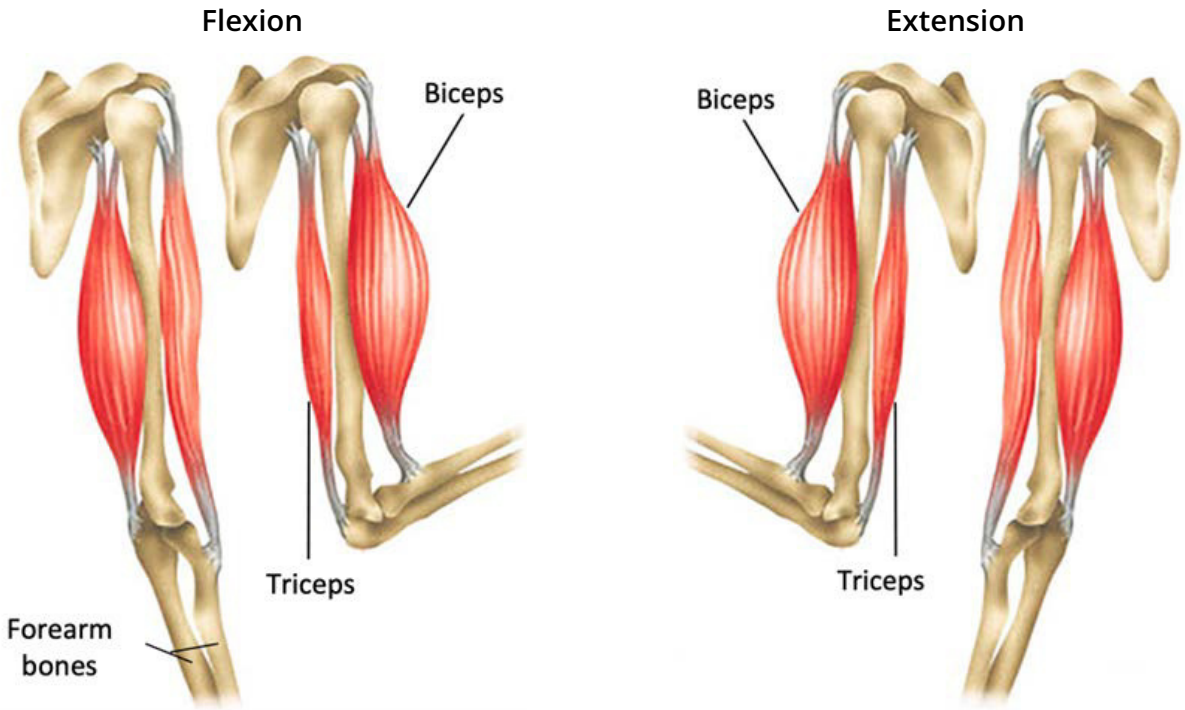
_____

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.



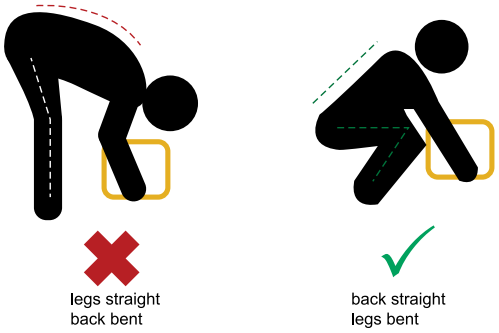
A pair of muscles that work opposite from each other i.e as one contracts the other relaxes, to produce movement around a joint are called **antagonistic pairs**, or antagonistic muscles. The muscle that contracts to perform the desired action is called the **agonist**. The muscle that relaxes when the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

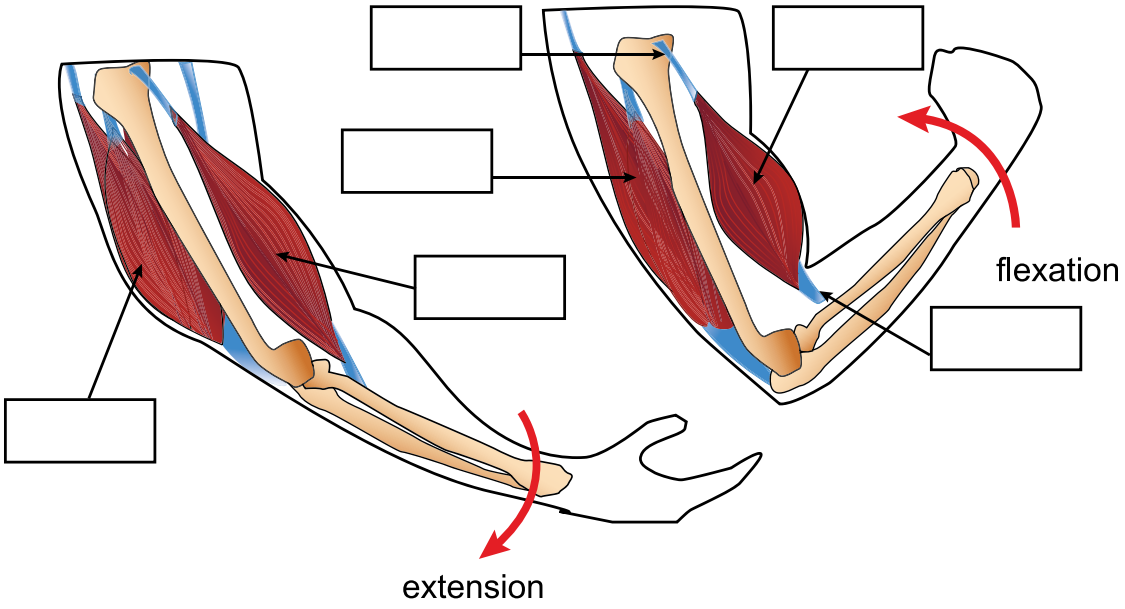
Fixators are muscles that stabilise one joint during the movement at another joint. In the same example, as you bend your elbow to lift the object, there are fixators attaching to your shoulder blade and down your back. They contract opposite to the agonist to hold your shoulder in place and keep your back straight. This is why people will often injure their back if a load it 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.

Time

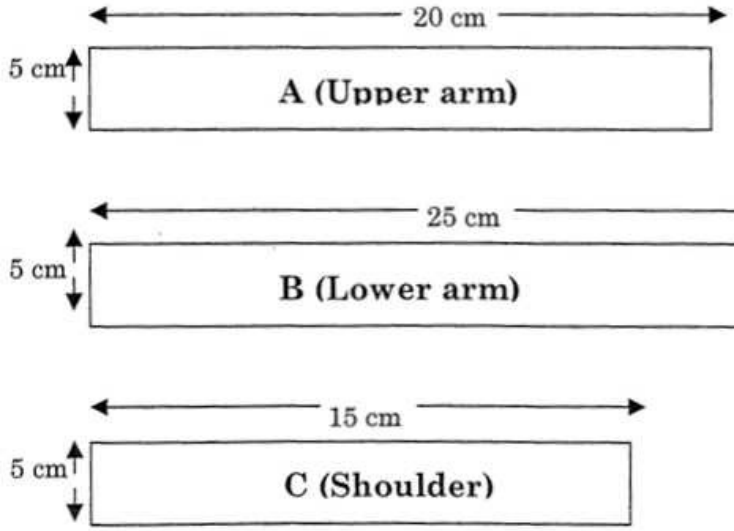
60 minutes.

Materials

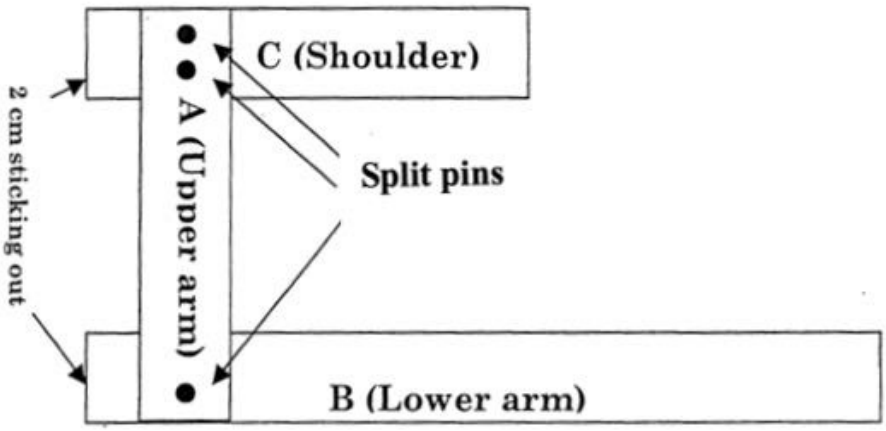
- 1 x scissors or box cutter
- 1 x ruler
- 1 x cardboard at least 25 cm by 15 cm
- 2 x pieces of string 40 cm long
- 3 x split pins
- Optional: craft materials for decorating (e.g. drawing muscle striations, or more cardboard to make a hand)

Procedure

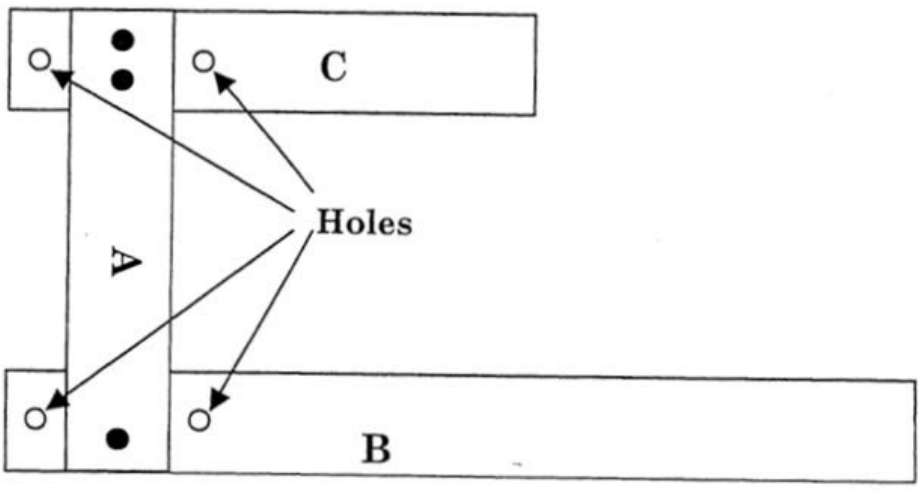
1. Use the scissors or box cutter to cut three strips of cardboard according to the dimensions below.



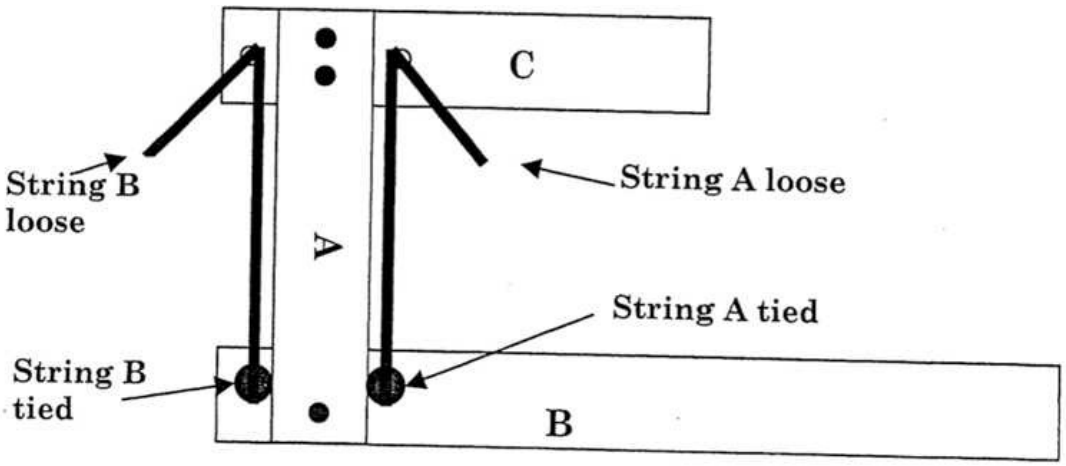
2. Place strip A on strips B and C. Leave 2 cm of strips B and C sticking out. Insert the split pins as shown below.



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		

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.

_____

_____

_____

_____

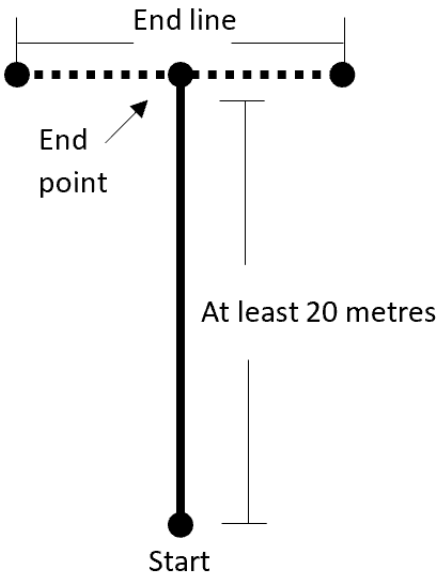
_____

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, addition 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 or 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.

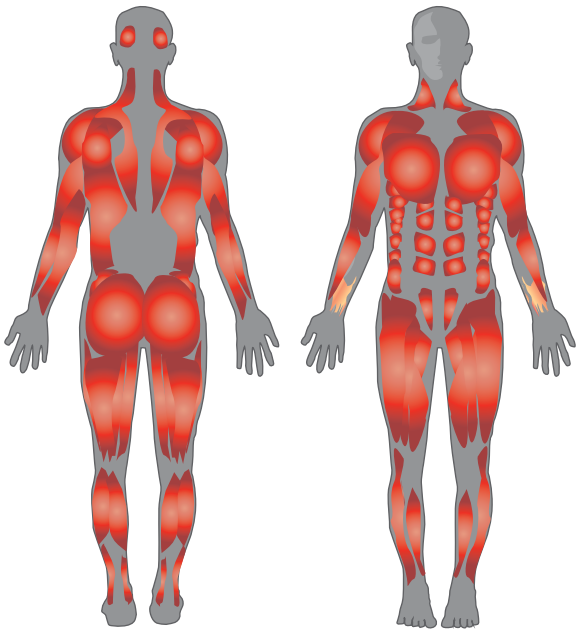
_____ contracts to stabilise another joint.

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

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 4
Dietary Decisions

Syllabus dot points

- The *Australian Dietary Guidelines* and the *Australian Guide to Healthy Eating* provide advice for health and wellbeing.
- Food labels assist with informed food purchases, healthier eating choices and protect public health and safety.
- Dietary choices can be influenced by various factors including food intolerances, food allergies, diseases, disorders, ethical values and sociocultural factors.

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. Understands that the many body activities rely on a healthy diet that consists of a balance of foods eaten in the correct amount.
2. Understand that there are guidelines available to Australians that provide advice about healthy diets that maintain health and wellbeing.
3. Understand the need for checking food labels to inform healthy choices.
4. Understand that dietary choices are influenced by a wide range of factors.

Success criteria

- Describe the general recommendtaions provided by the *Australian Dietary Guidelines* and the *Australian Guide to Healthy Eating*.
- Evaluate different diets using the *Australian Dietary Guidelines* and the *Australian Guide to Healthy Eating*.
- Recognise the need for food labels and describe the importance of the labels to protect public health and safety.
- Analyse food labels and make choices based on the information provided by the labels.
- Compare and contrast a healthy diet and an unhealthy diet.
- Describe a healthy balanced diet over a day for a teenager.
- Describe some consequences of food intolerances, food allergies, diseases, disorders, ethical values and sociocultural factors.
- Explain why dietary choices can be influenced by food intolerances, food allergies, diseases, disorders, ethical values and sociocultural factors.
- Describe some dietary choices that should be made by people with food intolerances, food allergies, diseases, disorders, ethical values and sociocultural factors.

Key terms

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

Key term	Definition
Carbohydrate	
Energy	
Dietary fibre	
Kilojoule	
Fats	
Nutrient	
Protein	

What is a healthy diet?

Think about the food you have eaten today; would you say it was healthy or unhealthy? We must eat food frequently to maintain our body functions; it is easy to choose a meal or a snack without giving much thought to the nutrients inside the food and the consequences of eating this food. Even if you would like to choose healthy options, you may be unsure how to select them.

Your diet depends on your selection of foods over days, months and even years. Understanding how to make healthy selections of food whenever you are buying food from a supermarket, eating out, or preparing your food at home, will make a difference to your overall wellbeing.

There are a few important principles to have when choosing a healthy meal.

- Eat a variety of nutritious foods
- Eat plenty of vegetables, legumes, and fruits
- Choose foods low in salt
- Drink plenty of water

How is energy measured in food?

All food we eat provides the body with energy. It is possible to measure the amount of energy food provides. In Australia we measure energy in **kilojoules**. How much energy a food provides will depend on the amount of carbohydrates, fats, proteins, or alcohol a food or a drink contains.

If a person eats a teaspoon of fat, it would provide more energy than a teaspoon of protein or carbohydrates. Therefore, the teaspoon of fat would contain more kilojoules than a teaspoon of carbohydrates or protein. It is important to know how much energy there is in the food we consume; this information can be accessed from the nutritional information panel on food labels.

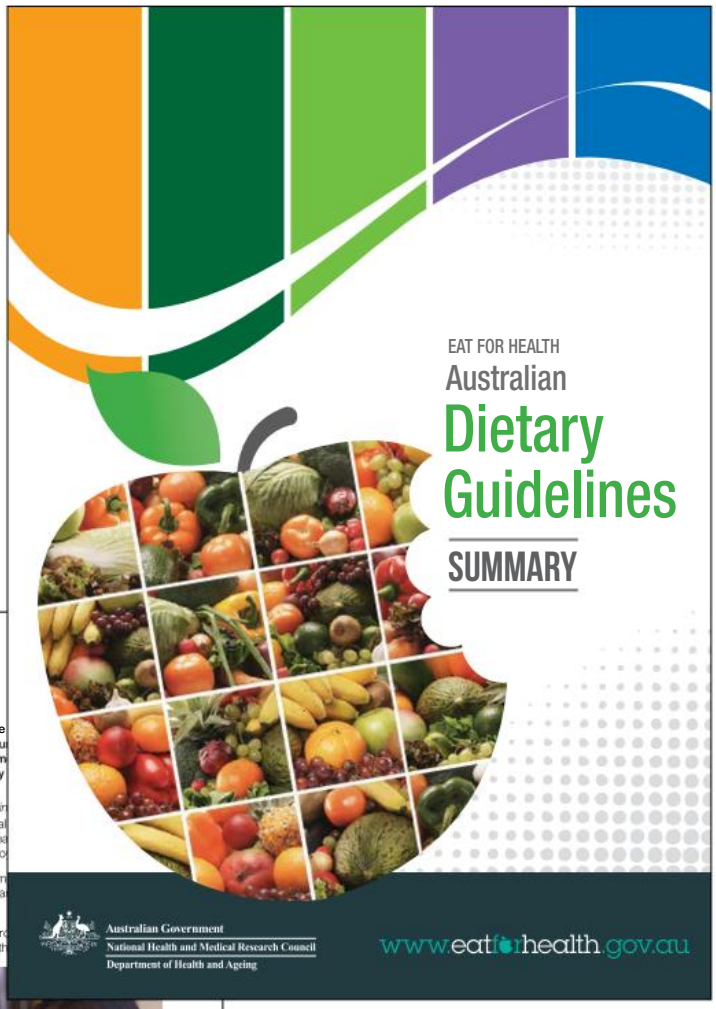
So, how much energy does an average teenager need daily and how much energy do they consume. The amount of energy required will depend on daily physical activities, height and weight, gender and age as teenagers need a lot of energy to fuel growth and development.

The Australian Dietary Guidelines and the Australian Guide to Healthy Eating

The *Australian Dietary Guidelines* and the *Australian Guide to Healthy Eating* are two key resources that provide advice for promoting health and wellbeing through proper nutrition. These guidelines are developed and maintained by the National Health and Medical Research Council (NHMRC) in Australia and are based on current scientific evidence.

The full document can be found at *Australian Dietary guidelines - Summary* (eatforhealth.gov.au)

The *Australian Dietary Guidelines* are a set of evidence-based recommendations that outline the types and amounts of foods, food groups, and dietary patterns that promote optimal health and wellbeing, and reduce the risk of chronic diseases such as obesity, heart disease, and diabetes.



INTRODUCTION

The *Australian Dietary Guidelines* (the *Guidelines*) and the *Healthy Eating* provide up-to-date advice about the amou that we need to eat for health and wellbeing. The recomm scientific evidence, developed after looking at good quality

By following the dietary patterns recommended in the *Guidelin to Healthy Eating*, we will get enough of the nutrients essential reduce our risk of chronic health problems such as heart disea cancers and obesity. We may also feel better, look better, enjo

Our dietary patterns are made up of foods and drinks, not sim and amounts of the foods and drinks that we consume regula our health.

However, there are many different ways to include foods to pr different cultural, economic, social and culinary preferences, th

Many Australians enjoy flexible dietary patterns that include different ways of healthy eating. But most of us need to choose foods and drinks more wisely to help protect our health.

The *Australian Dietary Guidelines* make this easier (see page 5) by helping us choose wisely from the wide range of foods and drinks now available in Australia.

The *Australian Guide to Healthy Eating* (see page 4) summarises this information pictorially.

Careful dietary choices must be made so we can all enjoy good health and wellbeing. Too many of us are overweight, have high blood pressure or are facing chronic diseases such as heart disease, type 2 diabetes, some cancers and obesity.

INTRODUCTION 1

Checkpoint

Describe the purpose of the *Australian Dietary Guidelines*.

_____

_____

_____

_____

List three diseases that can occur if people do not follow the Guidelines.

1. _____

2. _____

3. _____

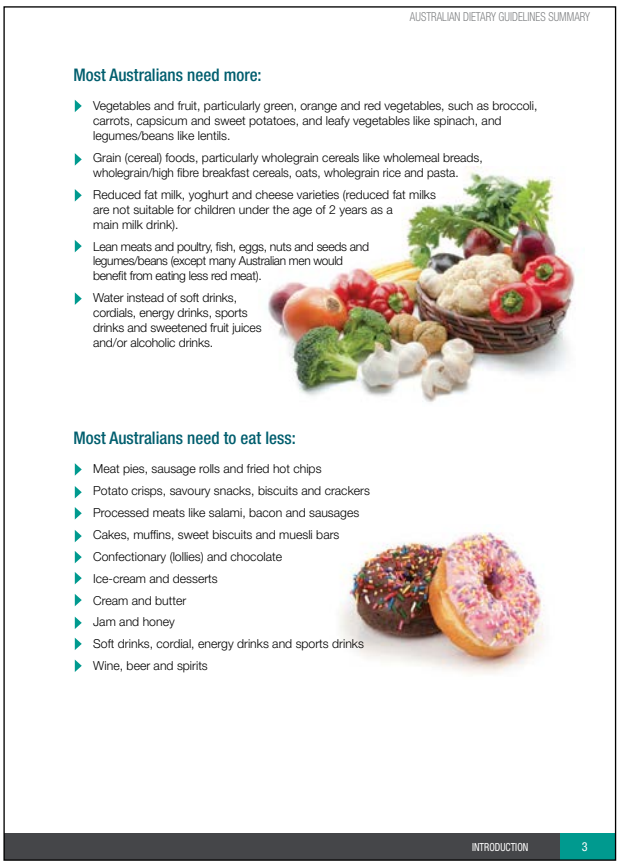
The guidelines emphasize the importance of a balanced diet that includes a variety of nutritious foods from the five food groups:

1. Vegetables and legumes: These should be consumed in abundance and should make up the majority of your meals. They provide essential vitamins, minerals, and dietary fibre.
2. Fruit: Aim to include a variety of fruits in your daily intake to ensure a range of vitamins, minerals, and dietary fibre.
3. Grains: Choose whole grains whenever possible, such as whole wheat, brown rice, oats, and quinoa. They are a good source of carbohydrates, fibre, and essential nutrients.
4. Lean proteins: Include lean meats, poultry, fish, eggs, tofu, legumes, nuts, and seeds in your diet for protein and other essential nutrients.
5. Dairy or dairy alternatives: Choose low-fat or reduced-fat options for milk, cheese, and yogurt. If you are lactose intolerant or follow a vegan diet, you can opt for fortified plant-based alternatives.

The guidelines also recommend limiting the intake of added sugars, saturated and trans fats, and salt. They encourage the consumption of water as the main drink and moderation in alcohol consumption.

Checkpoint

Describe the advice given by the Guidelines about vegetables and fruit.


AUSTRALIAN DIETARY GUIDELINES SUMMARY

Most Australians need more:

- Vegetables and fruit, particularly green, orange and red vegetables, such as broccoli, carrots, capsicum and sweet potatoes, and leafy vegetables like spinach, and legumes/beans like lentils.
- Grain (cereal) foods, particularly wholegrain cereals like wholemeal breads, wholegrain/high fibre breakfast cereals, oats, wholegrain rice and pasta.
- Reduced fat milk, yoghurt and cheese varieties (reduced fat milks are not suitable for children under the age of 2 years as a main milk drink).
- Lean meats and poultry, fish, eggs, nuts and seeds and legumes/beans (except many Australian men would benefit from eating less red meat).
- Water instead of soft drinks, cordials, energy drinks, sports drinks and sweetened fruit juices and/or alcoholic drinks.

Most Australians need to eat less:

- Meat pies, sausage rolls and fried hot chips
- Potato crisps, savoury snacks, biscuits and crackers
- Processed meats like salami, bacon and sausages
- Cakes, muffins, sweet biscuits and muesli bars
- Confectionary (lollies) and chocolate
- Ice-cream and desserts
- Cream and butter
- Jam and honey
- Soft drinks, cordial, energy drinks and sports drinks
- Wine, beer and spirits

INTRODUCTION 3

Describe the types of grains that are recommended for eating by the Guidelines.

List the nutrients that are supplied by grains.

List four foods that Australians should eat more of.

List four foods that Australians should est less of.

Healthy diet planning

There are five food groups, together they provide a balanced amount of energy, vitamins, and minerals for a daily diet. The amount required by your body depends on your age and activities. An elderly person will need a different diet compared to a teenager who plays sports.

The five food groups are:

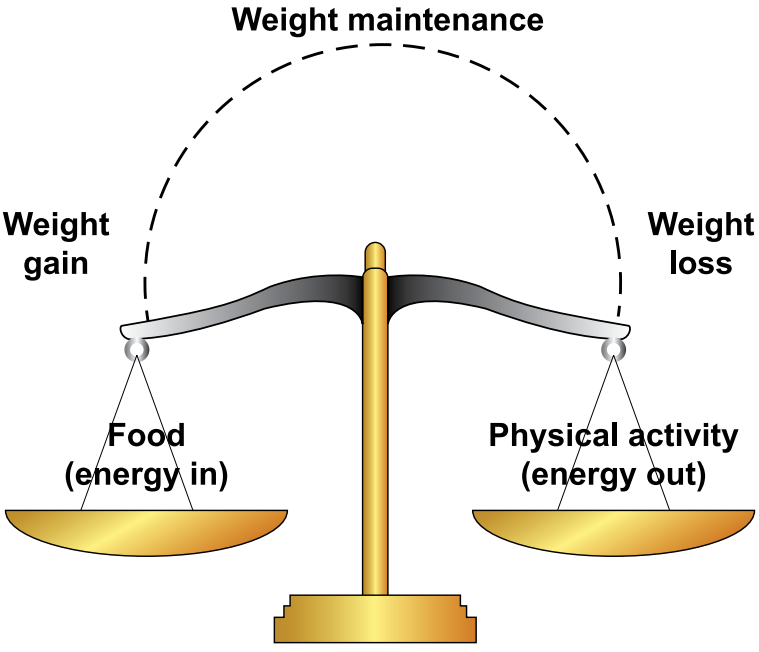
1. Grains and cereals
2. Vegetables and beans
3. Fruit
4. Milk yoghurt and cheese
5. Meats, eggs, and nuts

In addition to these five foods groups, it is recommended to drink plenty of water.

The *Australian Guide to Healthy Eating* complements the dietary guidelines by illustrating the recommended proportions of each food group in a balanced meal. It displays the five food groups as a simple visual aid, indicating that a healthy meal should consist of:

- 1/2 plate of vegetables and legumes
- 1/4 plate of grains (preferably whole grains)
- 1/4 plate of lean proteins
- A serving of dairy or dairy alternatives
- A serving of fruit

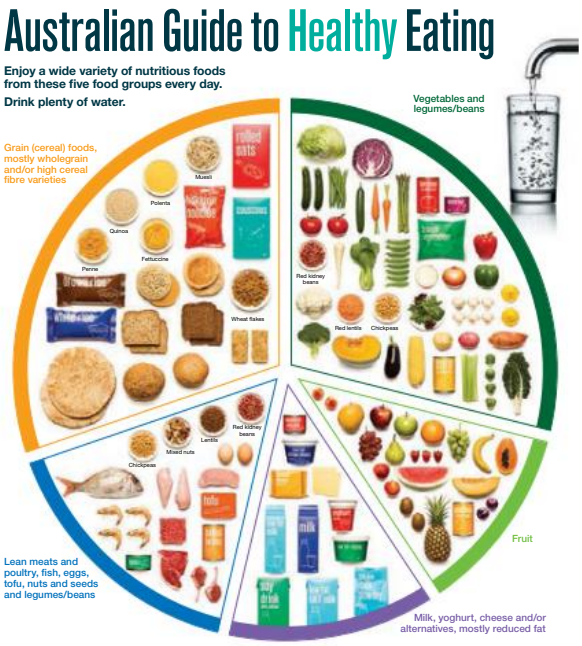
The guidelines and guide promote portion control, variety, and an overall balanced approach to eating for maintaining good health and wellbeing. They are regularly reviewed and updated to reflect the latest scientific research in nutrition.



Checkpoint

The image below shows the five food groups.

- Name examples of foods belonging to each group.
- Identify the portion of that group that should be eaten daily.



Go to the website https://www.eatforhealth.gov.au/guidelines/australian-guide-healthy-eating. Use the **Australian Guide to Healthy Eating** to answer the following questions:

Identify the recommendations for the daily intake of the five food groups for a teenager.

_____

_____

Identify the food groups that most of the daily food should come from. Give examples of foods in these groups.

_____

_____

Identify the food groups that less of your daily food should come from? Give examples of foods in these groups.

_____

_____

Food labels

Food labels provide detailed information about the nutritional content and ingredients of packaged food products. The information provided on these labels helps consumers make informed food purchases, make healthier eating choices, and protect public health and safety. Here is a more detailed explanation of how food labels assist in these areas:

1. Nutritional Information: Food labels display the nutritional content of the product, including the number of calories or kilojoules, macronutrients (such as fat, protein, and carbohydrates), as well as micronutrients (such as vitamins and minerals). This information allows consumers to understand the nutritional value of the food item and make choices that align with their dietary needs and goals. For instance, individuals aiming to reduce their sodium or sugar intake can easily compare products and choose the one with lower amounts.

2. Ingredient List: Food labels provide an ingredient list, which indicates the components of the product in descending order of prominence. This helps consumers be aware of the various components, additives, preservatives, or allergens in the food item. For individuals with specific dietary restrictions, food labels allow them to identify potential allergens or ingredients they want to avoid. Many people suffer from intolerance to gluten so need to make sure that the food they are consuming is gluten free (GF). Lactose intolerance is also common, and many people have vegetarian and vegan diets. It is thus essential for the labels on food to be accurate.

3. Serving Sizes: The serving size mentioned on the food label informs consumers about the recommended portion size of the product. This is crucial for maintaining balanced and healthy eating habits, as it allows individuals to understand how many servings they are consuming and make appropriate portion adjustments. This information assists people in controlling their caloric intake and understanding the nutritional content more accurately.

4. Health Claims: Food labels might include health claims approved by regulatory bodies, such as “low fat,” “high fibre,” or “good source of vitamin C.” These claims provide additional information and assist consumers in quickly identifying products that meet specific dietary requirements or health goals.

5. Allergen Warnings: Food labels also highlight potential allergens present in the product, such as nuts, dairy, or gluten, to help individuals with food allergies or intolerances avoid consuming items that may trigger adverse reactions. This information supports public health and safety, preventing allergic reactions and other health issues.

6. Food Safety: Food labels contain essential information regarding storage instructions, use-by or expiration dates, and safe handling procedures. This information ensures that consumers handle and consume the product safely, reducing the risk of foodborne illnesses and protecting public health.

7. Preventing Misleading Claims: Food labels are regulated by government agencies to curb false or misleading information regarding the product's health benefits. These regulations ensure that manufacturers do not make unsubstantiated claims that may mislead consumers and help maintain food safety standards.

By providing comprehensive information, food labels empower consumers to make informed choices based on their nutritional needs, dietary preferences, and health goals. They play a vital role in promoting healthier eating habits, preventing foodborne illnesses, and protecting public health and safety.

How to read a nutrition information panel

The nutritional information panel is found on the food packaging. This information helps to compare similar foods and to work out how much of this food is one serve. Understanding how to read these labels will help to make informed choices of foods we buy and eat.

Baked Beans - Nutritional Info

NUTRITION INFORMATION		
Servings per package: 2	Serving size: 150g	
Avg. Quantity	per Serving	per 100g
Energy	450kJ	300kJ
Protein	7.2g	4.8g
Fat, total	0.8g	0.5g
-saturated	0.2g	0.1g
Carbohydrate	14.4g	9.6g
-sugars	2.0g	1.3g
Dietary Fibre	6.2g	4.1g
Sodium	490mg	325mg

Checkpoint

How many breakfasts, lunches, dinners, snacks and drinks have you consumed this month?

Breakfasts _____

Lunches _____

Dinners _____

Snacks _____

Drinks _____

Using the following food labels (Cereal A, Cereal B) answer the questions that follow.

Cereal A

Toasted whole grain oat and honey muesli
Nutritional Information
Servings per package 11, Serve size 45g

	Average Qty per serve	Average Qty per 100g
Energy	802kJ	1782kJ
Protein	4.9g	10.9g
Fats total	5.4g	12.0g
Carbohydrates total	28.3g	62.9g
Dietary fibre	3.3g	7.3g
Sodium	5mg	11mg
Potassium	140mg	311mg

Cereal B

Whole grain flakes and sultanas
Nutritional Information
Servings per package 11 Serve size 40g

	Average Qty per serve	Average Qty per 100g
Energy	600kJ	1500kJ
Protein	3.2g	8.0g
Fats total	0.9g	2.3g
Carbohydrates total	24.4g	61.0g
Dietary fibre	4g	10g
Sodium	12mg	30mg
Zinc	1.2mg	3mg

Which of the two food products contains the highest amount of:

	Amount per 100g
Energy	
Protein	
Fats (total)	
Saturated fat	
Carbohydrates (total)	

Identify the recommended serve size of cereal to be eaten for cereal A and cereal B?

_____

Which of the two cereals would supply a healthy energy rich breakfast for a teenager?

_____

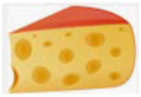
Which of the two cereals would supply an elderly person with the most dietary fibre?

_____

Serve size

The Australian Dietary Guidelines provide scientific evidence and information about the amounts of foods that promote healthy eating and reduce the risk of chronic disease, such as heart disease.

Below is a diagram outlining serve sizes of different foods:

Food groups	Serve size	
Grains and cereals	 ½ cup cooked  1 slice	A standard of bread is one slice 40g, cooked pasta half a cup 75g – 120g
Vegetables and beans	 ½ cup  ½ cup	A standard serve size vegetable is 75g
Fruit	 1 medium  2 small	A standard serve size fruit is 150g
Milk, yoghurt and cheese	 1 cup  2 slices	A standard serve size is 500-600kJ three quarter cup yo-ghurt, 1 cup of milk.
Meat, eggs and nuts	 100g fish  65g lean meat	A standard serve size fish 100g and lean meat 65g with a weekly limit of 455g.

Checkpoint

In the table below, identify what you have eaten today and work out how much energy you have eaten.

Meals	Food and drinks consumed	Total amount of energy from food and drinks
Breakfast		
Lunch		
Dinner		
Snacks		
Drinks		

Compare your energy intake with your peers.

Explain the difference between a calorie and a kilojoule?

_____

Explain what is meant by the Body Mass Index (BMI), calculate your BMI.

_____

_____

Some foods like margarine and milk have been fortified. What does this mean?

_____

_____

_____

Explain what is meant by a serve size?

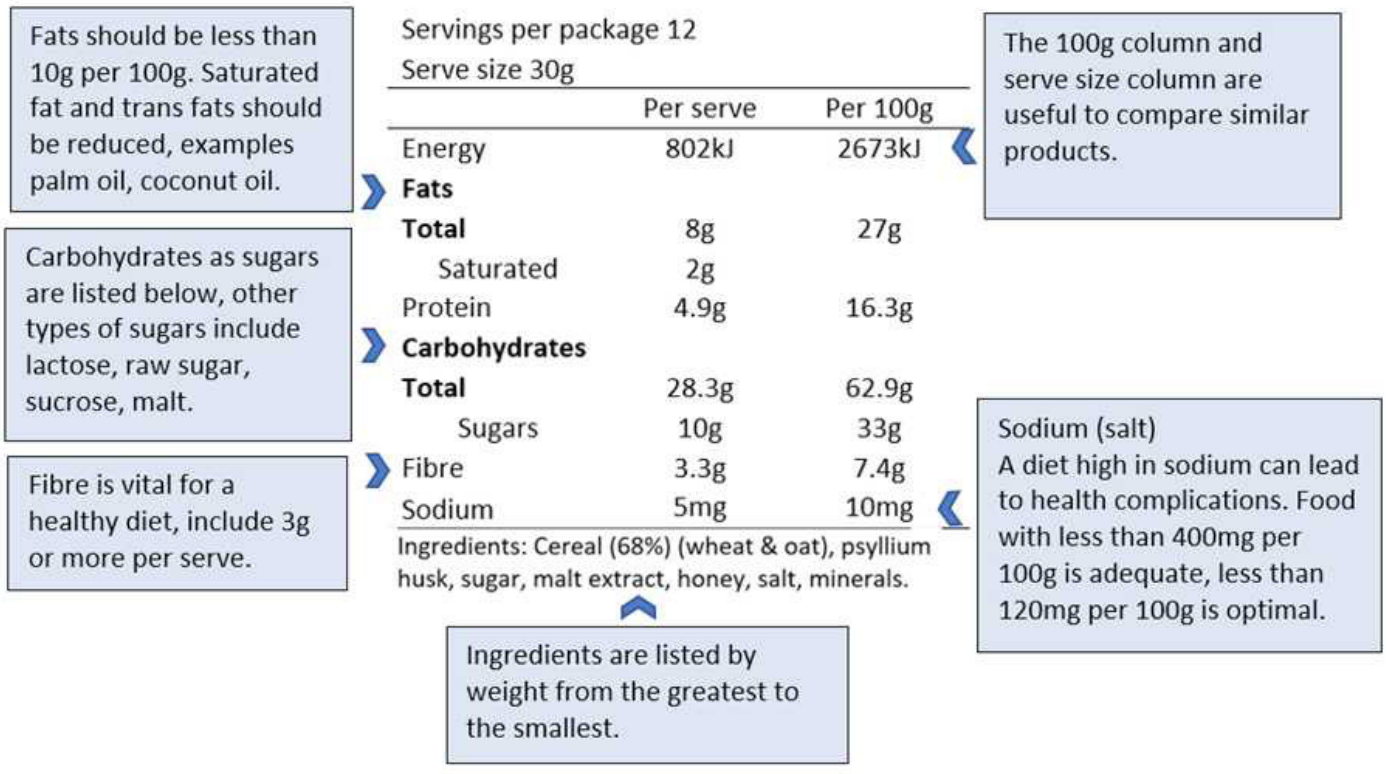
_____

_____

How much energy does each food group provide?

There are many different brands of food to choose from. How can we know which one will provide the most benefit to our body? Reading the food label is helpful in understanding ingredients in a food product. Each food label must meet an Australian standard that has strict requirements. The food label must list all ingredients found in the food from the ingredient that has the most weight in the food to the ingredient that has the least weight. Food labels must also list all food allergens and additives.

The image below shows a food panel with information about the product. This is helpful information to compare similar food products and decide which product will be better for you.



Checkpoint

Sarah is in Year 11. The following table shows what she has eaten in a day. Using the five food groups, help Sarah to improve on her choice of foods to make her daily diet more balanced.

Sarah's food and water options for a day

Food Eaten	Energy Intake	Food Group
Breakfast		
Glass of water	0kJ	
Morning break		
Chocolate nut bar	1500kJ	Grains
Lunch		
One apple	1200kJ	Fruit
Afternoon break		
Glass of water	0kJ	
Dinner		
Fried fish	1434kJ	Meat
Fried chips	902kJ	Vegetables
Green peas	117kJ	Vegetable

Help Sarah choose a healthy option to her daily diet

Food Eaten	Energy Intake	Food Group
Breakfast		
Morning break		
Lunch		
Afternoon break		
Dinner		

Foods that are not essential or necessary to your diet are called **discretionary** foods. Usually, these foods are high in energy (kilojoules), fats, sugars, or salts. If these foods are eaten, they should be eaten in smaller amounts. To determine if a food is a discretionary food, the amount of energy needs to be 600 kJ per serve or higher.

From the list of foods below work out which is a discretionary food.

	Indicate if the food is discretionary or not
2 scoops ice cream (75 g @ 600 kJ)	
1 donut (40 g @ 1560 kJ)	
2 tablespoons cream (40 g @ 600 kJ)	
½ small chocolate (25 g @ 1400 kJ)	
12 hot chips (60 g @ 1600 kJ)	

What are some other examples of discretionary food that you should limit in your diet choice?

_____

_____

Research recipes to create a healthy school lunch box plan for teenagers reducing discretionary foods.

Day	Recess	Lunch
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		

Dietary choices

Dietary choices can be influenced by various factors, including food intolerances, food allergies, diseases, disorders, ethical values, and sociocultural factors. These factors play a significant role in determining what individuals choose to eat, and they can greatly impact their overall health and well-being.

1. Food intolerances and allergies: Food intolerances occur when certain foods cause digestive discomfort or other adverse reactions, such as lactose intolerance or gluten sensitivity. Food allergies, on the other hand, trigger an immune response and can be life-threatening, like peanut or shellfish allergies. People with intolerances or allergies must avoid specific foods or ingredients, which can influence their dietary choices.

2. Diseases and disorders: Certain diseases and disorders necessitate specific dietary restrictions or modifications. For example, individuals with diabetes often need to monitor their carbohydrate intake and manage their blood sugar levels. People with high blood pressure may be advised to reduce their sodium intake. Celiac disease requires a strict avoidance of gluten. Such medical conditions significantly impact dietary choices and require individuals to follow specific diets tailored to their needs.

3. Ethical values: Many individuals make dietary choices based on their ethical values, such as vegetarianism or veganism. These dietary lifestyles are often motivated by concerns for animal welfare, environmental sustainability, or religious beliefs. Ethical values can determine which foods are consumed or avoided, for instance, avoiding any form of animal products or only consuming ethically-sourced food.

4. Sociocultural factors: Sociocultural factors, including cultural norms, traditions, and social influences, have a profound impact on dietary choices. Different cultures have distinct dietary practices, ingredients, and preparation methods. For instance, some cultures have a predominantly plant-based diet, while others consume more meats or seafood. Social factors, such as peer pressure or media influence, can also affect dietary choices by promoting certain foods or diets as desirable or fashionable.

It is crucial to understand and consider these various factors when making dietary recommendations or designing public health interventions. Recognizing the influence of food intolerances, allergies, diseases, disorders, ethical values, and sociocultural factors allows for the development of personalized and culturally sensitive approaches to nutrition, promoting better adherence and overall health outcomes.

Checkpoint

Describe the difference between food intolerance and food allergy.

Make a list of common food allergies.

Describe what people with high blood pressure should be aware of in their diet.

Describe how choosing to be a vegetarian is an ethical choice.

Describe three sociocultural factors that may influence dietary choices.

Activity: What's in a burger

Fast food meals have always been seen as unhealthy. Large fast food chains are now providing options that are healthier for growing bodies. The meals include salads and milk-based drinks rather than fries and cola drinks.

Activity purpose

- To compare the contents of different fast foods.
- To compare the nutritional value of different fast foods.

Materials

- nutritional information sheets provided for different meals from fast food outlets,
- eg. McDonalds, Hungry Jacks, Red Rooster, KFC, Chicken Treat.

Procedure

1. Draw up a table to compare the following for each fast food type.
    - energy
    - protein
    - fat (total)
    - fat - saturated
    - carbohydrate (total)
    - sugar
    - sodium
    - calcium
    - cost

Questions

Which of the meals contains the most fat (total)?

_____

State the total carbohydrate content of the items of food from the menu that you have chosen to study.

_____

_____

State the meal that supplies the greatest amount of energy.

Which meal will give you the best value as far as protein content is concerned?

These are all savoury foods yet they contain sugar. Identify the part of each food that is contributing to the sugar content.

Calcium is an important mineral. Could you obtain your daily requirement of calcium by eating any of the meals listed? Explain your answer.

Which meal is the best value for money in terms of its overall ability to supply your daily nutritional needs? Explain why.

Which meal should you avoid if you are concerned about gaining weight? Explain the reasons for your choice.

Which of the meal options could you recommend to a friend as a healthy option for lunch? Explain why.

Identify any significant difference/s between the meals based on chicken compared to those based on beef. Explain why those differences exist.

Activity: Healthy eating

The *Australian Guide to Healthy Eating* is a newly developed national and contemporary food guide for Australia which reflects the multicultural nature of the population and which is relevant for all sectors of the food system to use as a nutrition education and information tool.

https://www.eatforhealth.gov.au/guidelines/australian ustralian-guide-healthy-eating

Activity purpose

- To use guide lines to analyse your own and other's diets.

Procedure

1. Use the information given in the above website to discuss and answer the following questions.

Questions

Do ethnic diets eg. Mediterranean, Asian, African, Indian, conform to the suggested requirements shown in the Food Pie? Give reasons for your answer.

_____

_____

_____

_____

_____

_____

Advertisements on TV tells us that '2 fruit and 5 veg' are needed by our bodies each day. Is this supported by the 'Food Pie?

_____

_____

_____

_____

Choose one of the sections of the Food Pie and find out what would happen to your body if it was removed from your diet.

Describe changes that should you make to your diet if you are training for a sporting event.

A quarter chicken and chips is a good lunch snack for an active teenager'. Is this statement true or false? Justify your answer.

State the proportions of our diet that should be:

Breads, cereals, rice and noodles _____

Milk, yogurt and cheese _____

Fruits _____

Vegetables _____

Lean meat, fish, poultry, eggs, nuts and legumes _____

How much water should you have during the day? Does everyone need the same amount? What factors will determine how much water you need during the day?

What food should you have the least of and why? Is this the case for your current diet?

Some people have food allergies. If a person is allergic to dairy products how do they obtain the nutrients normally supplied by the milk band?

Should the diet of a small child differ from that of an adult? If so how?

Balancing your diet with your busy lifestyle is a challenge to most Australians. What advice could you give to your classmates about their eating habits?

Breakfast is considered to be one of the most important meals of the day. Breakfast cereals are a typical food for an Australian family. Why is starting your day with cereal a good option? What other alternatives are there to a cereal breakfast?

Choose one fruit or vegetable and investigate why it is so important for you to have in your diet.

Our supermarket shelves are full of snack foods high in sugar and fat. School canteens are generally more health conscious and carefully consider the foods they sell to students.

Health conscious snack food options in school canteen	Top selling snack foods from the school canteen

Compare and contrast the lists to comment on general awareness of healthy food options.

Many people have intolerance to gluten. Research the symptoms of gluten intolerance and make a list of the foods that people who need to be Gluten Free (GF) should avoid. Find out about the alternatives now available to people who need to be GF.

Chapter review

- Describe the purpose of the *Australian Dietary Guidelines*.
- Explain why Australians need to make more healthy diet choices.
- List the five food groups recommended by the Guidelines that people should eat most in their diets.
- Describe the recommended intake of meat and fish in an Australian adult diet.
- Describe the information that is provided on food labels.
- Explain the importance of food labels providing information about the ingredients in the food.
- Explain how food labels can help people make healthier choices concerning their diet.
- List the six factors that can influence dietary choices and provide one example of each.

Extras for experts

Many products contain a health star rating. Research this rating system to find out why it was introduced and how they measure the health rating of a food.

_____

_____

_____

_____

Lactose intolerance research

Describe the symptoms of a person who is lactose intolerant.

_____

_____

List the causes of lactose intolerance.

_____

_____

Explain if lactose intolerance is linked to ethnicity.

_____

_____

Describe dietary changes that can be made to eliminate the intolerance.

_____

_____

_____

Vegetarian diet

Research vegetarian diets and how to replace iron from meats.

Explain the health benefits of a vegetarian diet.

Identify ways a vegetarian diet can supplement iron intake.

Explain the difference between vegetarian and vegan diets.

Plan a vegetarian diet for a week:

Notes

Image References

Pg 1 Cover Artwork by David Keigwin

Pg 9 Chapter 1 cover image: https://www.rawpixel.com/image/2288485

Pg 24 “Animal cell showing structures that are contained in most cells“ Illustration by David Keigwin

Pg 25 Organelle - Illustration by David Keigwin

Pg 30 Types of cells - Illustration by David Keigwin

Pg 31 Type of cells from a stem cell https://upload.wikimedia.org/wikipedia/commons/d/d3/Final_stem_cell_differentiation_%281%29.svg

Pg 32 “Organisation of the human body” - Illustration by David Keigwin

Pg 34 “Where epithelial tissue is located in the human body” - Illustration by David Keigwin

Pg 35 “Where connective tissue is found in the human body” - Illustration by David Keigwin

Pg 36 “Where muscle tissue is found in the human body” - Illustration by David Keigwin

Pg 36 “Where nervous tissue is found in the human body” - Illustration by David Keigwin

Pg 37 “Structure of human skin” - Illustration by David Keigwin

Pg 39 Organs diagram - Illustration by David Keigwin

Pg 49 Chapter 2 Cover Image: Photo by Ivan Samkov: https://www.pexels.com/photo/a-woman-eating-an-apple-7990367/

Pg 71 “Figure 1: Mechanical digestion” Illustration by David Keigwin

Pg 71 “Figure 2: Enzyme action” Illustration by David Keigwin

Pg 81 Grease on paper - Illustration by David Keigwin

Pg 82 The test for protein steps - Illustration by David Keigwin

Pg 84 “Organs of the digestive system” Illustration by David Keigwin

Pg 85 “Peristaltic movement of a bolus” https://commons.wikimedia.org/wiki/File:2404_PeristalsisN.jpg

Pg 87 “Stomach and surrounding organs” HBS 1A &1B Looking Good Student Workbook, 2006 (page 36)

Pg 88 “Villi in the small intestine” https://www.google.com/url?sa=i&url=https%3A%2F%2Fcommons.wikimedia.org%2Fwiki%2FFile%3AIntestinal_villus_simplified_esp.jpg&psig=AOvVaw3yYZHQw37NnF3rGnDpCUni&ust=1652525851349000&source=images&cd=vfe&ved=0CAkQjRxqFwoTCOjM4t-o3PcCFQAAAAAdAAAAABAb

Pg 88 “Cross-section of a villus” https://www.google.com/url?sa=i&url=https%3A%2F%2Fcommons.wikimedia.org%2Fwiki%2FFile%3AIntestinal_villus_simplified_esp.jpg&psig=AOvVaw3yYZHQw37NnF3rGnDpCUni&ust=1652525851349000&source=images&cd=vfe&ved=0CAkQjRxqFwoTCOjM4t-

Pg 89 Diffusion process - Illustration by David Keigwin

Pg 90 Cell membrane passive process - Illustration by David Keigwin

Pg 90 Sugar cube dissolved - Illustration by David Keigwin

Pg 91 Osmosis - Illustration by David Keigwin

Pg 92 Endocytosis - Illustration by David Keigwin

Pg 92 Endocytosis vesicle - Illustration by David Keigwin

Pg 92 “Electron micrograph showing endocytosis” Human Perspectives 1A/1B p30

Pg 108 Digestive system http://www.westhoughton-high.bolton.sch.uk/primary%20science%20network/mission2files/digestion.jpeg

Pg 110 Label the diagram of the digestive system https://commons.wikimedia.org/wiki/File:Blausen_0316_DigestiveSystem.png

Pg 112 Chapter 3 Cover Image: Photo by cottonbro: https://www.pexels.com/photo/white-concrete-statue-of-man-under-the-light-bulb-3779021/

Pg 119 Bones - Illustration by David Keigwin

Pg 120 Long bone https://upload.wikimedia.org/wikipedia/commons/2/23/603_Anatomy_of_Long_Bone.jpg

Pg 123 Pelvic bones https://commons.wikimedia.org/wiki/File:906_Cartiliginous_Joints.jpg

Pg 124 Synovial knee joint https://commons.wikimedia.org/wiki/File:907_Synovial_Joints.jpg

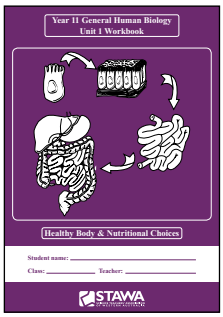
Pg 127 Synovial knee joint without Labels https://commons.wikimedia.org/wiki/File:907_Synovial_Joints.jpg

Pg 129-130 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

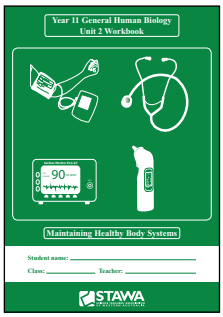
https://open.oregonstate.education/aandp/chapter/9-5-types-of-body-movements/
Pg 138 Flexion https://upload.wikimedia.org/wikipedia/commons/6/6c/Musclesbicepstriceps_esp.jpg
Pg 138 Extension https://upload.wikimedia.org/wikipedia/commons/6/6c/Musclesbicepstriceps_esp.jpg
Pg 139 Lifting technique - Illustration by David Keigwin
Pg 139 Bicep flexion - Illustration by David Keigwin
Pg 142-143 Activity Steps 1-4: Marron Publications: Human Physiology p. 53, 54
Pg 152 Muscle diagram - Illustration by David Keigwin
Pg 155 Chapter 4 Cover Image: Photo by Kristina Snowasp: https://www.pexels.com/photo/person-slicing-vegetables-on-chopping-board-9986235/
Pg 159 National Health and Medical Research Council (representing the Commonwealth of Australia). Australian Dietary Guidelines summary Cover, pg1 https://www.eatforhealth.gov.au/sites/default/files/2022-09/n55a_australian_dietary_guidelines_summary_131014_1.pdf
Pg 159 National Health and Medical Research Council (representing the Commonwealth of Australia). Australian Dietary Guidelines summary, Introduction pg6 https://www.eatforhealth.gov.au/sites/default/files/2022-09/n55a_australian_dietary_guidelines_summary_131014_1.pdf
Pg 161 National Health and Medical Research Council (representing the Commonwealth of Australia). Australian Dietary Guidelines summary, pg8 https://www.eatforhealth.gov.au/sites/default/files/2022-09/n55a_australian_dietary_guidelines_summary_131014_1.pdf
Pg 162 "Weight maintenance" Illustration by David Keigwin
Pg 163 Australian Dietary Guidelines summary, Australian Guide to Healthy Eating, pg9 https://www.eatforhealth.gov.au/sites/default/files/2022-09/n55a_australian_dietary_guidelines_summary_131014_1.pdf
Pg 165 "Baked beans - nutritional info" https://world.openfoodfacts.org/product/9300657235109/heinz-beans-no-sugar
Pg 167 Noodles https://www.istockphoto.com/search/2/image?mediatype=illustration&phrase=noodles
Pg 167 Bread https://www.istockphoto.com/search/2/image?mediatype=illustration&phrase=slice+of+bread
Pg 167 Carrot https://illustoon.com/?id=777
Pg 167 Potato https://www.abcteach.com/documents/clip-art-sweet-potatoes-color-i-abcteachcom-43560
Pg 167 Banana http://clipart-library.com/banana-clipart.html
Pg 167 Apricot https://www.123rf.com/stock-photo/apricot_clipart.html?sti=ncyht4f4jbrljvnsk1
Pg 167 Milk https://illustoon.com/?id=4903
Pg 167 Cheese https://clipartpng.com/?3044,swiss-cheese-png-clip-art
Pg 167 Tuna https://www.clipartmax.com/middle/m2i8i8d3G6A0b1K9_food-clipartfood-itemsplay-canned-tuna-clip-art/
Pg 167 Meat https://www.dreamstime.com/illustration/meat.html

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.

www.stawa.net

STAWA
SCIENCE TEACHERS' ASSOCIATION OF WESTERN AUSTRALIA