SCIENCE YEAR 9

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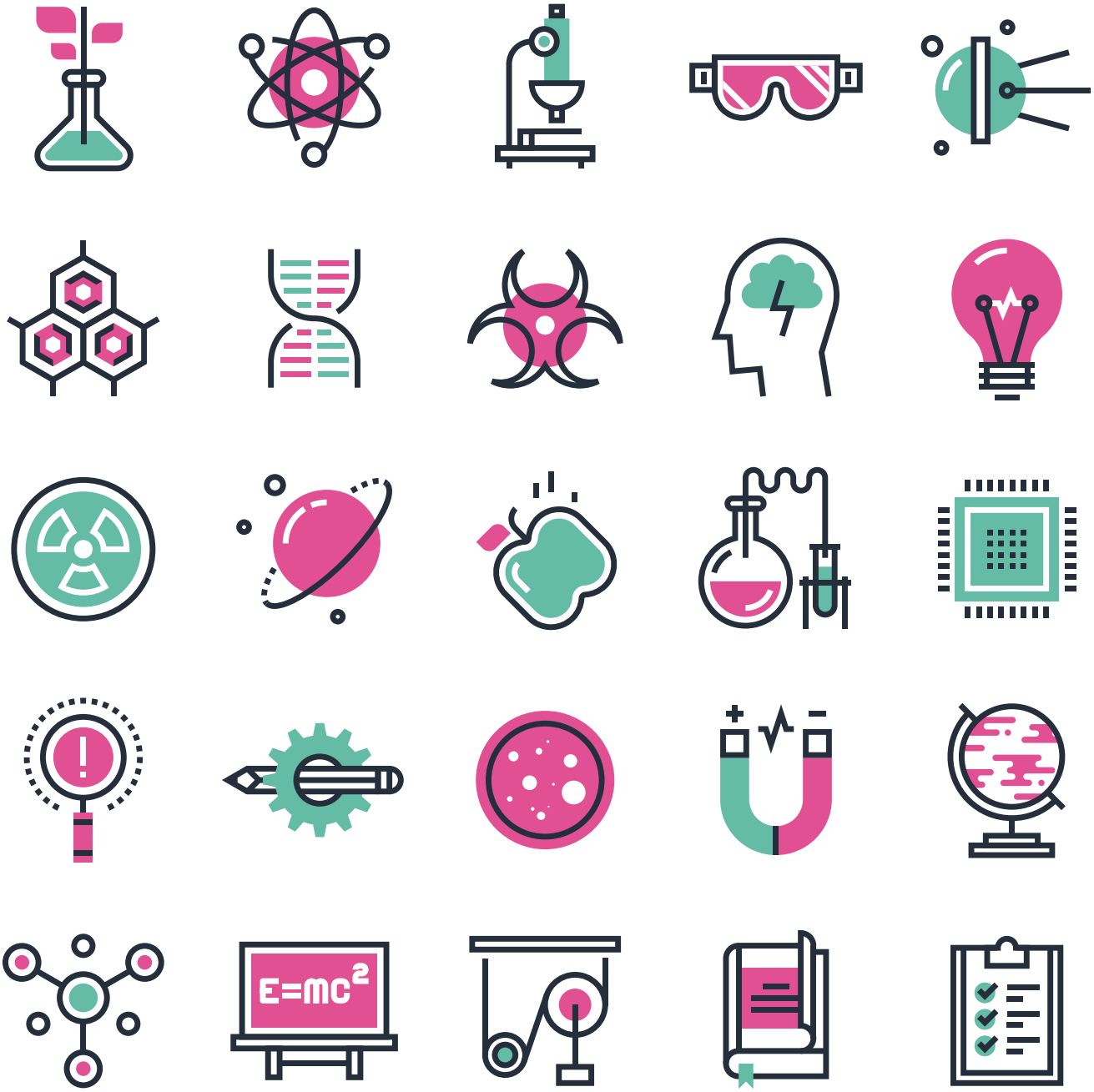

ALIGNED TO THE **AUSTRALIAN CURRICULUM**

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Science Year 9
Lesson Plans for the ClickView Curriculum Library

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Published by:
ClickView Pty Ltd.
Jones Bay Wharf,
125/26-32 Pirrama Rd,
Pyrmont NSW 2009

ABN: 78 106 176 514

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SCIENCE YEAR 9

LESSON PLANS FOR THE CLICKVIEW CURRICULUM LIBRARY

ALIGNED TO THE **AUSTRALIAN CURRICULUM**

Hello There Lovely Science Teachers,

Hope you have not waited for long for this new lesson plan book!

Thank you for your support for the last two books. We are really happy to present you with the Year 9 Lesson Plan Book!

As in the previous books, these 19 brand-new lesson plans are aligned to the Australian Curriculum to ensure and maximise their usefulness and relevance.

But unlike previous books, this Year 9 Book will be a digital version - and that means that all web links in the book are clickable within a PDF reader.

Do let us know of any feedback because we want to work with you to provide the best resources for you and the students and we can't do it without your help. :)

Enjoy and cheerio!

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Key to Icons in Book

ClickView Video

Presentation

SCIENCE YEAR 9
ALIGNED TO THE **AUSTRALIAN CURRICULUM**

CONTENTS

BIOLOGICAL SCIENCES

CHEMICAL SCIENCES

EARTH AND SPACE SCIENCES

PHYSICAL SCIENCES

The Human Respiratory System

OBJECTIVES

In this lesson, students will learn about the human respiratory system, including creating a model to understand how air flows in and out of the lungs.

ACARA CONTENT DESCRIPTIONS

Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment (ACSSU175)

- describing how the requirements for life (for example oxygen, nutrients, water and removal of waste) are provided through the coordinated function of body systems such as the respiratory system

Planning and conducting:

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)

- using modelling and simulations, including using digital technology to investigate situations and events

LESSON PLAN

Activities	Resources
Activity 1: Inhalation and Exhalation Give out the *Inhalation and Exhalation* worksheet. Play Chapter 8 of the video and give time to the students to attempt Part A of the worksheet in pencil so they can correct their answers. Without revealing the answers, give out the materials required for Part B of the worksheet. Divide the class into groups of 3-4 and ask students to follow the instructions and make a model of the lungs. Using the model, review answers for Part A of the worksheet. Note to teachers: The diaphragm is represented by the balloon located on the outside of the bottle. 30	• Photocopies of the *Inhalation and Exhalation* worksheet • ClickView video: *In Focus: Functional Anatomy* Chapter 8 • For each group of 3-4: A 500 mL plastic bottle, with the bottom removed (about 6 cm), scissors, 2 balloons, clear tape, drinking straw, a rubber band, playdough
Activity 2: The Respiratory System Give out the *Zooming into the Respiratory System* and *Learning about the Respiratory System* worksheets. Before playing the same chapter from 01:06, go through the instructions on *Zooming into the Respiratory System* worksheet with students to guide them to complete Part A of *Learning about the Respiratory System* worksheet. Give students some time to research online for the answers to Part B of the worksheet. Ask students to share their answers and what they've learnt about the respiratory system. 30	• Photocopies of the *Learning about the Respiratory System* and *Zooming into the Respiratory System* worksheets • For each student: paper fasteners, scissors • ClickView video: *In Focus: Functional Anatomy* Chapter 8

ANSWERS

Inhalation and Exhalation

Part A:

Inhalation	Exhalation
contracts, downwards, larger, an increase, lower	relaxes, upwards, smaller, a decrease, higher

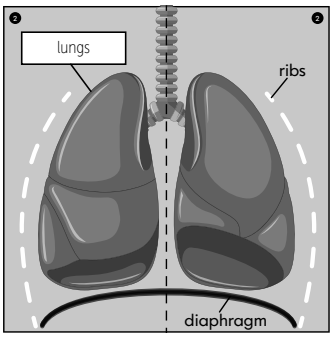
Part B:

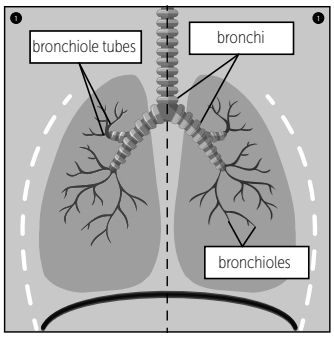
Possible answer:

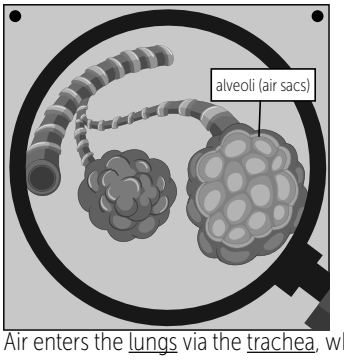
When the balloon was pulled downwards, the balloon inside the body inflated slightly. Subsequently, when the balloon on the outside was released back to the neutral position, the balloon on the inside deflated.

Learning about the Respiratory System

Part A:







Air enters the lungs via the trachea, which divides into two bronchi. These bronchi branch into bronchiole tubes, which then branch into smaller bronchioles. Air passes through these bronchioles which are connected to alveoli (air sacs). In the alveoli, oxygen is extracted from the air and passes into the blood stream. There are millions of alveoli in our lungs. The alveoli are surrounded by capillaries, which allow the exchange of gases.

Part B:

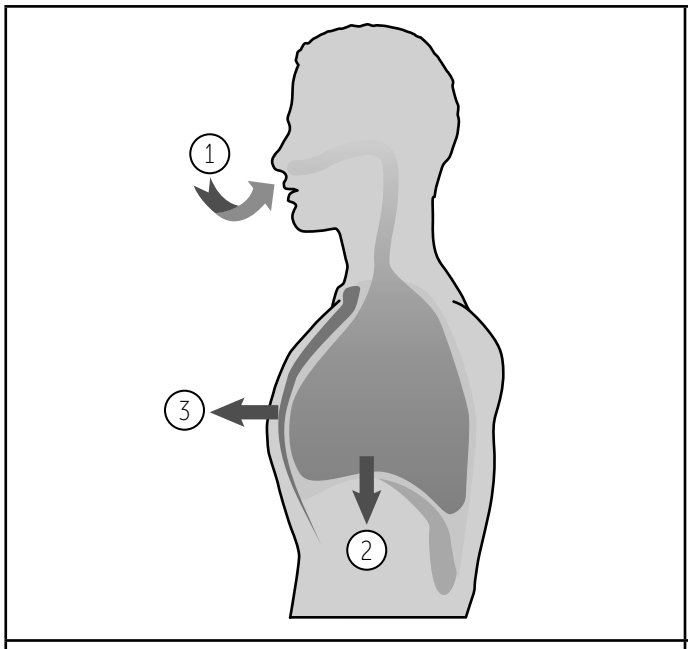
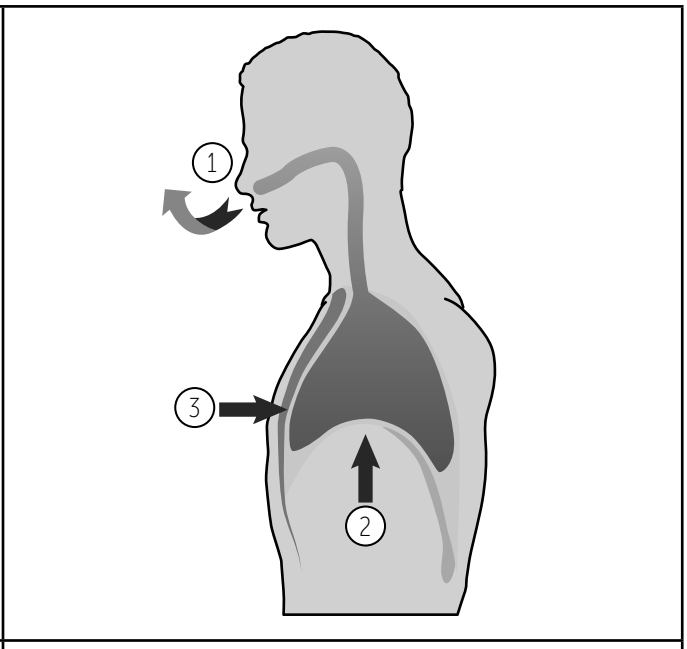
Possible answers:

Feature	How does it helps to make gas exchange effective?
The wall of each alveolus is one cell thick.	This reduces the diffusion distance the gas has to travel.
The combined surface area of all the alveoli in one lung is about the size of half a tennis court.	This allows larger volumes of air to be exchanged at any one time.
The alveoli is surrounded by many capillaries.	This provides a good supply and network for oxygen to be exchanged for carbon dioxide.

Gases move across the walls of the alveoli through diffusion, from a region of higher concentration to a region of lower concentration.

Inhalation and Exhalation

Part A: Complete the following sentences by circling the correct words.

	
INHALATION	**EXHALATION**
When you inhale, the diaphragm **relaxes/contracts** and moves **upwards/downwards**. This makes the chest cavity **smaller/larger**, resulting in **an increase/a decrease** in the volume of the ribcage. The air pressure is **lower/higher** in the lungs, causing air to be drawn in naturally.	When you exhale, the diaphragm **relaxes/contracts** and moves **upwards/downwards**. This makes the chest cavity **smaller/larger**, resulting in **an increase/a decrease** in the volume of the ribcage. The air pressure is **lower/higher** in the lungs, causing air to be forced out.

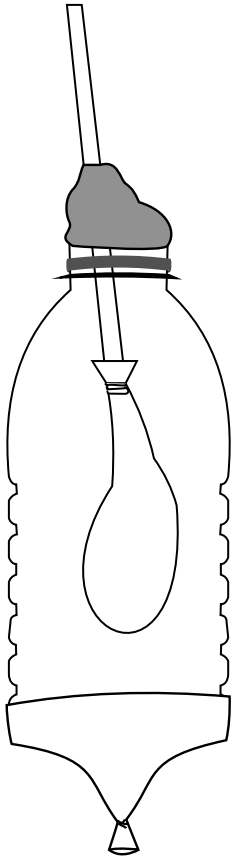
Part B: Making a Lung!

Materials:

- 500 mL plastic bottle, with the bottom removed (about 6 cm)
- scissors
- 2 balloons
- clear tape
- a drinking straw
- a rubber band
- playdough

Instructions:

Step 1: Tie a knot to one of the balloons and snip off with scissors half of the balloon, away from the knot.
Step 2: Stretch the balloon so it covers the bottom of the plastic bottle. If the edge of the bottle is too sharp, use tape to cover it.
Step 3: Insert a straw into the neck of the second balloon and secure it tightly with the rubber band. When you blow into the balloon, it should still inflate.
Step 4: Insert the end of the straw with the balloon into the bottle.
Step 5: Make a secure seal around the bottle with the playdough. Take care to not crush the straw.



What happens when you pull the balloon that is on the outside of the bottle? Write your observations below.

Zooming into the Respiratory System

Materials:

- scissors
- a pair of paper fasteners

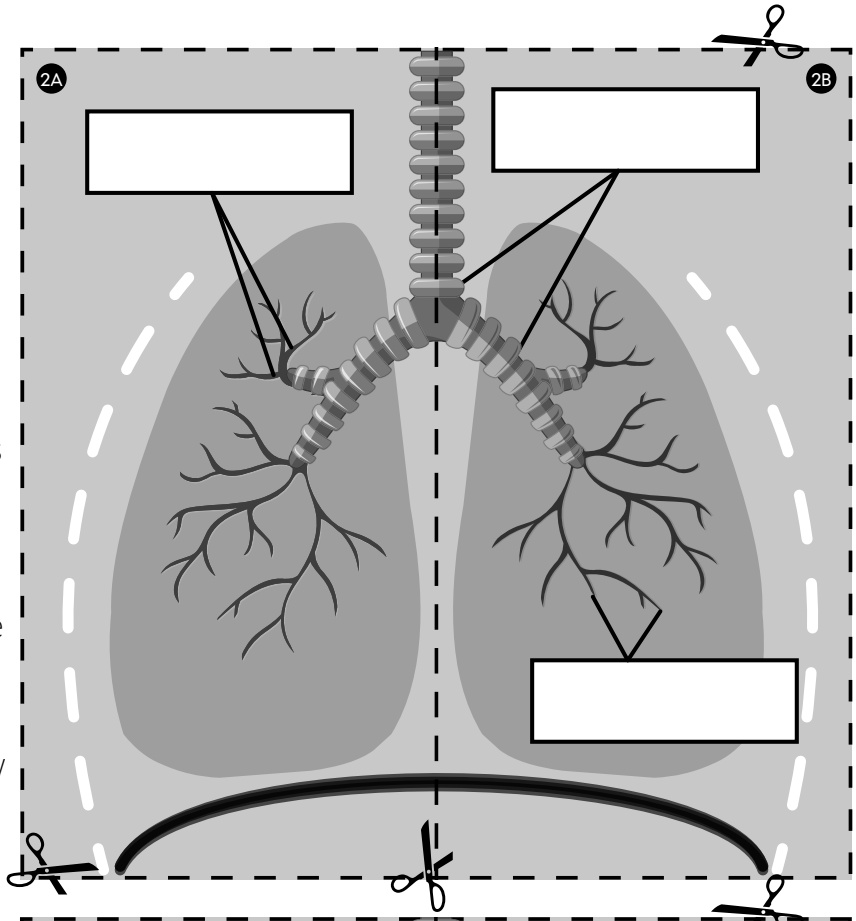
Instructions:

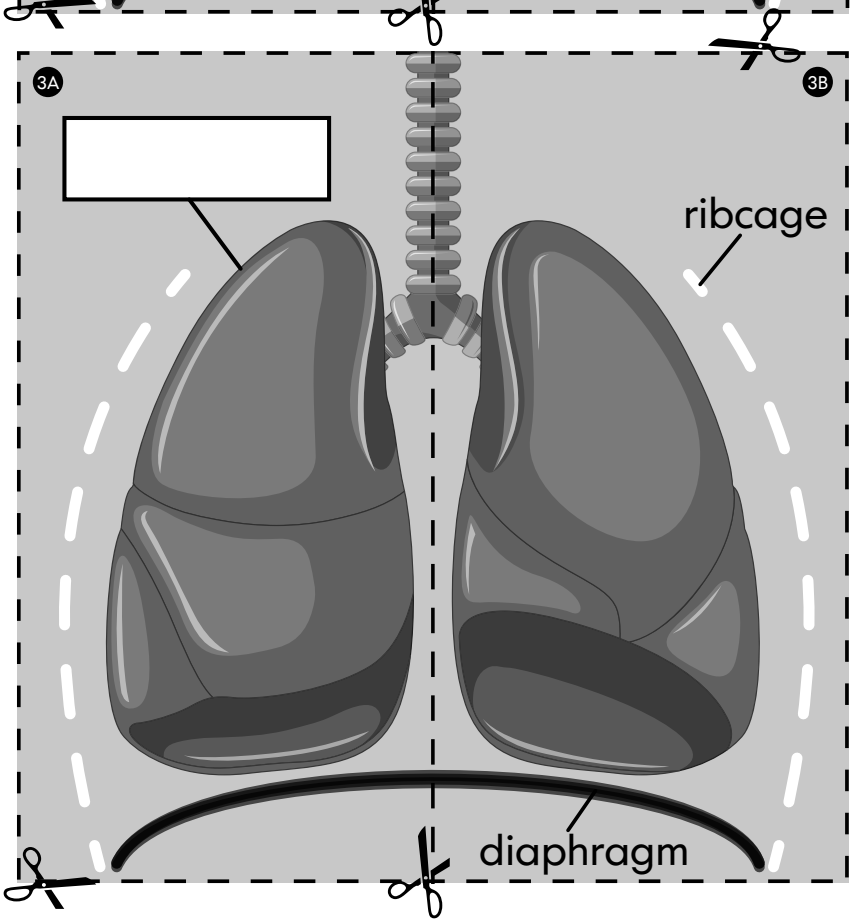
Step 1: Cut out the boxes along the dotted lines.

Step 2: On Part A of the 'Learning about the Respiratory System' worksheet, align the rectangle boxes with '2A' on top of '1A' followed by '3A' and attach the pieces of paper at the black circles with a paper fastener.

Step 3: Repeat the same for the '2B' on top of '1B' followed by '3B' and attach the pieces of paper together.

Step 4: As the video is played, label the various structures found in the respiratory system and complete the passage. Use the helping words found in the helping box.

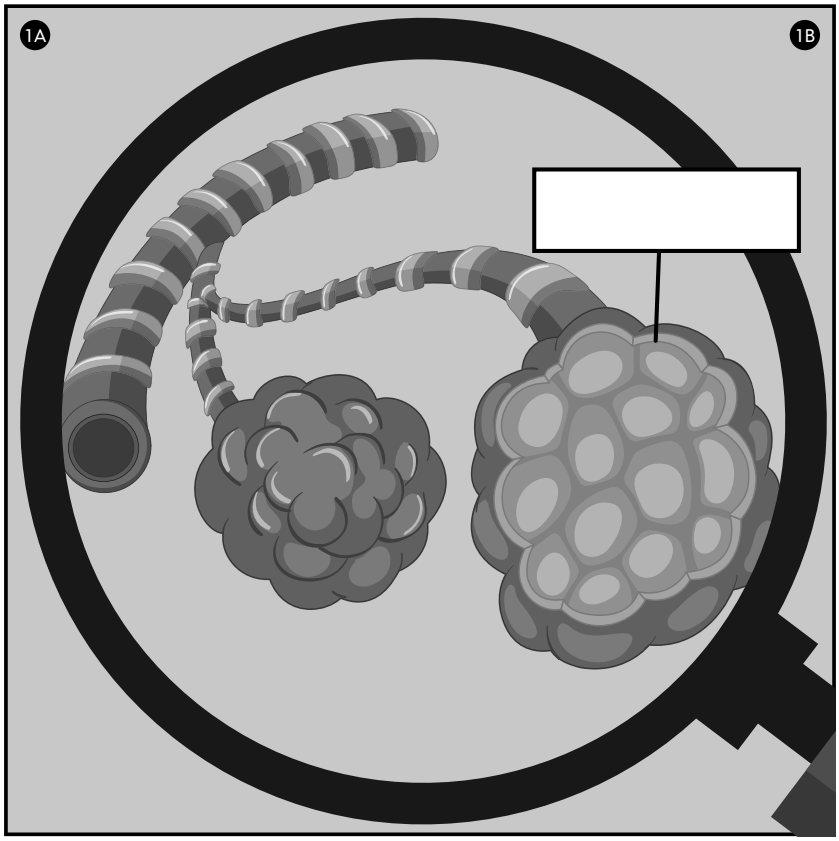




Learning about the Respiratory System

Part A: Parts of the Respiratory System

Complete this section following the instructions on the 'Zooming into the Respiratory System' worksheet.



HOW DO THE LUNGS WORK?

Air enters the _____ via the _____, which divides into two _____. These bronchi branch into _____ _____, which then branch into smaller _____. Air passes through these bronchioles which are connected to _____. In the alveoli, oxygen is extracted from the air and passes into the blood stream. There are millions of alveoli in our lungs. The alveoli are surrounded by _____, which allow the exchange of gases.

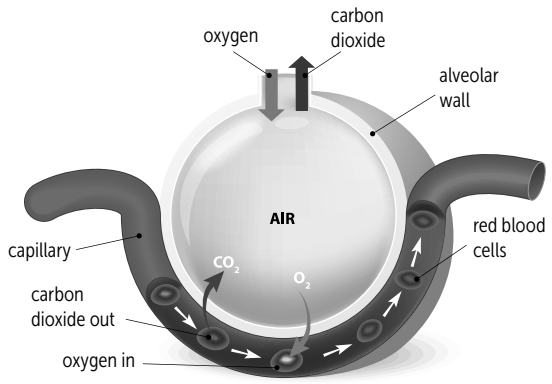
Trachea	Lungs	Alveoli (air sacs)	Bronchiole tubes
Bronchi	Bronchioles	Capillaries	

Part B: The Alveoli (Air Sacs)

Each alveolus has features that allows effective gas exchange in the lungs. In pairs, research and find out more about the features of alveoli.

Feature	How does it helps to make gas exchange effective?
The wall of each alveolus is one cell thick.	
The combined surface area of all the alveoli in one lung is about the size of half a tennis court.	
The alveoli are surrounded by many capillaries.	

Cross Section of an Air Sac



Gases move across the walls of the alveoli through _____, from a region of _____ concentration to a region of _____ concentration.

The Human Digestive System

OBJECTIVES

In this lesson, students will learn about the different parts of the digestive system, including their location and function in the digestion process.

ACARA CONTENT DESCRIPTIONS

Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment (ACSSU175)

- describing how the requirements for life (for example oxygen, nutrients, water and removal of waste) are provided through the coordinated function of body systems such as the digestive system

Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

- using internet research to identify problems that can be investigated
- evaluating information from secondary sources as part of the research process

LESSON PLAN

Activities	Resources
Activity 1: Learning about the Digestive System Give out the *Organs of the Digestive System* worksheet to each pair of students and ask them to cut out and fold the individual labels in preparation for the task. Give out the *Label the Digestive System* worksheet to students. Play Chapter 5 of the video and ask students to complete the worksheet after watching the video. Give students some time to research the organs not mentioned in the video online. Review answers using the presentation slides. 35	• Photocopies of the *Organs of the Digestive System* and *Label the Digestive System* worksheets (printed in A3) • Scissors and glue • ClickView video: *The Human Body: How It Works* Chapter 4 • Laptops • Presentation: The Human Digestive System
Activity 2: Digestion and Absorption Give out the *Digestion and Absorption* worksheet and divide students into pairs. Ask students to research online to find the answers for Part A and Part B of the worksheet. Ask students to share their findings once they have finished. 25	• Photocopies of the *Digestion and Absorption* worksheet • Laptops

ANSWERS

Label the Digestive System

Students' answers may vary.

Possible answers:

Organs and Processes	Function
Mouth (ingestion, digestion)	Food starts to be digested here. The mouth produces saliva which helps to break down the food.
Oesophagus (ingestion)	It is a muscular tube that pushes the food down into the stomach. The walls of the oesophagus contract (squeeze together) to aid the movement of food from the mouth to the stomach. This allows food to be swallowed even while we are lying down!
Stomach (digestion)	The stomach has muscles that crush and squash what we eat and drink. The food also mixes with digestive juices.

ANSWERS

Label the Digestive System - continued

Organs and Processes	Function
Liver (digestion)	It produces bile required to emulsify lipids (fats) in the small intestine.
Gall bladder (digestion)	It stores bile between meals and releases it through the bile duct into the small intestine to help in the digestion of lipids (fats).
Pancreas (digestion)	It produces pancreatic juice required to digest proteins and carbohydrates. The juice is released through the pancreatic duct into the small intestine.
Small intestine (digestion, absorption)	The small intestine is a long (about 7.5m), hollow tube that snakes around the abdomen. The lining of the small intestine is made up of tiny fingers called villi. Villi contain small blood vessels that collect nutrients. In the small intestine, proteins are further broken down by enzymes produced in the pancreas and fats are emulsified by bile produced in the liver.
Large intestine (absorption, excretion)	The food not taken into the bloodstream by the small intestine travels into the large intestine. It is shorter than the small intestine, at about 1.5 m. Water is absorbed here as well.
Appendix	Recent research suggested that the appendix serves as a reserve for good bacteria that the body can use when required.
Rectum and anus (Excretion)	Undigested food is stored in the rectum as waste, this comes out of the anus as faeces.

Digestion and Absorption

Students' answers may vary.

Possible answers:

Part A:

Product	Carbohydrates	Lipids	Proteins
What the product is broken into	Simple sugars	Fatty acids and glycerol	Amino acids
Type of enzymes used in the digestive process	Amylase	Lipase	Protease
Location(s) where the digestion takes place	• mouth • stomach • small intestine	• small intestine	• stomach • small intestine

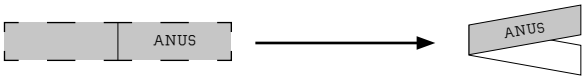
Part B:

Question #1	This decreases the diffusion distance required for nutrients to be absorbed, increasing efficiency of absorption.
Question #2	This increases the surface area for absorption, ensuring that the maximum amount of nutrients can be absorbed.

Organs of the Digestive System

The organs found in the digestive system are labelled in the boxes below.

Instructions:
Cut out each individual label along the dashed lines, then fold along the dotted lines to create a mini book with the name of the organ appearing on the outside.



Task A
As you watch the video, paste each label on the correct organ on the 'Label the Digestive System!' worksheet. Write the function of each organ inside the mini book. For organs not mentioned in the video, research to find out how they also contribute to the digestive process.

Task B
There are four stages of food processing: ingestion, digestion, absorption and excretion. They occur in different organs. In your groups, research which stage(s) each organ is part of and write your findings on the same pieces of paper from Task A.

GALL BLADDER

APPENDIX

LARGE INTESTINE

LIVER

MOUTH

OESOPHAGUS

PANCREAS

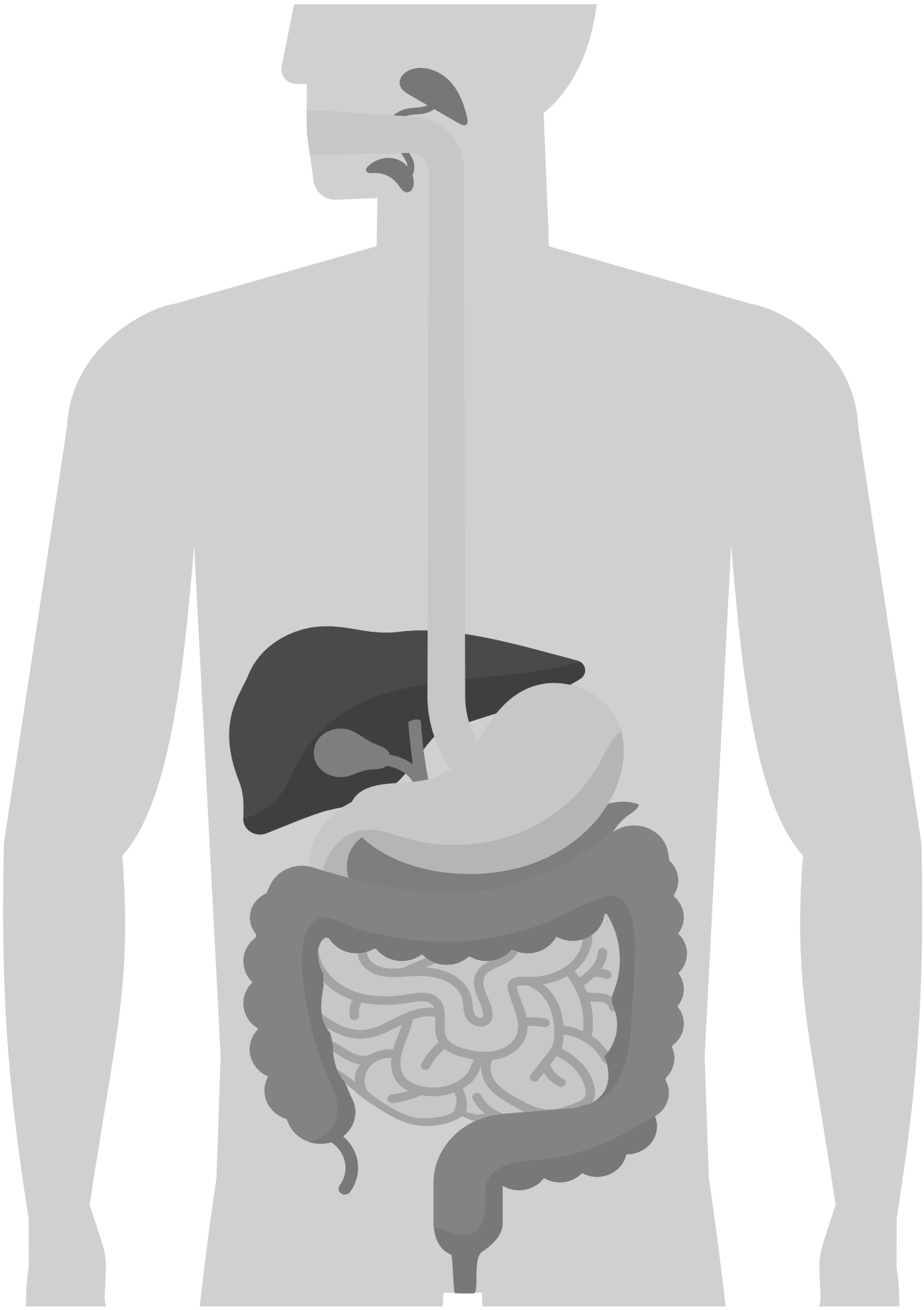
RECTUM AND ANUS

STOMACH

SMALL INTESTINE

Label the Digestive System!

Task A: Complete the diagram using the labels from the 'Organs of the Digestive System' worksheet.



Digestion and Absorption

Part A: Digestion and Enzymes

The foods we eat have to be broken down chemically into really tiny particles before the body can absorb them. The breakdown is carried out by special proteins called enzymes. Different types of enzymes are required to break down different types of nutrients. In pairs, conduct research to complete the table below.

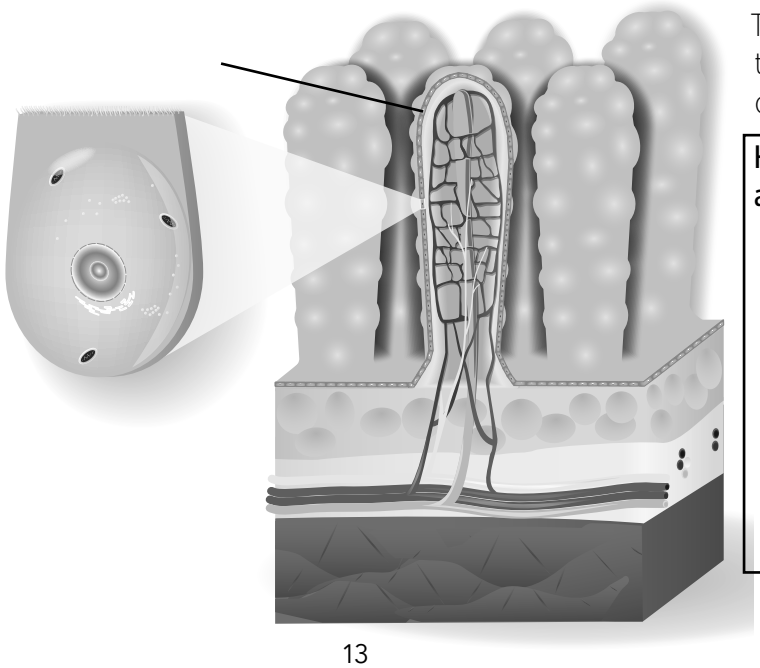
Product			
	Carbohydrates (starch, sugar and fibre)	Lipids (fats and oils)	Proteins (meat, eggs, dairy products, fish, nuts and beans)
What the product is broken into			
Type of enzymes used in the digestive process	a__yl__ __ __	l__p__ __ __	__ro__ __ __ __ __
Location(s) where the digestion takes place			

Part B: Absorption and Villi

Most of the nutrients in the food you eat are absorbed into the blood as they pass through the lining of the small intestine. The lining of the intestine is made up of an important feature that aids the absorption of nutrients. Research to find answers to the questions below.

Question #1:
Villi have very thin walls that are only one cell thick.

How does this help in absorption?



Question #2:
There are millions of tiny villi lining the walls of the small intestine.

How does this help in absorption?

The Human Nervous System

OBJECTIVES

In this lesson, students will learn about the human nervous system, what makes up the system and understand better using analogy activities.

ACARA CONTENT DESCRIPTIONS

Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment (ACSSU175)

- describing how the requirements for life (for example oxygen, nutrients, water and removal of waste) are provided through the coordinated function of body systems such as the nervous system
- identifying responses using the nervous system

Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

- using internet research to identify problems that can be investigated
- developing ideas from students own or others' investigations and experiences to investigate further

Planning and conducting:

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)

- using modelling and simulations, including using digital technology to investigate situations and events

LESSON PLAN

Activities	Resources
Activity 1: What a Nervous System! Give out the *What a Nervous System!* worksheet. Play Chapter 3 of the video and give time to students to attempt Part A of the worksheet individually. Give time to students and ask them to work in pairs to complete Part B of the worksheet in their notebooks. Review the answers for both parts of the worksheet. 20	• Photocopies of the *What a Nervous System!* worksheet • ClickView video *Multicellular Organisms and Their Nervous System* Chapter 3 • Notebooks
Activity 2: Function of the Nervous System Give out the *Function of the Nervous System* worksheet to each pair of students. Allow students to try the worksheet, first on their own, before sharing their answers with their partner and explaining their analogy. 15	• Photocopies of the *Function of the Nervous System* worksheet
Activity 3: Transmitting the Message Give out the *Transmitting the Message* worksheet to students. Divide the class into groups of 6 and have them play the Chinese whispers game in Part A of the worksheet. In this game, the groups stand in a line and the same secret message is relayed quietly from the first to last person of each group. At the end of the line, the last person will write down the message that they have heard. This activity will allow students to understand how everyone's nervous system relays messages differently. Allow students to research online to find the answers for Part B of the worksheet. Review answers when students are done. Extension: Ask students to find out some of the factors that might affect a neuron's effectiveness in transmitting messages. 25	• Photocopies of the *Transmitting the Message* worksheet • Secret message • Laptop

ANSWERS

What a Nervous System!

Part A:

1. nervous cells or neurons
2. nervous tissues
3. Neurons transmit electrical impulses in the nervous tissue throughout the body.
4. Support cells don't transmit signals but allow neurons to transmit signals.
5.

Part	Made up of...
Central Nervous System (CNS)	Brain and spinal cord
Peripheral Nervous System (PNS)	Nerve fibres throughout the body

6. Eyes, ears and skin (video); tongue and nose (knowledge)

Part B:

	1	2	3
Stimulus	sunlight	loud sound	foul smell
Sensory receptors	eyes	ear	nose
Brain			
Effector cells	eye muscles	hand muscles	hand muscles
Effect/response	close eyes	cover ears	pinch nose

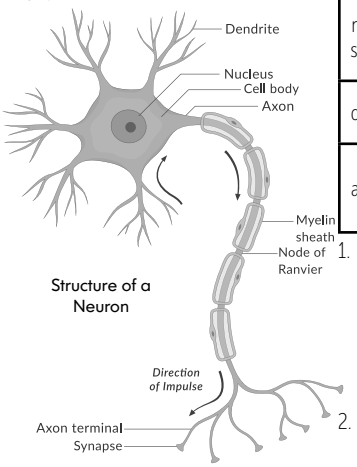
Functions of the Nervous System!

Students' answers may vary.

Post office mail headquarters of postal services	Brain part of the central nervous system, sends and receives messages from the body
Mail mail received from people and sent to the post office	Electrical signals signals received from sensory organs and sent to the brain
Postman delivering mail delivering mail at the request of the post office	Effector cells carry out the desired actions told by the brain
Mail truck delivering and collecting mail to and from people	Spinal cord consists of the nerves that run down your back and carry messages to and from the brain
People posting out mail people sending out mail, wanting it to be delivered	Sensory receptors get stimulated and send information to the brain, demanding an action

Transmitting the Message

Part B:

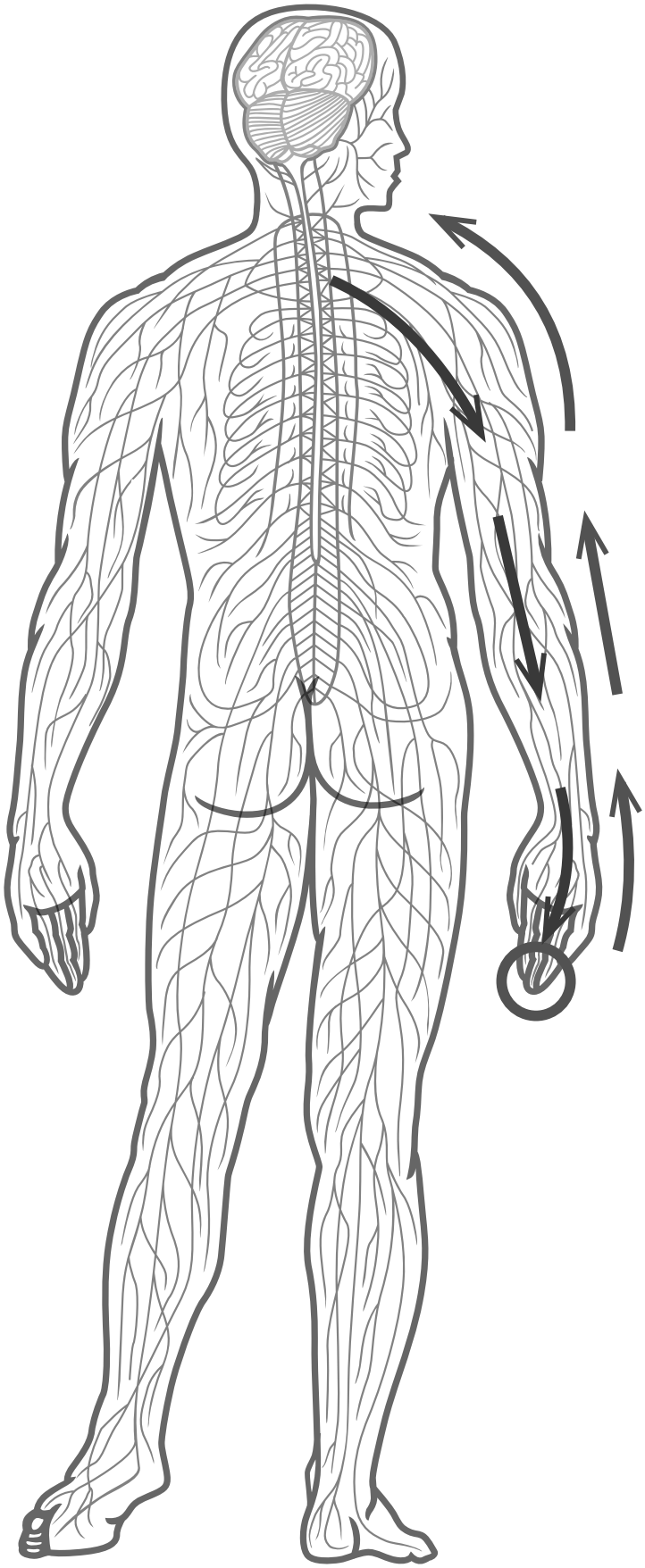


Part	Function
myelin sheath	speeds up the rate of transmission of an electrical impulse along the axon
dendrite	receives electrical messages from other neurons
axon	conducts electrical impulses away from neuron cell's body and transmit to other neurons

1. At the axon terminals at the end of one neuron, chemicals known as neurotransmitters are released. They travel across synapses to receptors found on dendrites and this triggers the message to be passed on.
2. a) sensory neurons
   b) motor neurons
   c) interneurons

What a Nervous System!

As you watch the video, answer and complete the questions in the worksheet.



Part A:

1. What is the name of the specialised cells that transmit messages in the nervous system?

_____

2. What kind of tissues do these cells form?

_____

3. How do these cells transmit messages?

_____

_____

4. What are support cells?

_____

_____

5. There are two parts that make up the nervous system.

What are they and what do they consist of?

Part	Made up of...

Highlight the two different parts of the nervous system in the diagram. Use two different colours.

6. What are the main sensory organs mentioned in the video and from your knowledge?

_____

_____

Part B:

The flowchart below describes what happens in the nervous system when you touch a hot surface.

Stimulus = Hot surface
↓ ↓
Sensory receptors = Skin
↓ ↓
Brain
↓ ↓
Effector cells = Muscle
↓ ↓
Effect/response = Move hand away

Choose one of the scenarios below and draw a flowchart describing a plausible action.

1. Exposing eyes to very bright light
2. Hearing a prolonged loud sound
3. Smelling something foul

Functions of the Nervous System

The parts of the nervous system are just like the postal system! Each of the following components that make the post system efficient corresponds to a part in the nervous system. Match the components and list the function of each part in the nervous system and how it matches with the analogy. An example has been done for you.

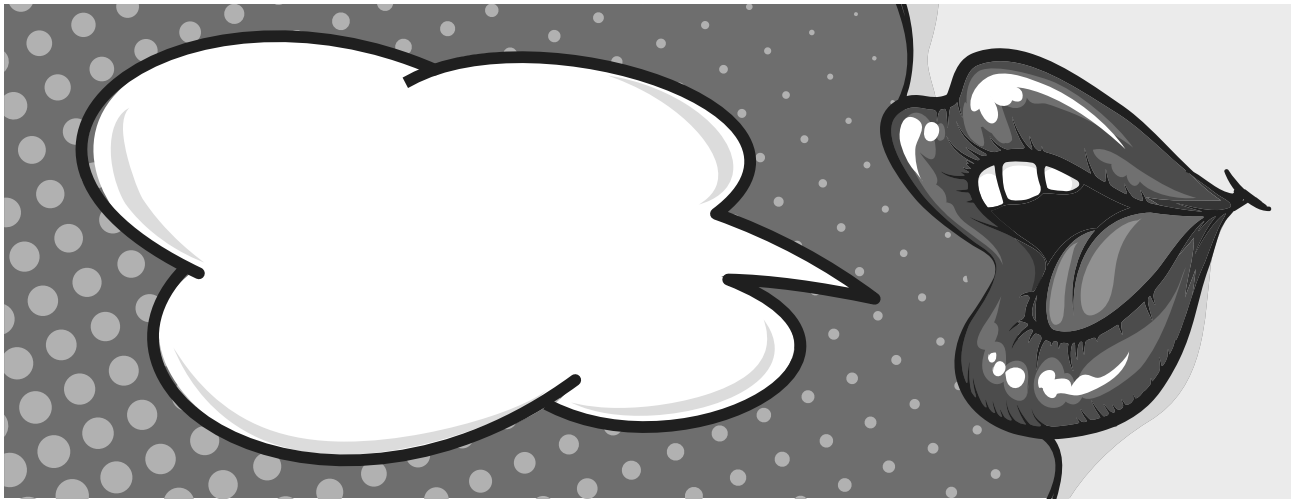
Post office	Mail	Postman delivering mail	Mail truck	People posting out mail
Effector cells	Spinal cord	Brain	Electrical Impulses	Sensory receptors

The parts of the nervous system are just like the postal system! Each of the following components that make the post system efficient corresponds to a part in the nervous system. Match the components and list the function of each part in the nervous system and how it matches with the analogy. An example has been done for you.

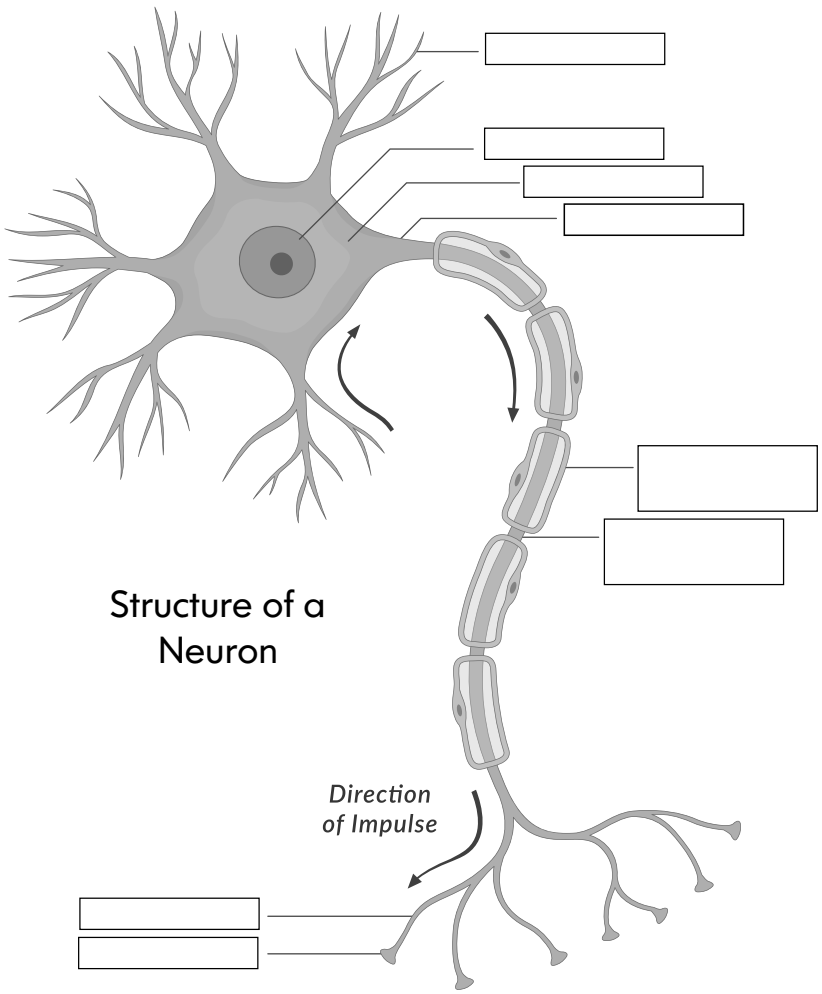
Post office	Mail	Postman delivering mail	Mail truck	People posting out mail
Effector cells	Spinal cord	Brain	Electrical Impulses	Sensory receptors

Transmitting the Message

Part A: Write down the message that you've heard from your friend.



Part B: Research online to understand more about the neuron, the basic cell unit of the nervous system. Complete the diagram and answer the questions.



Questions:

Part of the neuron	Function
myelin sheath	
dendrite	
axon	

1. Messages flow from one neuron to another at the **synapse**, but they do not make direct contact. How do cells communicate with each other?

_____

_____

_____

_____

_____

_____

2. There are three main kinds of neurons. Find out what they are.

a) _____

b) _____

c) _____

The Electromagnetic Spectrum

OBJECTIVES

In this lesson, students will learn about the electromagnetic spectrum, the features of the spectrum and the effects of exposure to electromagnetic radiation, such as x-rays.

ACARA CONTENT DESCRIPTIONS

Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment (ACSSU175)

- investigating the effects on humans of exposure to electromagnetic radiations such as X-rays and microwaves

Nature and development of science:

Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries (ACSHE158)

- considering how common properties of electromagnetic radiation relate to its uses, such as radar, medicine, mobile phone communications and microwave cooking

Use and influence of science:

People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people's lives, including generating new career opportunities (ACSHE160)

- investigating how technologies using electromagnetic radiation are used in medicine, such as in the detection and treatment of cancer

Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

- using internet research to identify problems that can be investigated
- evaluating information from secondary sources as part of the research process

LESSON PLAN

Activities	Resources
Activity 1: All about the Spectrum Give out the *All about the Spectrum* worksheet. Ask students to work independently to go through the presentation to find the answers for the worksheet. Allow students to share their answers once they have finished. 20	• Photocopies of the *All about the Spectrum* worksheet • Presentation: The Electromagnetic Spectrum • Laptops
Activity 2: Learning about X-Rays Give out the *What's Inside Our Body?* worksheet to students. Give them time to read through the article. Give out the *X-Rays: Friends or Foes?* worksheet to students and play Chapter 3 of the video. Ask students to complete Part A of the worksheet using information from the article and the video. Allow additional time for students to research online for answers not found in the video or article. Review answers when students have finished. For Part B of the worksheet, divide students into pairs and ask them to have a debate on whether radiation is good or bad for humans. They may use information from the section or research online to come out with evidence to support their stance. Have a mini discussion to allow students to share their answers. 20	• Photocopies of the *What's Inside Our Body?* and *X-Rays: Friends or Foes?* worksheet • ClickView video *The Physics of Medical Imaging* Chapter 3

ANSWERS

All about the Spectrum!

	increasing wavelength, decreasing frequency/energy →
Features of the electromagnetic spectrum	• Made up of electromagnetic waves of different frequency and wavelengths • Transverse waves, travel at the speed of light and do not need a medium

Type of ER	Features
Gamma rays	• has the highest energy • smallest wavelength • largest frequency • harmful to humans
X-rays	• has many medical uses
Ultra-violet	• produced by the Sun • best natural source of vitamin D
Visible light	• only part of the spectrum that is visible
Infrared	• used commonly in thermal-infrared imaging in airports
Microwaves	• used most commonly in cooking
Radio waves	• weakest in energy • used in telecommunications

X-Rays: Friends or Foes?

Part A:

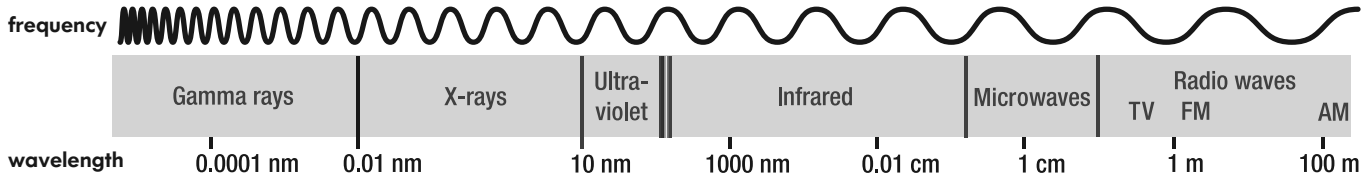
1. Different parts of the body absorb X-rays differently. Denser parts of our bodies, (e.g. our bones) absorb more of the X-rays and appear as white/light grey. Less dense areas absorb less X-rays and show up in a darker colour.
2. Possible answer:

X-ray imaging allows doctors a view of the insides of the body in a short period of time. They help in the detection of abnormal growth, and help doctors diagnose the presence of a tumour. As it is painless and non-invasive, it's a relatively safe procedure to be carried out on patients.
X-ray is a form of ionising radiation, and prolonged exposure to such radiation like X-rays and CT scans may increase a person's risk of developing cancer in future. Children are more sensitive to radiation, which may put them at higher risk as compared to adults.
CT/CAT is a medical imaging procedure that is based on the principles of X-ray. Tomography comes from the word *tomos*, which means a slice/cut, and *graphein*, which means to record. Imagine slicing a loaf of bread, each image recorded in CT/CAT is like a slice of bread. These individual images can be viewed on its own or put together to produce a 3D picture.

Part B: Students' answers may vary.

All about the Spectrum

Complete the worksheet with details from the presentation.



increasing _____, decreasing _____

Features of the electromagnetic spectrum	

	Type of ER and features
	
	
	
	

	Type of ER and features
	
	
	

What's Inside Our Body?

X-RAY

MEDICAL USAGE

What is X-ray?

X-ray is a form of electromagnetic radiation. It was discovered by a German physics professor Wilhelm Röntgen in 1895. He referred to the radiation "X", purely to mean that it was an unknown type of radiation at that time.

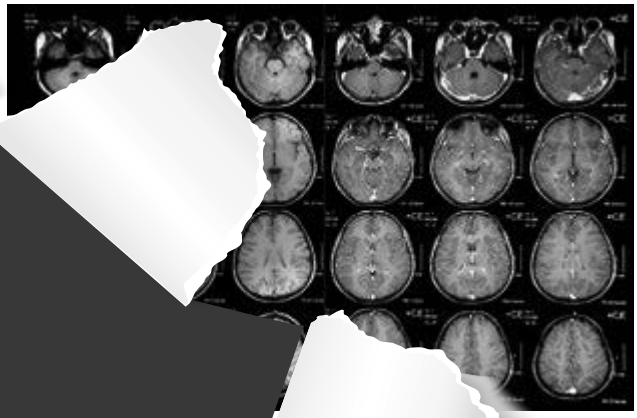
It is able to penetrate bodies, which makes it widely used to image the inside of objects, especially in medical imaging. The first use of X-rays under clinical conditions was in 1896 by John Hall-Edwards in England, when he stuck a needle in the hand of his friend and radiographed it.

How do X-rays work in medical imaging?

Unlike light, our bodies are able to absorb X-rays, and different parts of the body absorb X-rays differently. When X-rays pass through the body, denser parts, such as our bones, absorb more of the X-rays and they show up as white/light grey areas on an X-ray image. Less dense areas, such as our heart and lungs, absorb less X-rays and show up as darker images. This allows a 2D image to be created by machines.

What is Computed Tomography (CT)?

CT is a medical imaging [illegible]
on the principles of X-[illegible]
from the word tomos[illegible]
graphein, which mea[illegible]
loaf of bread, each i[illegible]
slice of bre[illegible]
view on i[illegible]
picture. C[illegible]
fashion.



The C[illegible]

X-ray im[illegible]
insides of the[illegible] like
as results can be [illegible] CT sca[illegible]
They help in the dete[illegible] of a[illegible] risk of developing cancer in future.
growth, and help doctors dia[illegible] are more sensitive to radiation,
presence of a tumour. As it is painl[illegible] ay put them at higher risk as
non-invasive, it's a relatively safe proce[illegible] to adults.
to be carried out on patients.

X-Rays: Friends or Foes?

Part A: Answer the following questions as you read the article on 'Seeing the Insides of Our Body' and watching the videos.

1. Why are we able to see different colours on the film during X-ray scanning?

_____

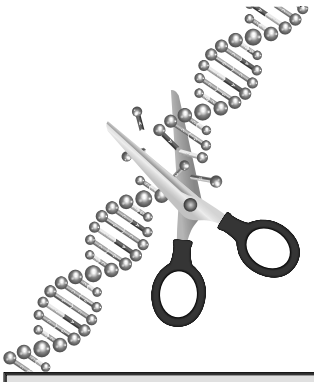
_____

_____

2. Someone has made a big hole in the middle of the article. In your pairs, watch the videos and look out for the answers. After that, research online to find out answers not found in the article or video..

Questions	Your research
What are the benefits of using X-rays in medical imaging?	
What are the risks of using X-rays in medical imaging?	
What is Computed Tomography (CT) or Computer Axial Tomography (CAT)?	

Part B: After reading this short paragraph, have a discussion in pairs about how radiation can be both beneficial and bad for us.



Radiation Damage to our Cells

Radiation damages our cells through ionisation. When it enters a human cell, it strikes the nucleus and damages the DNA, causing cells to divide in an uncontrolled way. Fast growing cells (such as cells of fetuses, reproductive organs, bone marrow as well as cancerous cells) are radiation sensitive.

How is radiation bad to humans?	How is radiation beneficial to humans?

Energy in Ecosystems

OBJECTIVES

In this lesson, students will learn about ecology relationships in an ecosystem and how organisms in an ecosystem are interdependent.

ACARA CONTENT DESCRIPTIONS

Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems (ACSSU176)

- exploring interactions between organisms such as predator/prey, parasites, competitors, pollinators and disease
- examining factors that affect population sizes such as seasonal changes, destruction of habitats, introduced species

Processing and analysing data and information:

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)

- comparing conclusions with earlier predictions and reviewing scientific understanding where appropriate

LESSON PLAN

Activities	Resources
Activity 1: Language in an Ecosystem! Ask students what they recall about food chains and food webs. Have a discussion to throw out key terms related to the topic. Give out the *Language in an Ecosystem* worksheet. Play Chapter 2 and 5 of the video and ask students to complete the crossword puzzle. Not all answers come from the video. Allow students some time to discuss their answers. Review the answers when students have finished. 20	• Photocopies of the *Language in an Ecosystem* worksheet • ClickView video *Energy in Ecosystems* Chapter 2 Chapter 5
Activity 2: Ecology Relationships Give out the *Ecology Relationships* worksheet to each pair of students. Ask students to work in pairs to figure out what happens to the ecosystem under different situations. Some guidance and prompts might be required to get students to think of the many possibilities. Allow students to share their answers. 20	• Photocopies of the *Ecology Relationships* worksheet
Activity 3: Other Ecology Relationships Give out the *Other Ecology Relationships* worksheet. Go through the flowchart and explain to students each of the different kinds of relationships between organisms. Ask students if they know of any examples off the top of their head. Allow students to work in groups of 3 and research to find out the type of relationships between organisms found in the table. Ask students to share their answers. 20	• Photocopies of the *Other Ecology Relationships* worksheet • Laptop

ANSWERS

Language in an Ecosystem

1. habitat
2. photosynthesis
3. decomposers
4. food chain
5. autotroph
6. food webs
7. population
8. heterotroph
9. trophic levels
10. ecosystem
11. biotic
12. abiotic

Ecology Relationships

1. Students' answers may vary
   grass → grasshopper → snake → wedge-tailed eagle
2. It means to be mutually reliant or sense of dependency. It allows for the natural balance of nature to take place, preventing the overpopulation of certain species and allowing for the thriving of others.

Possible answers:

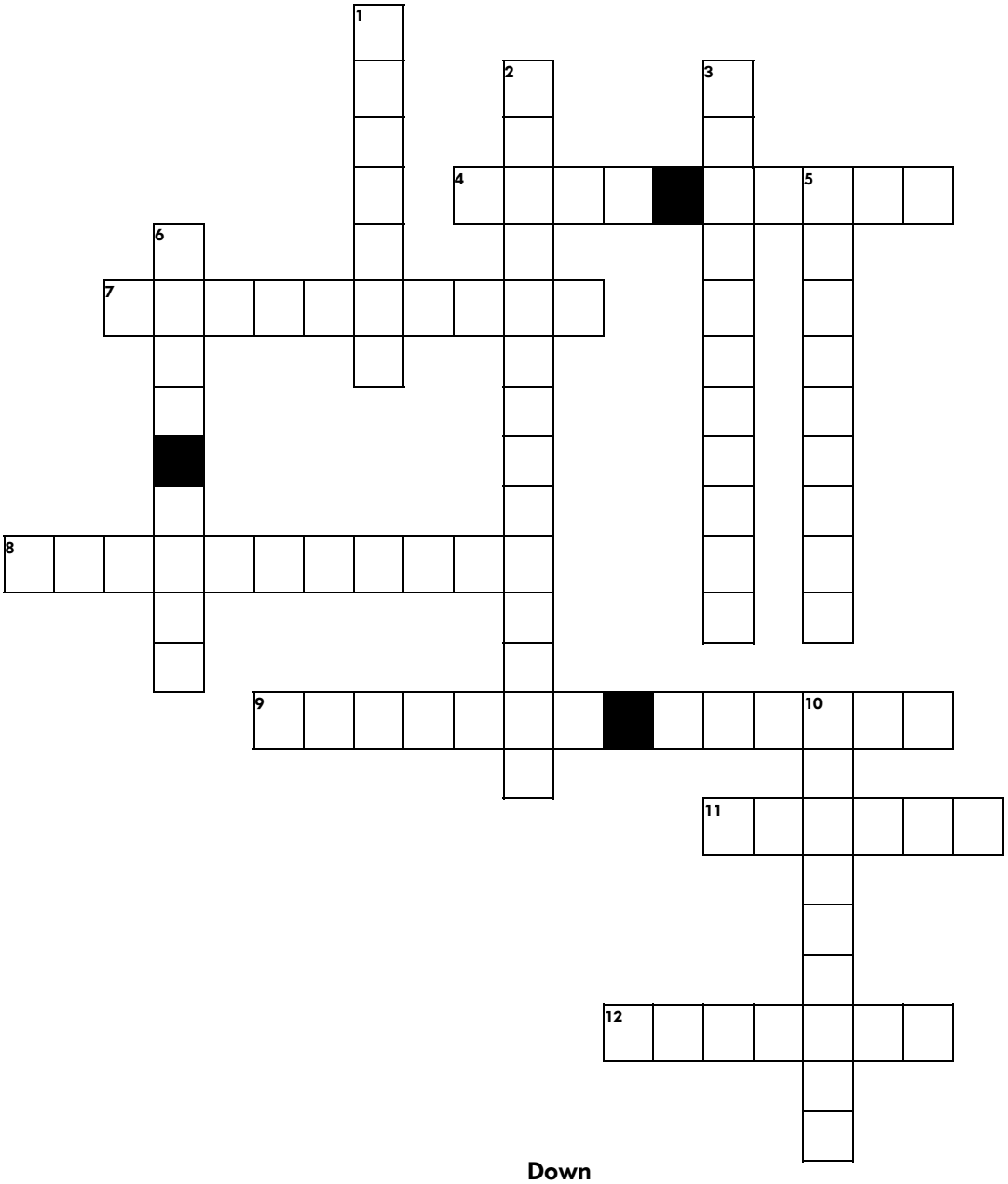
3. a) The population of the grasshoppers, rabbits and field mice would eventually decrease as their source of food is gone. In the long term, the entire ecosystem would shut down as the animals do not have their source of food.
   b) The population of grasshoppers would decrease as it will be the only source of food for the snake and kookaburra.
   c) The number of kookaburra and snakes would increase due to the lack of a predator.
4. Students' answers may vary

Other Ecology Relationships

	Type of relationship	Elaboration
1	commensalism	Orchids are epiphytes, which means that they grow on plants. They benefit from this arrangement because it prevents them from being eaten and receive more sunlight. The tree that they grow on is not harmed at all.
2	predation	The venus flytrap attracts flies with its reddish colour and scent, trapping flies when the flies touch their leaves.
3	parasitism	Bed bugs feed on the blood of humans and cause itchy red papules and humans do not benefit from this relationship.
4	mutualism	Both organisms benefit in this relationship. Gobies live in the burrows made by the shrimps and protect shrimps from predators. The shrimp uses its antennae to stay in constant contact with a goby's tail while searching for food. They rest together at night in the burrow.
5	mutualism	Both organisms benefit in this relationship. The oxpeckers feed on the ticks and parasites that live on the skin of zebras.
6	commensalism	The book scorpion hides under the wing covers of the harlequin beetle from predators and for transport. The beetle is not harmed in any way.
7	parasitism	The tetrastigma vines provide everything that is required for the rafflesia plant to survive. However the vine suffers as all its nutrients are sucked by the rafflesia.
8	predation	The praying mantis feeds on the cicada.

Language in an Ecosystem

Complete the crossword puzzle with information from the video and your own knowledge.



Across

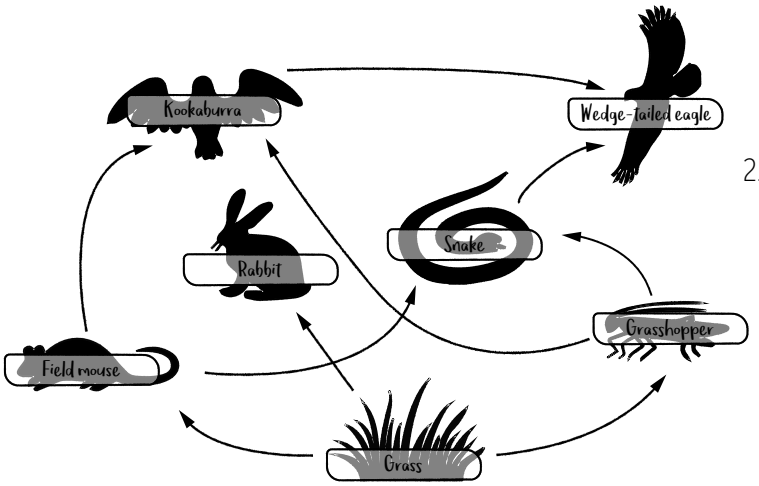
4. The sequence of energy transfer between organisms in the form of food
7. A group of individuals of one species that live in a particular habitat
8. The term describing organisms that obtain their energy through the eating of other organisms (living or non-living)
9. Feeding level in a food chain
11. Factors such as living organisms that may affect a plant or animal's survival (living components)
12. Factors in the physical environment that affect the survival of an organism (non-living components)

Down

1. A place where an organism lives
2. The process where producers convert light energy into chemical energy
3. The group of organisms that feed on dead organic matter
5. The term describing any organism that uses sunlight as energy to make their own food
6. Interlinking food chains
10. A self sufficient community of organisms interacting with each other and their environment

Ecology Relationships

Answer the following questions as you look at the food web found below.



1. List the longest food chain you can find in the food web.

_____

_____

2. All animals in the food web are interdependent. What does the word 'interdependent' mean? Why do you think this is important for an ecosystem?

_____

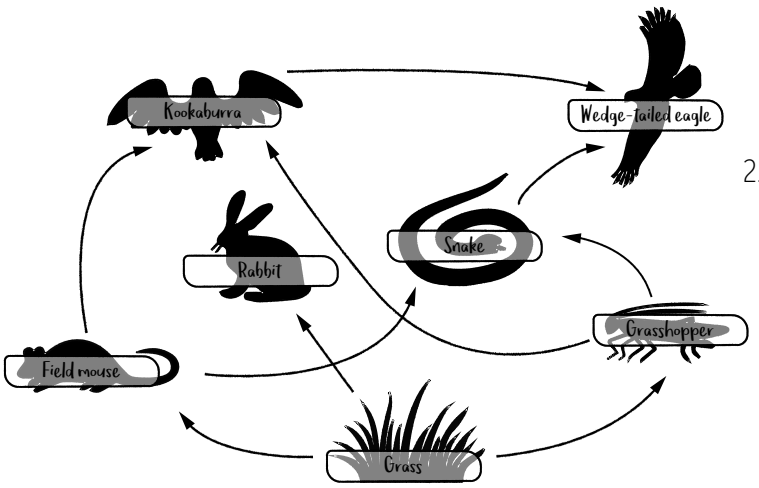
_____

_____

_____

3. Describe how the food web will be affected when: a) a bushfire happens and kills all the grass	c) humans hunt for eagles
b) a plague wipes out all the mice	4. Describe a situation that results in the increase of the population of snakes in the long term.

Answer the following questions as you look at the food web found below.



1. List the longest food chain you can find in the food web.

_____

_____

2. All animals in the food web are interdependent. What does the word 'interdependent' mean? Why do you think this is important for an ecosystem?

_____

_____

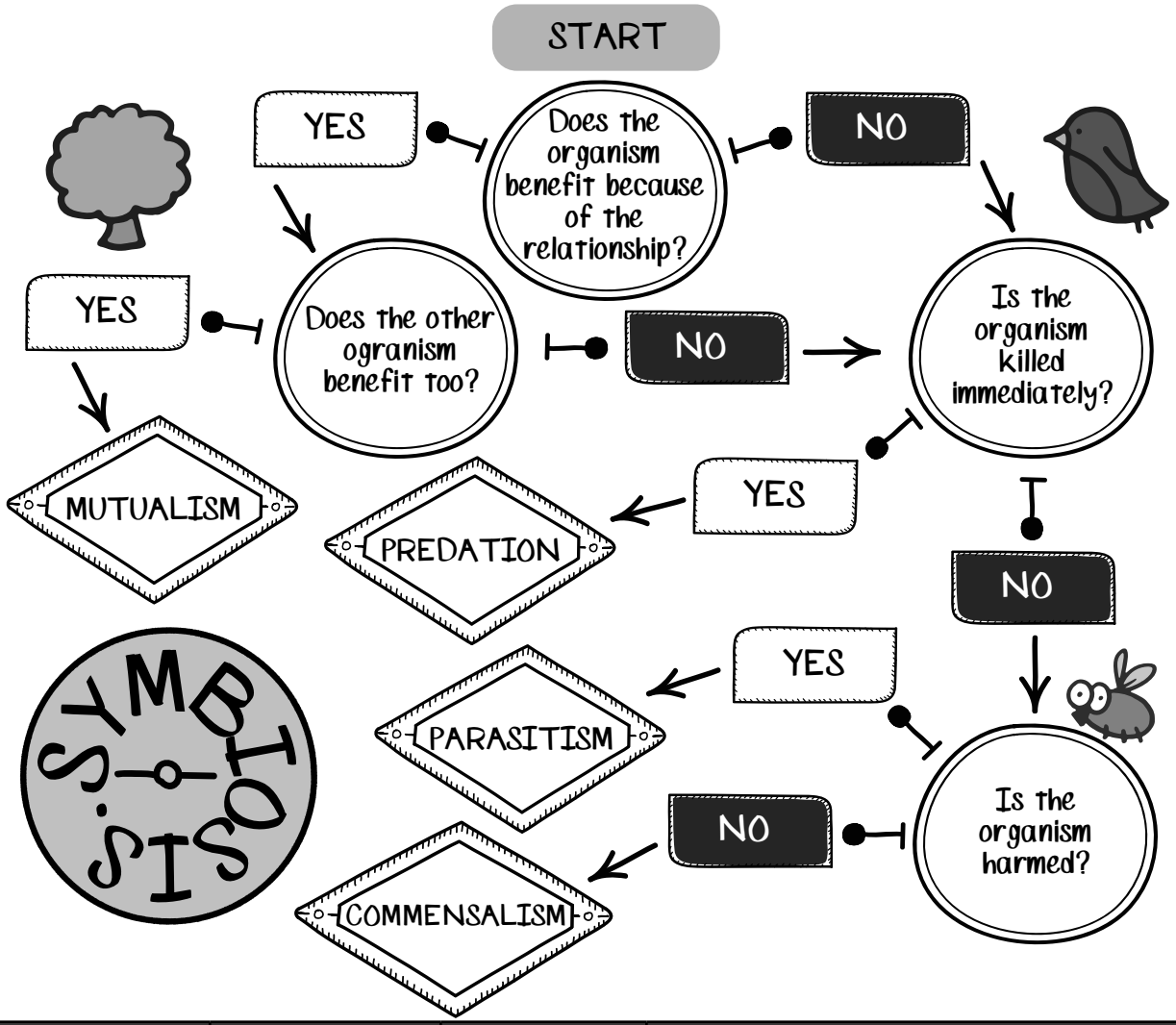
_____

_____

3. Describe how the food web will be affected when: a) a bushfire happens and kills all the grass	c) humans hunt for eagles
b) a plague wipes out all the mice	4. Describe a situation that results in the increase of the population of snakes in the long term.

Other Ecology Relationships

Part A: Complete this section with information from the video.



	Organism 1	Organism 2	Type of relationship	Elaboration
1	orchid	tree		
2	fruit fly	venus flytrap		
3	bed bug	human		
4	goby fish	pistol shrimp		
5	oxpeckers	zebras		
6	book scorpion (pseudoscorpion)	harlequin beetle		
7	raffesia	tetrastigma vines		
8	praying mantis	cicada		

The Atom

LAB LESSON

OBJECTIVES

In this lesson, students will learn about the atom, a brief history of its discovery with special reference to John Dalton, the scientist who developed the modern atomic theory.

ACARA CONTENT DESCRIPTIONS

All matter is made of atoms that are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms (ACSSU177)

- describing and modelling the structure of atoms in terms of the nucleus, protons, neutrons and electrons
- comparing the mass and charge of protons, neutrons and electrons

Nature and development of science:

Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community (ACSHE157)

- investigating the historical development of models of the structure of the atom

Planning and conducting:

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)

- using modelling and simulations, including using digital technology to investigate situations and events

CHEMICAL SCIENCES

LESSON PLAN

Activities	Resources
Activity 1: Dalton's Atomic Theory Divide students into pairs. Give out the *Dalton's Atomic Theory* worksheet and allow time for students to read through the activities. Ask each student pair to research information for Part A. Allow students to share their findings. In pairs, students must create a poster about John Dalton. Showcase the posters in class when students have finished. 25	• Photocopies of the *Dalton's Atomic Theory* worksheet • Laptops
Activity 2: Deconstructing the Atom Give out the *Deconstructing the Atom* worksheet to students. Play Chapters 2 and 3 of the video and ask students to complete the worksheet. Allow students to share their answers with their partners. 15	• Photocopies of the *Deconstructing the Atom* worksheet • ClickView video: *What Are Atoms Made of?* Chapter 2 Chapter 3
Activity 3: Making Edible Atoms Divide students into groups of 4 and give out the *Making Edible Atoms* worksheet. Provide the materials to each group and ask students to complete their models. Remind students to take a picture of their models with a camera. 20	• Photocopies of the *Making Edible Atoms* worksheet • For each group of 4: a packet of multicoloured sweets, camera • Periodic table

Dalton's Atomic Theory

Part A:

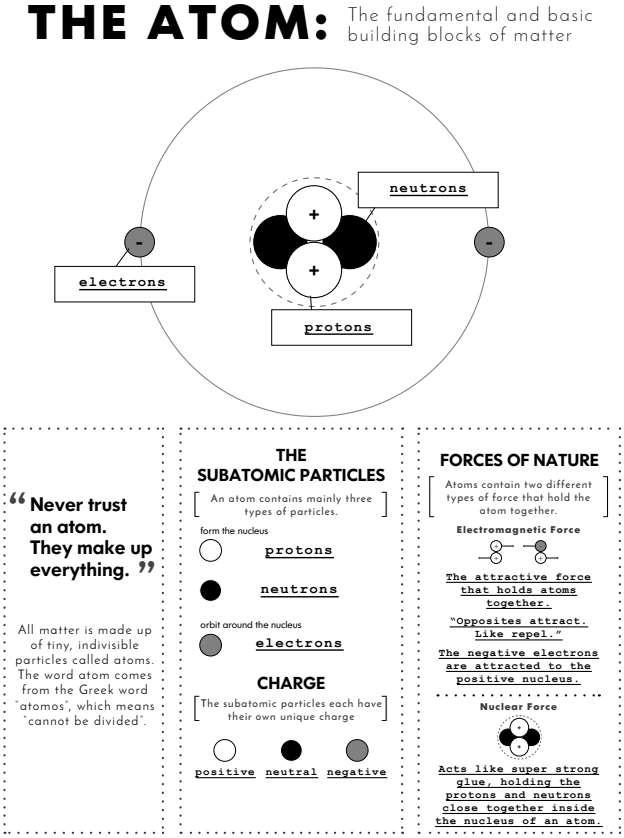
Students' answers may vary depending on the source (between 3-5 conclusions).

Possible answers

1. Everything is made of atoms
2. Atoms are indivisible and cannot be destroyed.
3. All atoms of a given element are identical.
4. Compounds are formed by a combination of two or more different kinds of atoms.
5. A chemical reaction is a rearrangement of atoms in the reactant and product components.

ANSWERS

Deconstructing the Atom



Making Edible Atoms

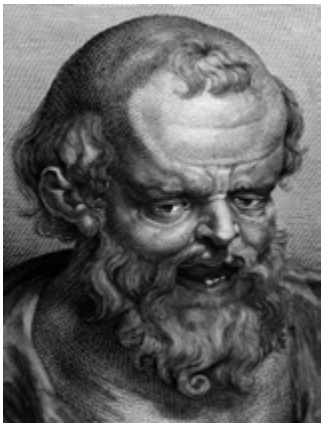
Hydrogen atom

Number of protons:	2
Number of electrons:	2
Number of neutrons:	2

Carbon atom

Number of protons:	6
Number of electrons:	6
Number of neutrons:	6

Dalton's Atomic Theory



Democritus and John Dalton

Democritus was a Greek philosopher and was credited to be one of the first few, together with his mentor Leucippus, to suggest the existence of the atom. Astonishingly, it wasn't until approximately 2000 years later that a scientist by the name of John Dalton developed the atomic theory to explain all matter in terms of atoms and their properties. The essence of Dalton's theory remains valid in today's world.

Part A: Dalton postulated a number of conclusions for his atomic theory. In your pairs, research the conclusions and write about them below.

John Dalton's Atomic Theory

His Conclusions

Part B: In pairs, research John Dalton and create an A4 poster about him.

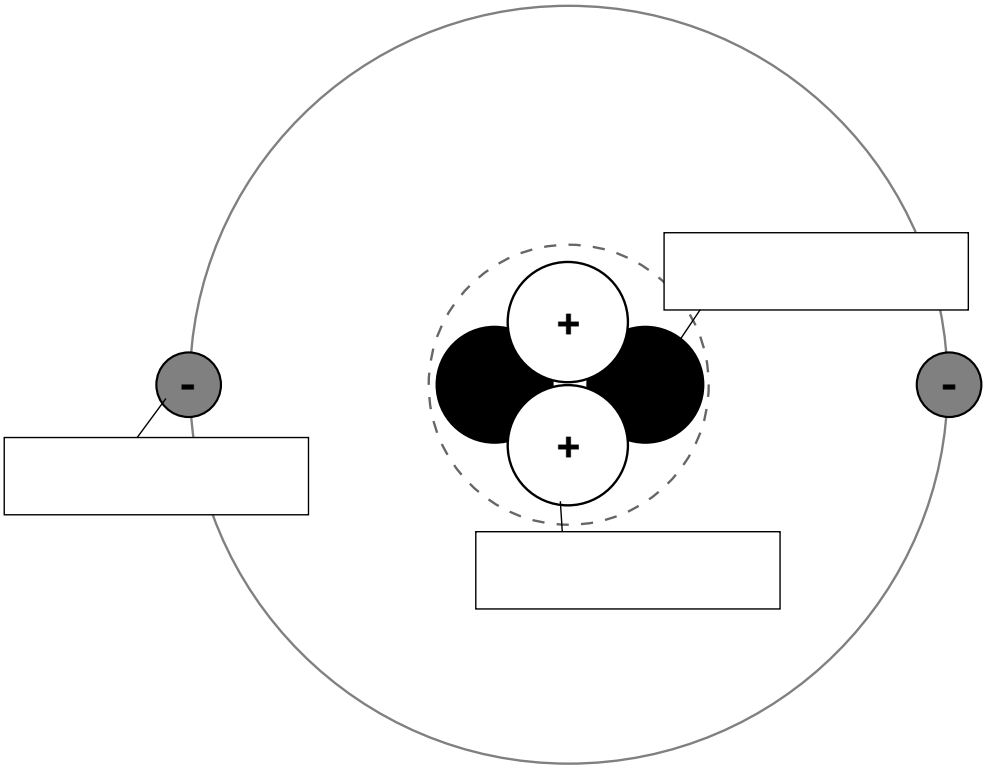
Your poster should include the following:

- his portrait
- the conclusions of his atomic theory
- why Dalton's model was a sucesss and widely accepted
- why it was eventually replaced by the nuclear model

Deconstructing the Atom

Fill in the blank boxes on the poster below with information from the video. Research online for the answers to the 'Forces of Nature' section.

THE ATOM: The fundamental and basic building blocks of matter



CHEMICAL SCIENCES

"Never trust an atom. They make up everything!"

All matter is made up of tiny, indivisible particles called atoms. The word atom comes from the Greek word "atomos", which means "cannot be divided".

THE SUBATOMIC PARTICLES

[An atom contains mainly three types of particles.]

form the nucleus

orbit around the nucleus

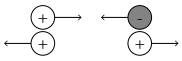
CHARGE

[The subatomic particles each have their own unique charge]

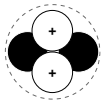
FORCES OF NATURE

[Atoms contain two different types of force that hold the atom together.]

What is Electromagnetic Force?



What is Nuclear Force?



Making Edible Atoms

Materials:

- a packet of sweets (M&Ms or skittles)
- camera

Instructions:

1. In your groups, choose three different coloured sweets, then collect 5 of each colour from the packet. Each colour represents a different subatomic particle.
2. Fill in the key.
3. Use the periodic table to find the number of protons, electrons and neutrons in a hydrogen atom and a carbon atom..
4. Represent each on the diagrams below.
5. Take a picture of your atoms when you have finished.
6. Enjoy the sweets!

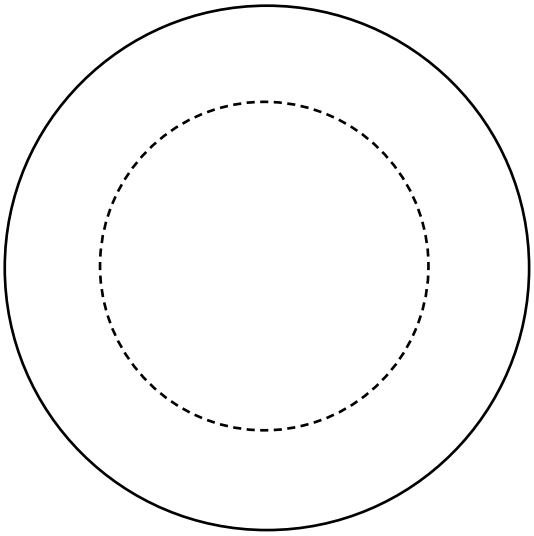
Key

Sweets' colour	Subatomic particle
	proton
	electron
	neutron

CHEMICAL SCIENCES

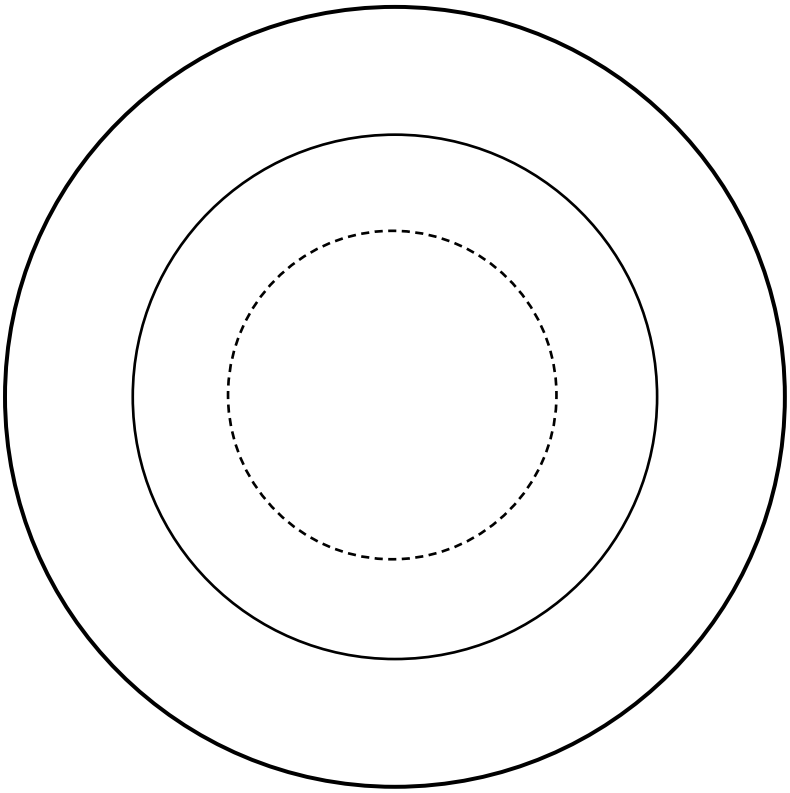
Hydrogen atom

Number of protons:	
Number of electrons:	
Number of neutrons:	



Carbon atom

Number of protons:	
Number of electrons:	
Number of neutrons:	



Reactants and Products

OBJECTIVES

In this lesson, students will learn about chemical reactions and identify reactants and products. They will understand the difference between word and balanced equations and the Law of Conservation of Mass.

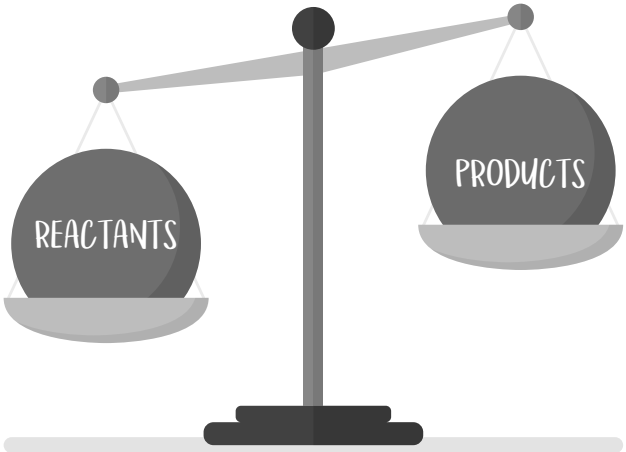
ACARA CONTENT DESCRIPTIONS

Chemical reactions involve rearranging atoms to form new substances; during a chemical reaction mass is not created or destroyed (ACSSU178)

- identifying reactants and products in chemical reactions
- describing observed reactions using word equations
- recognising that the conservation of mass in a chemical reaction can be demonstrated by simple chemical equations

LESSON PLAN

Activities	Resources
Activity 1: Chemistry in Chemical Reactions Give out the *Chemistry in Chemical Reactions* worksheet and allow time for students to read through the activities. Play Chapter 1 of the video and ask students to complete the worksheet as they watch. Discuss and allow students to come up to the board to share their answers. 25	• Photocopies of the *Chemistry in Chemical Reactions* worksheet • ClickView video *The Energy of Chemical Reactions* Chapter 1
Activity 2: The Fine Balance of Chemical Reactions Give out the *The Fine Balance of Chemical Reactions* and *Can You Find the Balance?* worksheets to students. Ask students to work in pairs using guidance from *The Fine Balance of Chemical Reactions* worksheet to work out the questions on the *Can You Find the Balance?* worksheet. Review answers when students have finished. 35	• Photocopies of the *The Fine Balance of Chemical Reactions* and *Can You Find the Balance?* worksheets



ANSWERS

Chemistry in Chemical Changes

1. One or more new substances are formed.
   Energy is either given off or absorbed.
2. Energy is taken in — to form bonds
   Energy is given out — to break bonds
3. a) Propane reacts with oxygen to give carbon dioxide and water.
   b) Propane and oxygen
   c) Carbon dioxide and water
   d) It is a chemical reaction, new substances are formed and a gas is released

e)

C_3H_8	O_2	CO_2	H_2O
3(12.0) + 8(1.0) = 44.0 g	2(16.0) = 32.0 g	12 + 2(16.0) = 44.0 g	2(1.0) + 16.0 = 18.0 g

f)

44.0 + 5(32.0) = 204.0 g	3(44.0) + 4(18.0) = 204.0 g

4. Students' answers may vary.

Iron rusting	A new substance is formed and the reaction is irreversible.
Burning fossil fuels	A gas is released, the reaction is irreversible and energy is given off.
Baking a cake	New substances are formed and it is irreversible.

The Fine Balance of Chemical Equations

2,1,1

Mass of Reactants = Mass of Products (36.0g)

Can You Find the Balance?

Balanced	$2\,Na + Cl_2 \rightarrow 2\,NaCl$		
Word equation	Sodium reacts with chlorine to give sodium chloride.		
Total mass of all reactants	2(23.0) + 2(35.5) = 117.0 g	Total mass of all products	2(23.0 + 35.5) = 117.0 g

Balanced	$Mg + Cl_2 \rightarrow MgCl_2$		
Word equation	Magnesium reacts with chlorine gas to form magnesium chloride ($MgCl_2$).		
Total mass of all reactants	24.3 + 2(35.5) = 95.3 g	Total mass of all products	24.3 + 2(35.5) = 95.3 g

Balanced	$2\,Cu + O_2 \rightarrow 2\,CuO$		
Word equation	Copper reacts with oxygen gas to give copper oxide.		
Total mass of all reactants	2(63.5) + 2(16.0) = 159.0 g	Total mass of all products	2(63.5 + 16.0) = 159.0 g

Balanced	$N_2 + 3\,H_2 \rightarrow 2NH_3$		
Word equation	Nitrogen gas reacts with hydrogen gas to produce ammonia.		
Total mass of all reactants	2(14.0) + 3(2(1.0)) = 34.0 g	Total mass of all products	2(14.0 + 3(1.0)) = 34.0 g

Balanced	$4\,Fe + 3\,O_2 \rightarrow 2\,Fe_2O_3$		
Word equation	Iron reacts with oxygen to give iron oxide.		
Total mass of all reactants	4(55.8) + 3(2(32.0)) = 319.2 g	Total mass of all products	2(2(55.8) + 3(16.0)) = 319.2 g

Balanced	$2\,Na + 2\,H_2O \rightarrow 2\,NaOH + H_2$		
Word equation	Sodium reacts with water to form sodium hydroxide and hydrogen gas.		
Total mass of all reactants	2(23.0) + 2(18.0) = 82.0 g	Total mass of all products	2(23.0 + 16.0 + 1.0) + 2(1.0) = 82.0 g

Chemistry in Chemical Reactions

After you watch the videos, answer the following questions using information from the video and your own knowledge.

1. How do you know a chemical reaction has taken place?

   1) _____

   2) _____

2. Between molecules...

Energy is taken in •	• to form bonds
Energy is given out •	• to break bonds

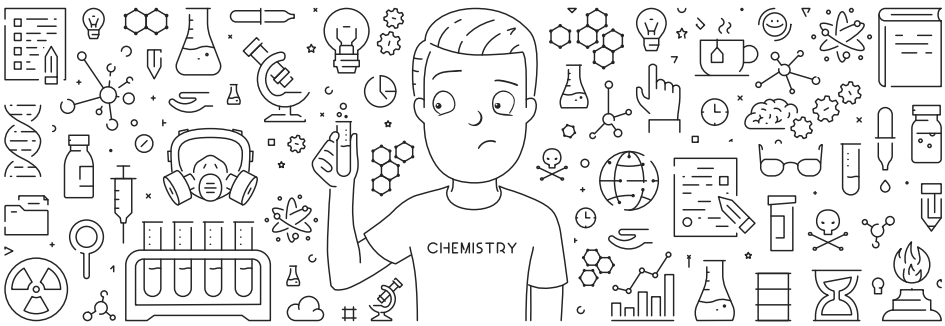
3. The below shows the **chemical equation** of the combustion of propane. Answer the following parts of the question.

Atomic mass of C = 12.0, H = 1.0, O = 16.0

Balanced equation	C_3H_8 + $5\ O_2$		→	$3\ CO_2$ + $4\ H_2O$		
a) Word equation						
b) What are the reactants?						
c) What are the products?						
d) Is this a physical or chemical reaction? Why?						
e) Molecular mass of one unit of each substance		one O_2 = 2 x 16.0 = 32.0 g				
f) Total mass of all reactants	(There are 5 units of O_2...)		Total mass of all products			

4. For the following scenarios, explain how you know when a chemical change has occurred.

Iron rusting	
Burning fossil fuels	
Baking a cake	



CHEMICAL SCIENCES

The Fine Balance of Chemical Equations

Read this section carefully and complete the questions.

LAW OF CONSERVATION OF MASS

One of the most important laws in chemistry is the Law of Conservation of Mass. It states that matter is neither created nor destroyed in an ordinary chemical reaction. No atoms will be gained or lost during the reaction. This means that the mass of reactants will equal to the mass of products.

EQUATIONS IN CHEMISTRY

There are two types of equations that can be used in Chemistry - word equations and balanced equations.
Chemical equations represents the reaction taking place. Generally, they are written as:

Reactants react to form products.

reactants → products

Word equations:

A word equation is a chemical equation written in words rather than in chemical formulae.

For the formation of water, the word equation for the reaction can be written as:

Hydrogen reacts with oxygen to form water.

However, this equation does not tell us the amount of each substance needed or produced. That's when the second type of equation - the balanced equation - become more useful to us.

Balanced equations:

Balanced equations show us the symbols and formulae of the substances involved.
For the word equation above, if we replace the words with their formulae and separate substances with a '+' sign, the reaction can be re-written as:

$$H_2 + O_2 \rightarrow H_2O$$

What do you notice about this equation? It's not yet balanced! To make an equation balanced, we need to adjust the number of units of some of the substances by adding coefficients (for example $2H_2O$ = 2 water molecules) until we get equal numbers of each type of atom on both sides. Do not change the formulae of the compounds or elements (numbers within the formula). The final balanced equation will tell us the ratio of reactants required for this reaction to occur and the amount of products formed.

Have a go at balancing the above equation! Are there equal numbers of each element on each side?

_____ H_2 + _____ O_2 → _____ H_2O

When you've finished, check whether your equation follows the Law of Conservation of Mass!
(Atomic mass of H = 1.0, O = 16.0)

Total mass of reactants	Total mass of products

Can You Find the Balance?

Fill in the missing information and answer the questions. Check that the symbol equation is balanced before calculating the mass of the reactants and products. Research online for any unknown compounds.

Key

Atomic Mass	
H (hydrogen)	1.0
C (carbon)	12.0
N (nitrogen)	14.0
O (oxygen)	16.0
Na (sodium)	23.0
Mg (magnesium)	24.3
Cl (Chlorine)	35.5
Fe (iron)	55.8
Cu (Copper)	63.5

1.

Balanced equation	___ Na + ___ Cl_2 → ___ NaCl		
Word equation			
Total mass of all reactants		Total mass of all products	

2.

Balanced equation			
Word equation	Magnesium reacts with chlorine gas to form magnesium chloride ($MgCl_2$).		
Total mass of all reactants		Total mass of all products	

3.

Balanced equation	___ Cu + ___ O_2 → 2 CuO		
Word equation			
Total mass of all reactants		Total mass of all products	

4.

Balanced equation			
Word equation	Nitrogen gas reacts with hydrogen gas to produce ammonia.		
Total mass of all reactants		Total mass of all products	

5.

Balanced equation	___ Fe + ___ O_2 → ___ Fe_2O_3		
Word equation			
Total mass of all reactants		Total mass of all products	

6.

Balanced equation			
Word equation	Sodium reacts with water to form sodium hydroxide and hydrogen gas.		
Total mass of all reactants		Total mass of all products	

Acids and Bases

LAB LESSON

OBJECTIVES

In this lesson, students will learn about acids and bases. They will learn how to identify whether a substance is acidic or basic through the use of indicators.

ACARA CONTENT DESCRIPTIONS

Chemical reactions, including combustion and the reactions of acids, are important in both non-living and living systems and involve energy transfer (ACSSU179)

- investigating reactions of acids with bases

Processing and analysing data and information:

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)

- comparing conclusions with earlier predictions and reviewing scientific understanding where appropriate

LESSON PLAN

Activities	Resources
Preparation: Test the pH of the samples used in Activity 3 to get a rough idea of the colour students would obtain in the experiment. Label the sample of each test tube accordingly with its respective letter.	• (A) Egg white, (B) dilute sodium hydroxide, (C) baking soda, (D) dilute hydrochloric acid, (E) lemon juice, (F) milk, (G) soap, (H) vinegar, (I) fizzy drink, (J) powdered antacid
Activity 1: Properties of Acids and Bases Give out the *Properties of Acids and Bases* worksheet to students and ask them to complete Part A and B of the worksheet while watching Chapter 3 and 4 of the video. Review the answers when they have completed the task. 15	• Photocopies of the *Properties of Acids and Bases* worksheet • ClickView video *Acids and Bases in the Home* Chapter 2 Chapter 3
Activity 2: pH Scale and Indicators Give out the *pH Scale and Indicators* worksheet to students. Play Chapter 5 of the video and ask students to complete Part A. Allow time for students to research on the internet to complete Part B of the worksheet. Allow students to share their answers and review them when they have completed. 15	• Photocopies of the *pH Scale and Indicators* worksheet • ClickView video *Acids and Bases in the Home* Chapter 4 • Laptops/tablets • coloured pencils
Activity 3: Let the Colour Do the Talking! Give out the *Let the Colour Do the Talking!* worksheet and distribute the materials required for the activity. Divide students into groups of 3 and go through the instructions with the students. Allow time for students to complete the task and allow them to share their answers once they have finished. >30	• Photocopies of the *Let the Colour Do the Talking!* worksheet • For each group of 3: samples in 10 test tubes (labelled A-J), dropper, distilled water, litmus paper, universal indicator

ANSWERS

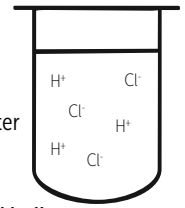
Properties of Acids and Bases

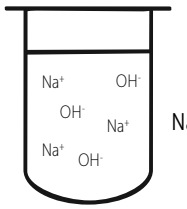
Part A:

Acids	Bases
• corrosive • sour • loses H^+ ion in water	• slippery to touch • bitter • loses OH^- ion in water

Part B:

HCl in water





NaOH in water

pH Scale and Indicators

Part A:

1. The pH scale measures the strength of the acid/base.
2.

pH	What is it?
<7	Acid
7	Neutral
>7	Base

3.

Strong acid	pH 0-3
Weak acid	pH 4-6
Strong base	pH 11-14
Weak base	pH 8-10

Part B:

1. Indicators change colour under different pH levels, which allows us to know how acidic or basic a certain substance is.

2 and 3. Answers

4. Students' answers may vary.
   Name of indicator: Congo Red

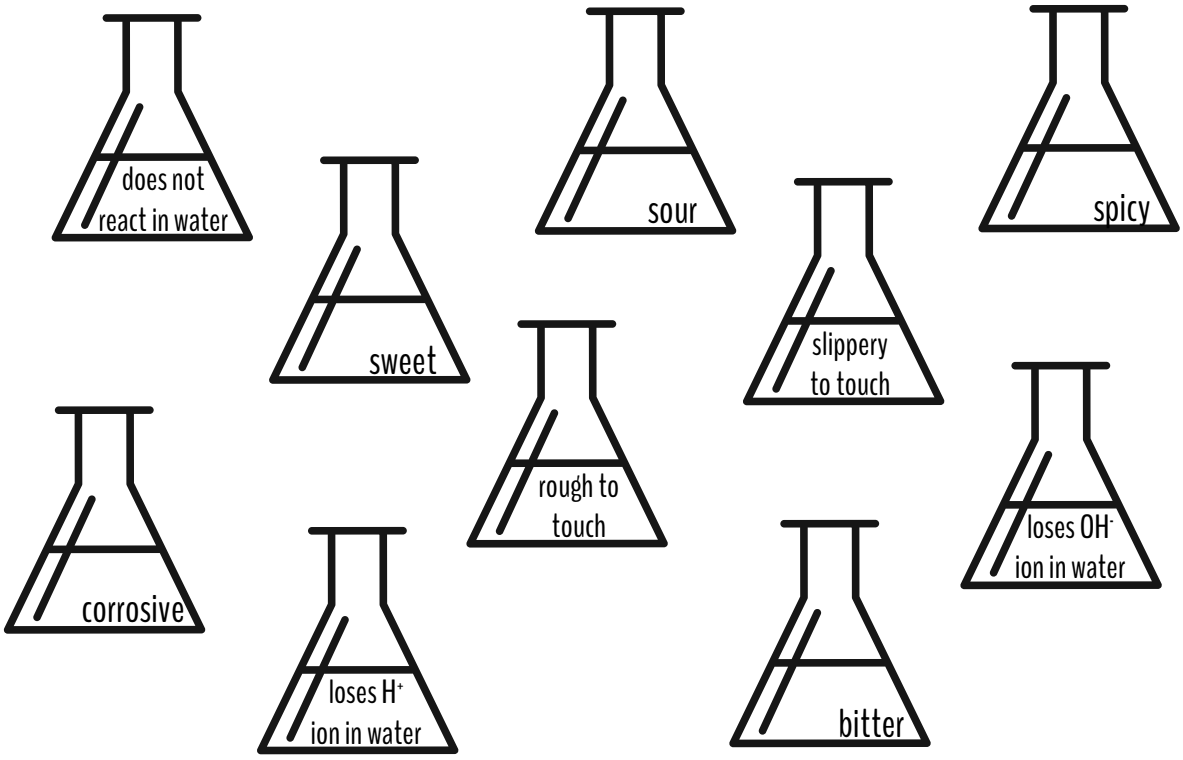
pH	Colour
<7	Yellow
7	Yellow
>7	Blue

Let the Colour Do the Talking!

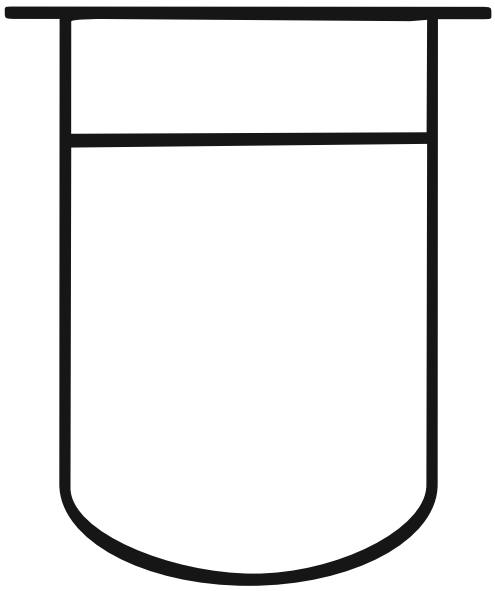
	Name	Litmus paper	Universal indicator	Acid or base?	Theoretical pH
A	egg white	blue	to be compared with a pH chart	base	8.9-9.4
B	dilute sodium hydroxide	red		acid	14
C	baking soda	blue		base	9
D	dilute hydrochloric acid	red		acid	1
E	lemon juice	red		acid	2
F	milk	red		acid	6.5-6.7
G	soap	blue		base	depends
H	vinegar	red		acid	2.6
I	fizzy drink	red		acid	3.3
J	powdered antacid	blue		base	depends

Properties of Acids and Bases

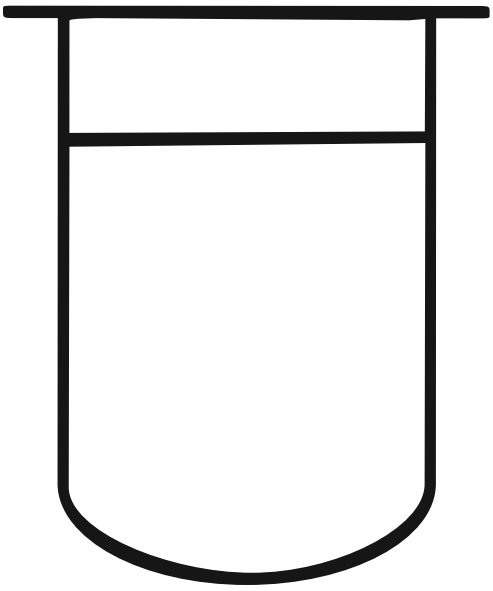
Part A: The flasks below show some properties of acids and bases. As you watch the video, circle the flasks that show properties of an acid with a red pen. For flasks showing properties of a base, circle the flasks with a blue pen.



Part B: Draw what happens when an acid (HCl) and a base (NaOH) dissolve in water in each beaker using information from the video.



HCl in water



NaOH in water

pH Scale and Indicators

Fill in the worksheet with information from the video.

Part A: pH Scale

1. What do we use the pH scale for?

_____

2. Complete the following table with the words 'acid', 'neutral' or 'base'. Only use each word once.

pH	What is it?
<7	
7	
>7	

3. Suggest a pH for the following substances.

Strong acid	
Weak acid	
Strong base	
Weak base	

Part B: pH Indicators

1. How are indicators useful?

_____

_____

2. Colour the boxes with the relevant colour when a litmus paper is used against the following substances.

Substance	Colour
Acid	
Base	

3. Universal indicators are useful because they can turn into many colours. Use colour pencils to show the colours the indicator will turn into at each pH.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
							Neutral							

4. Research online for another common indicator used in science labs and write down the colour changes in different pHs. Refer to the example on the left.

Name of indicator: Turmeric

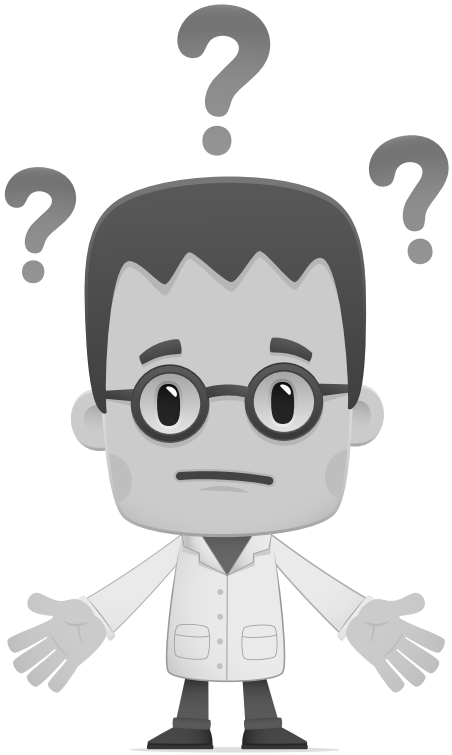
pH	Colour
<7	yellow
7	yellow
>7	red

Name of indicator: _____

pH	Colour
<7	
7	
>7	

Let the Colour Do the Talking!

Imagine yourself as a laboratory assistant. You know it is important that substances are labelled correctly in the science lab. One day, you find some of the labels incomplete. You are given the mixed up samples and some information about each sample. Identify each sample based on their pH and appearance and complete the table using the materials given. If a sample is in a powdered form, dissolve it in distilled water before testing them.



Materials:

- samples in 10 test tubes (labelled A - J)
- dropper
- distilled water
- litmus paper
- universal indicator

Instructions

1. Using the dropper, put some of sample A on the red and blue litmus paper. Record your observations.
2. Add a few drops of the universal indicator into the test tube A. Record the colour change.
3. Wash the dropper with distilled water.
4. Repeat steps 1-3 with the rest of the samples.

Label on sample	Name	Colour change (litmus paper)	Colour change (universal indicator)	Acid or basic?
A		blue		
B	dilute sodium hydroxide			
C	baking soda			
D	dilute hydrochloric acid			
E				acid
F		red		
G		blue		
H	vinegar			
I				acid
J	powdered antacid			

Based on your experiment and observations, fill up the names of the unknown samples from the following substances: **fizzy drink, soap, lemon juice, milk, and egg white.**

Neutralisation

OBJECTIVES

In this lesson, students will learn about neutralisation reactions between acid and bases. They will also learn how to write word equations for chemical reactions.

ACARA CONTENT DESCRIPTIONS

Chemical reactions, including combustion and the reactions of acids, are important in both non-living and living systems and involve energy transfer (ACSSU179)

- investigating reactions of acids with bases

LESSON PLAN

Activities	Resources
Activity 1: What Is Neutralisation? Give out the *What Is Neutralisation?* worksheet to students. Ask students to complete the worksheet as they watch Chapter 6 of the video. Review answers and concepts with the first three slides of the presentation. 15	• Photocopies of the *What Is Neutralisation?* worksheet • ClickView video *Acids and Bases in the Home* Chapter 6 • Presentation: Neutralisation
Activity 2: Neutralise It! Divide students into groups of 3. Give out the *Neutralise It!* worksheet to each group. Open the presentation to slide 4. Ask students to read the instructions and then cut out the individual boxes on the worksheet. Each box contains either an acid or a base. In this game, students first place the boxes with the words facing down on the table. They are given 5 minutes time for one student in each group to flip over two pieces of paper in turn. If the flipped pieces of paper contain an alkali and acid, the group has to write out the word equation for that neutralisation reaction on a blank piece of paper. Put the chosen pieces of paper aside after they finish writing the equations. If two acids/bases are flipped open, the student flips them back and the next student in the group gets to choose two other pieces of paper. The first group to go through all the pieces of paper with all the correct word equations wins the game. 25	• Photocopies of the *Neutralise It!* worksheet • For each group of 3: scissors, blank paper • Presentation: Neutralisation
Activity 3: Neutralisation in Your Daily Life Give out the *Neutralisation in Your Daily Life* worksheet to students and ask them to research neutralisation reactions in their daily life on the Internet. Allow students to share their answers with the class. Review the answers with slides 5-12 of the presentation. 20	• Photocopies of the *Neutralisation in Your Daily Life* worksheet • Laptops/tablets • Presentation: Neutralisation

ANSWERS

What Is Neutralisation?

Part A:

base + acid ⟶ salt + water

Word equation:

sodium hydroxide + hydrochloric acid ⟶ sodium chloride + water

Base in water: OH^- ion

Acid in water: H^+ ion

Part B:

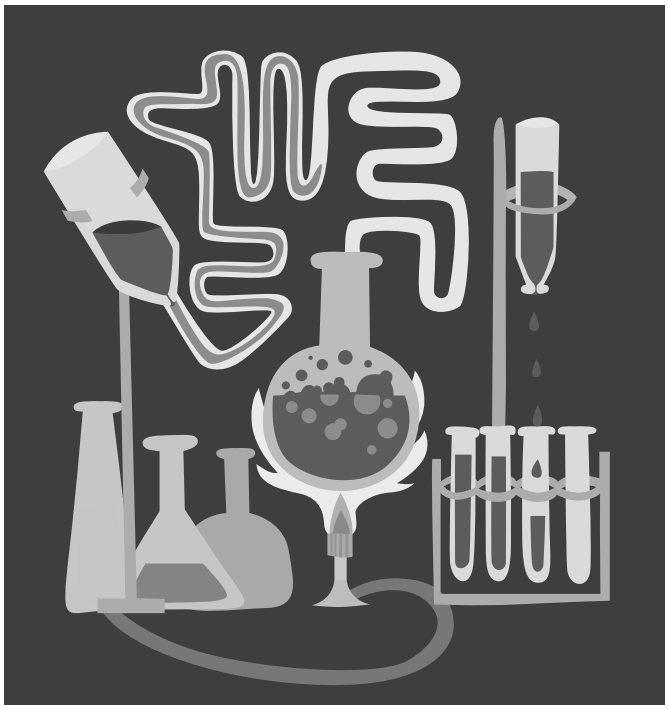
1. Neutralisation is a chemical reaction. New substances are produced (salt and water).
2. neutral
3. a metal and a non-metal
4. The reactants are sodium hydroxide and hydrochloric acid.
5. The products are sodium chloride and water.
6. It would be green in colour.

Can You Remember Neutralisation?

Students' answers may vary.

Neutralisation in Your Daily Life

Example	Acid	Base
#1	Bee sting (Methanoic acid in venom)	Soap
#2	Hair conditioner	Hair shampoo
#3	Stomach acid	Antacid pill
#4	Acid from food and drink	Fluoride toothpaste
#5	Acidic soil	Lime fertiliser
#6	Rust remover (phosphoric acid)	Rust



What Is Neutralisation?

Part A: Complete this section of the worksheet with information from the video.

NEUTRALISATION

base + acid ⟶ s_____ + w_____

WORD EQUATION

sodium hydroxide (A)	+	hydro**chloric** acid (B)	⟶	s_____ c_____	+ w_____

BASE IN WATER

Circle the correct ion produced.

sodium hydroxide ⟶ sodium ion + H^+ ion/ OH^- ion

ACID IN WATER

hydrochloric acid ⟶ chloride ion + H^+ ion/ OH^- ion

combine to form H_2O.

Part B: Complete the following section after watching the video.

NAMING SALTS

The name of a salt contains 2 parts: A & B

Part A is derived from: the metal in the **base** (before the hydroxide/oxide) **A**

B Part B is derived from: the **acid**
-chloric to chloride
-sulphuric to sulfate
-nitric to nitrate

1. Is neutralisation a chemical or physical reaction? Why?

_____

_____

2. What kind of products are formed in a neutralisation reaction? Tick the correct option.

☐ acidic ☐ basic ☐ neutral

3. What is a salt made out of?

☐ two metals ☐ a metal and a non-metal ☐ two non-metals

4. What are the **reactants** for the reaction in the word equation box above? (Reactants are on the left of an equation.)

_____

5. What are the **products** for the reaction in the word equation box above? (Products are on the right of an equation.)

_____

6. What colour would the universal indicator be in a neutral reaction?

_____

CHEMICAL SCIENCES

Neutralise It!

How much do you know about neutralisation? Follow the instructions and play this game to find out!

Pre-game Instructions:

1. Cut along the dotted lines to produce 16 individual pieces of paper squares.
2. Place these squares on the table with the words facing down.
3. Randomly mix and shuffle the boxes.
4. Wait for your teacher's instructions to start.

You will be given 5 minutes. In your groups, choose and flip two squares. If they contain an acid and an alkali, write out the word equation for the neutralisation reaction (producing a salt and water) on a blank piece of paper and put those squares aside. If they contain two acids or two bases, flip them back and choose two new squares. The first group to complete all 8 word equations correctly wins the game!

NAMING SALTS

The name of a salt contains 2 parts: A & B

Part A is derived from: the metal in the **base** (before the hydroxide/oxide) **A**

B Part B is derived from: the **acid**
-chloric to chloride
-sulphuric to sulfate
-nitric to nitrate

Cut along the dotted lines.

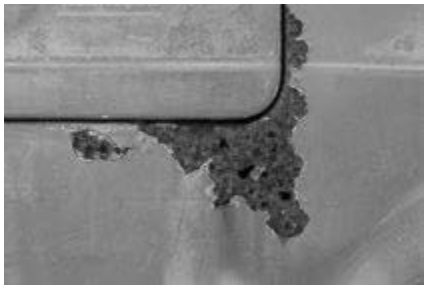
Lithium hydroxide	Sodium hydroxide	Calcium hydroxide	Potassium hydroxide
Magnesium hydroxide	Lead oxide	Iron oxide	Zinc oxide
Hydrochloric acid	Sulphuric acid	Acetic acid	Nitric acid
Hydrochloric acid	Sulphuric acid	Acetic acid	Nitric acid

CHEMICAL SCIENCES

Neutralisation in Your Daily Life

Did you know that neutralisation reactions are all around us? The situations described below are all examples of neutralisation reactions in your daily life. Research online to determine what the acid/ base is in each example.

#1: Treating a bee sting with soap	#2 Using hair conditioner after shampoo	#3 Treating indigestion with antacid
		
Acid:	Acid:	Acid:
Alkali:	Alkali:	Alkali:

#4 Using fluoride toothpaste to prevent cavities	#5 Using lime fertilisers in soil	#6 Cleaning metals with rust removers
		
Acid:	Acid:	Acid:
Alkali:	Alkali:	Alkali:

Can you think of any other examples around you?

Exothermic vs. Endothermic

LAB LESSON

OBJECTIVES

In this lesson, students will learn about the difference of exothermic and endothermic reactions.

ACARA CONTENT DESCRIPTIONS

Chemical reactions involve rearranging atoms to form new substances; during a chemical reaction mass is not created or destroyed (ACSSU178)

- considering the role of energy in chemical reactions

Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

- using internet research to identify problems that can be investigated
- evaluating information from secondary sources as part of the research process

Planning and conducting:

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)

- identifying the potential hazards of chemicals or biological materials used in experimental investigations
- combining research using primary and secondary sources with students' own experimental investigation

Communicating:

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS174)

- using secondary sources as well as students' own findings to help explain a scientific concept

CHEMICAL SCIENCES

LESSON PLAN

Activities	Resources
Activity 1: Toothpaste Fit for Elephants Give out the *Toothpaste Fit for Elephants* worksheet to students. Divide students into groups of 4 and give out the materials needed for the experiment. Ensure that students understand the risk of the experiment (hydrogen peroxide is corrosive). Ask students to record their observations and complete the questions, then allow them to share their answers. 25	• Photocopies of the *Toothpaste Fit for Elephants* worksheet • For each group of 4: gloves, safety goggles, measuring cylinder, 100 mL of 6% hydrogen peroxide, empty 500 mL bottle, funnel, plastic tray, dishwashing detergent, dropper, food colouring (any colour but cochineal), 1 sachet dry yeast (powder) + 4 tbs of warm water, 50 mL beaker
Activity 2: All about Ex-En Reactions Give out the *All about Ex-En Reactions* worksheet to students. Play Chapter 1 of the video and ask students to complete the first section of the worksheet. Give time to students to research online and have them work individually on the second part of the worksheet. Review the answers when students are done. 25	• Photocopies of the *All about Ex-En Reactions* worksheet • ClickView video *Characteristics of Chemical Reactions* Chapter 1 • Laptops, notebooks
Activity 3: Are They Exo or Endo? Give out the *Are They Exo or Endo?* worksheet and allow time for students to read through the information. Ask students to work in pairs to carry out the experiment. Give out the materials to them. Review the answers when students have finished. 35	• Photocopies of the *Are They Exo or Endo?* worksheet • For each group of 4: chemicals listed in the table, beaker, thermometer, stirrer, two 50 cm³ measuring cylinders, spatula

ANSWERS

Toothpaste Fit for Elephants

1. It feels warm.
2. Word: Hydrogen peroxide decomposes into oxygen and water.
   Chemical: $2H_2O_2 \rightarrow O_2 + 2H_2O$
3. A catalyst is a substance that increases the rate of a chemical reaction without undergoing any chemical change.

All About Ex-En Reactions

In endothermic reactions, heat energy is absorbed. There is a decrease in the temperature of the surroundings.

In exothermic reactions, heat energy is released. There is an increase in temperature of the surroundings.

Hydration of cement	Instant ice packs
When water is added to cement, it hardens as it forms bonds with water molecules, hardening into concrete. This is an exothermic reaction as bonds are formed and there is an increase in the temperature of the surroundings.	This is an endothermic reaction. An ice pack consists of two bags: water and an ammonium salt. When the bag of water is broken, it dissolves the salt, breaking their bonds. Energy is taken in for this reaction and there is an endothermic reaction. The temperature of the surroundings decreases hence helping to cool an injury.
Instant hand warmers	**Inflating airbags**
Instant hand warmers contain iron powder and when exposed to air, it reacts with oxygen to form rust and give off heat, increasing the temperature of the surroundings. This is an exothermic reaction.	Airbags contain sodium azide, which is quite stable in normal situations. In the event of a collision, it heats up and the bonds break down into sodium and nitrogen gas. This nitrogen gas inflates the air bag. This is an exthothermic reaction and it increases the temperature of the surroundings.

Are They Exo or Endo?

Students' answers may vary.

Test	Exothermic or Endothermic?
1	Exothermic
2	Endothermic
3	Exothermic
4	Endothermic
5	Exothermic

Toothpaste Fit for Elephants

Decomposition of Hydrogen Peroxide

Materials:

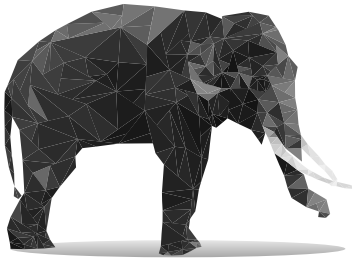
- gloves
- safety goggles
- measuring cylinder
- 100 mL of 6% hydrogen peroxide
- empty 500 mL bottle
- funnel
- plastic tray
- dishwashing detergent
- dropper
- food colouring (any colour but cochineal)
- 1 sachet dry yeast (powder) + 4 tbs of warm water
- 50 mL beaker

Instructions:

1. Put on safety goggles and gloves.
2. Measure 100 mL of the hydrogen peroxide with the measuring cylinder and pour it into the empty bottle with the funnel.
3. Place the bottle on the plastic tray.
4. Add a large squirt of dishwashing detergent into the bottle. Swirl the bottle to mix the detergent and hydrogen peroxide.
5. Add in 10 drops of food colouring with the dropper.
6. Dissolve 1 sachet of dry yeast with the warm water in the 50 mL beaker. Stir well.
7. Using the funnel, add the yeast mixture to the bottle.
8. Remove the funnel and observe what happens in the bottle.
9. After the reaction has finished, touch the foam. Record your observations.

What's Happening in the Bottle?!

In this reaction, the hydrogen peroxide is decomposed into oxygen and water. The yeast behaves as a catalyst for this reaction, breaking down the hydrogen peroxide quicker. The oxygen produced in this reaction gets trapped by the dishwashing detergent, forming the foam. Doesn't the foam look like toothpaste that the elephants could use?



Observations and Questions:

1. Touch the bottle after the reaction has completed. How does it feel?

   _____

2. Write a word equation and chemical equation for the reaction. The chemical symbol for hydrogen peroxide is H_2O_2.

   Word equation: _____

   Chemical equation: _____

3. What is a catalyst?

   _____

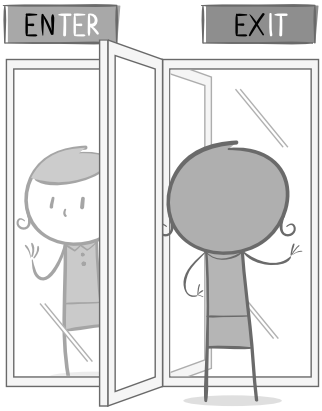
   _____

All About Ex-En Reactions

Complete the worksheet with information from the video and online research.

In endothermic reactions, heat energy is _____ (heat "enters" the system).

There is a_____ in the temperature of the surroundings.



In exothermic reactions, heat energy is _____ (heat "exits" the reaction).

There is an _____ in the temperature of the surroundings.

CHEMICAL SCIENCES

There are many different exothermic and endothermic reactions around us. In the following activity, research the following questions and explain the science behind these reactions on your notebook!

In your answers, include the following:
- Is it an endothermic or exothermic reaction?
- How does the reaction occur?
- State the change in temperature of the surroundings.

Are They Exo or Endo?

Materials:
- chemicals listed in the table
- beaker
- thermometer
- stirrer
- two 50 cm^3 measuring cylinders
- spatula

Amounts to use for:
All liquids - 20 cm^3
All solids - 1 spatula

Instructions:
1. Collect the chemicals used in Test 1.
2. Place chemical A in the beaker.
3. Place the temperature in the beaker and measure the temperature of chemical A.
4. Add chemical B to the beaker.
5. Record all observations, feeling the beaker and note down the final temperature of the mixture in the beaker.
6. Repeat steps 1-5 for the other tests.

Test	Chemical A	Chemical B	Temperature (before) / °C	Temperature (after) / °C	Temperature difference	Observations (How does the beaker feel?)
1	sodium hydroxide	hydrochloric acid				
2	acetic acid	baking soda				
3	silver nitrate	sodium chloride				
4	ethanoic acid	sodium carbonate				
5	copper sulphate salt	water				

Plate Tectonics

LAB LESSON

OBJECTIVES

In this lesson, students will learn about the history of plate tectonics and understand seafloor spreading.

ACARA CONTENT DESCRIPTIONS

The theory of plate tectonics explains global patterns of geological activity and continental movement (ACSSU180)

- recognising the major plates on a world map
- modelling sea-floor spreading

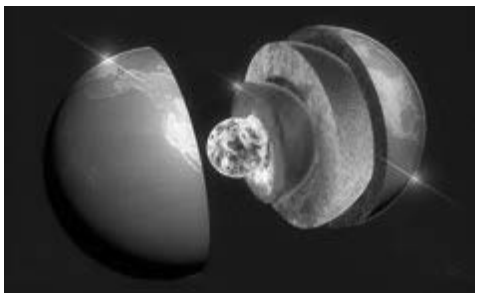
Nature and development of science:

Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community (ACSHE157)

- investigating how the theory of plate tectonics developed, based on evidence from sea-floor spreading and
- occurrence of earthquakes and volcanic activity

LESSON PLAN

Activities	Resources
Activity 1: Earth's Many Facades Give out the *Earth's Many Facades* worksheet to students. Play Chapter 3 of the video and ask students to complete Part A of the worksheet. Review answers when students have finished. Give out the *Let's Learn about Plates* worksheet and give time for students to try to piece the puzzle together. 30	• Photocopies of the *Earth's Many Facades* worksheet • ClickView video *Global Tectonics: Competing Theories* Chapter 3 • Photocopies of the *Let's Learn about the Plates* worksheet • Scissors, glue, a blank A4 paper
Activity 2: Movement of the Plates Give out the *Movement of the Plates* worksheet to students. Play Chapter 4 of the video before asking students to work in pairs to research on the questions on the worksheet. Allow students to share their answers with the class once they have finished. 30	• Photocopies of the *Movement of the Plates* worksheet • ClickView video *Global Tectonics: Competing Theories* Chapter 4 • Laptops
Activity 3: Hess' Seafloor Spreading Give out the *Hess' Seafloor Spreading* and *Model the Seafloor Spreading* worksheets. Divide students into pairs and ask them to read the article on the *Hess' Seafloor Spreading* worksheet. Have them work on the modelling experiment and ask them to complete the discussion questions in their notebooks. Students may need guidance on how to conduct the modelling experiment. >30	• Photocopies of the *Hess' Seafloor Spreading* and *Model the Seafloor Spreading* worksheets • For each pair: scissors, pencils, coloured pencils • Notebooks



ANSWERS

Earth's Many Facades

Part A:

Compositional layers	Mechanical layers
core lower and upper mantle crust	lithosphere asthenosphere mesosphere outer core inner core

1. The compositional layer is defined by the chemical properties of the layers while the mechanical layer is defined by physical properties of the layers.
2. It is the crust.
3. They are the crust and upper mantle.

Part B:

Answers: Link

Movement of the Plates

Students' answers may vary.

Type	How do the plates move?	Famous landforms
Divergent	Plates move away from each other.	• Mid-Atlantic Ridge • East African Great Rift Valley
Convergent	Plates (both continental crust) move towards each other.	• Himalaya Mountains • Swiss Alps
Convergent	Plates move towards each other and the ocean lithosphere slides under the continental crust.	• Cascade Mountain Range • Andes Mountain Range
Transform	Plates slide past each other, lithosphere is neither created nor destroyed.	• San Andreas fault

The density of continental crust is approximately 2.7 gm/cm^3. Oceanic crust on the other hand, has a density of 3.0 g/cm^3. The difference in density is due to the difference in the composition of the crust. Continental crust contains felsic rocks (e.g. granite) while oceanic crust, mainly contains mafic rocks (e.g. basalt). This dark coloured rock is rich in iron and magnesium which is heavier than the minerals found in continental granitic rock.

Hess' Seafloor Spreading

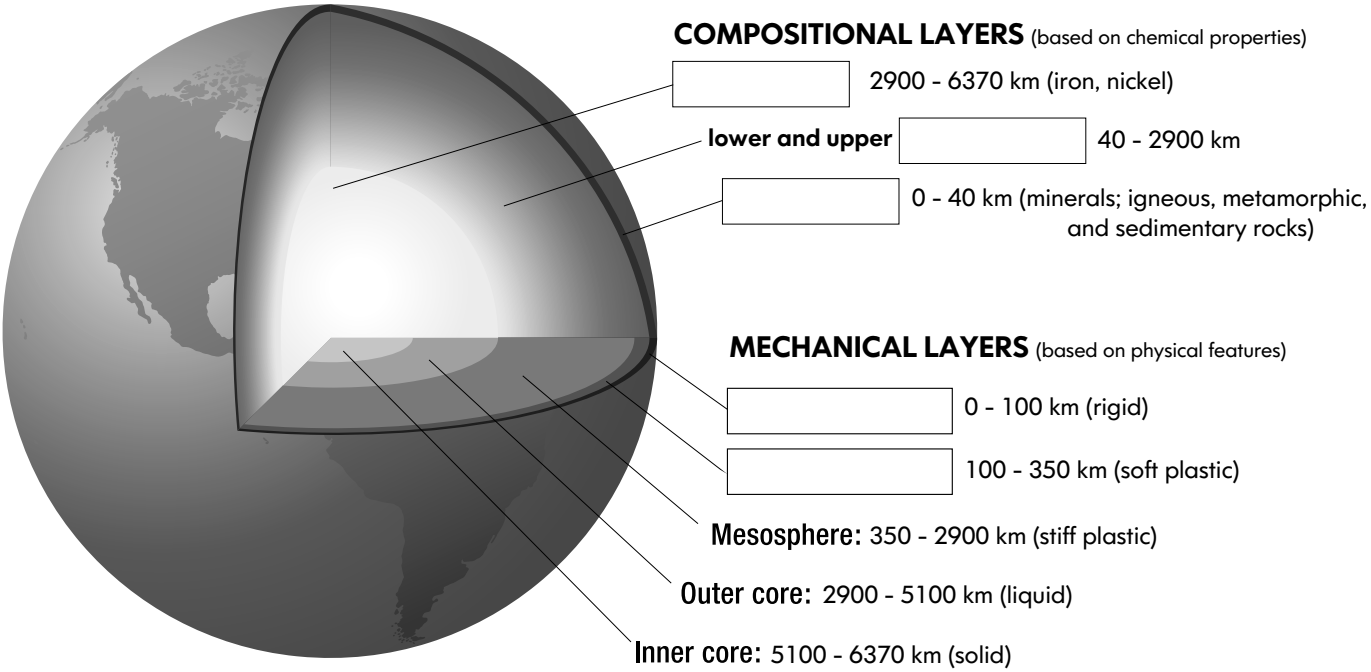
Students' answers may vary.

1. They represent oceanic crust.
2. They represent the polarity of the crust when it is formed at that time.
3. There is a symmetric pattern across the seafloor spreading center. This pattern provides evidence for seafloor spreading because it suggests that new material is formed in the middle of the pattern (at the spreading center) and moves outwards in both directions causing a symmetric pattern on each side.
4. The oceanic crust slides under the continental crust as it is less dense than continental crust.
5. The Atlantic Ocean will grow overtime due to seafloor spreading. (Pacific Ocean will shrink.)

Earth's Many Facades

Part A: Fill in the blanks as you watch the video. Answer the questions after you've watched the video.

From the outside, Earth may look like it is made up of one solid rock, but in fact, it is composed of many different layers, each with their own properties.



Questions:

1. What is the difference between a compositional layer and a mechanical layer?

   _____

   _____

   _____

2. Which is the thinnest compositional layer?

   _____

3. The lithosphere is made up of two compositional layers. What are they?

   _____

Part B: Crusty Puzzle (Hess' Plate Tectonics Theory)

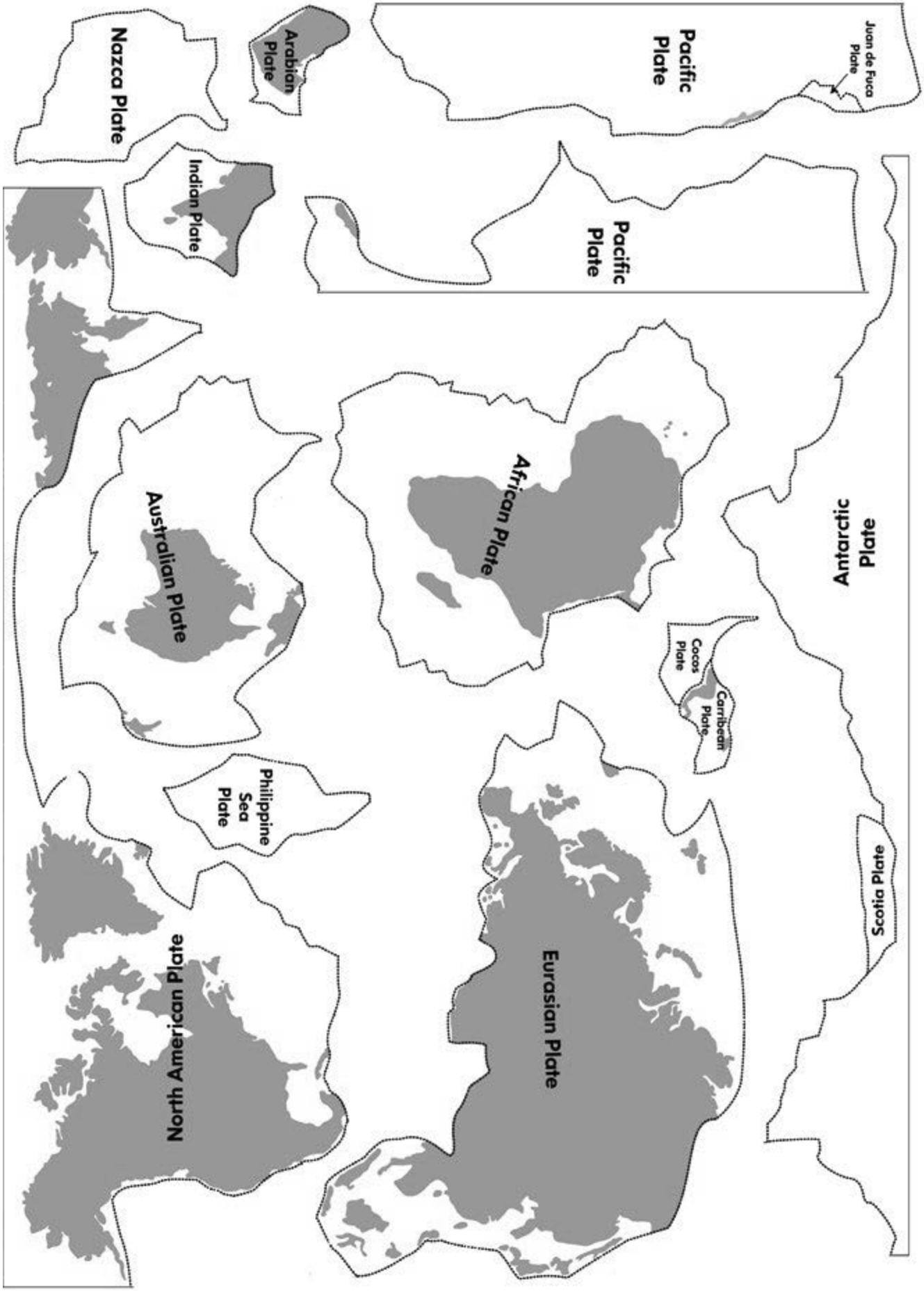
Materials:

- 'Let's Learn about the Plates' worksheet
- scissors
- glue
- a blank A4 paper

Instructions:

1. Cut all the plates out on the 'Let's Learn about the Plates' worksheet.
2. Arrange and piece the plates together as they are located on the Earth's surface, referring to the world map if you need hints.
3. After you have arranged the plates, glue them down on a blank piece of A4 paper.

Let's Learn about the Plates



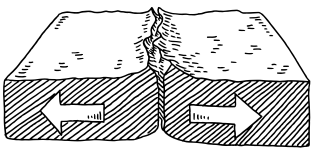
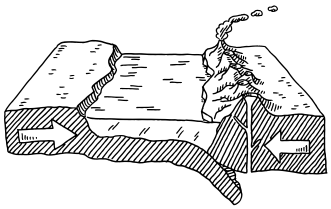
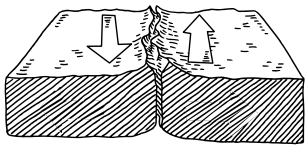
EARTH AND SPACE SCIENCES

Movement of the Plates

In your pairs, research all the possible movements of the plates at the boundaries. Record your answers in the table below.

HOW DO PLATES MOVE?

A tectonic plate can have a continental crust (land masses), an oceanic crust (under oceans), or both types of crusts. Due to a process called 'partial melting', the crusts are different in composition. This results in the continental crust being less dense (lighter) than oceanic crust. At plate boundaries, there are three types of plate movements that could occur. Let's find out more about them!

	Type of boundary	How do the plates move?	Famous landforms
			
			
			
			

EARTH AND SPACE SCIENCES

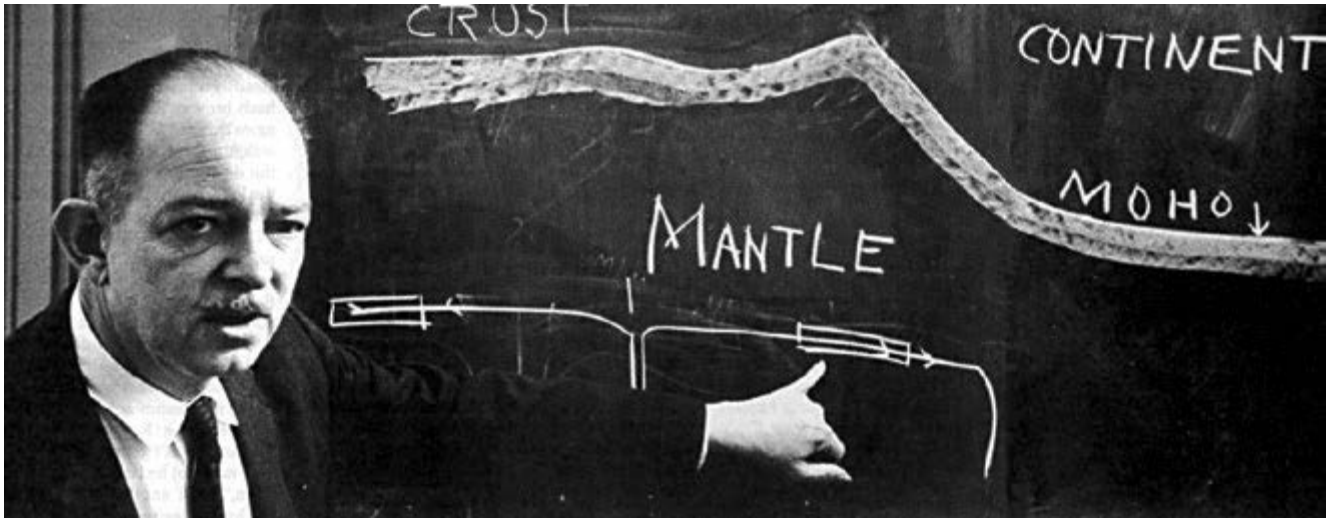
Discussion questions

Why is continental crust less dense than oceanic crust?

Hess' Seafloor Spreading

Read the following paragraph. In your pairs, read the instructions on 'Model the Seafloor Spreading' and create a model of seafloor spreading to understand how it works. Discuss the questions found below and record them in your notebooks.

How did this theory came about?



Previously, many geologists had thought the seafloor was just a smooth, flat area collecting mud from the continents. However during World War II, Harry Hammond Hess, a geologist, discovered with sounding gear that the bottom of the sea was not smooth at all. It instead contained canyons, trenches and even volcanic sea mountains!

In 1962, Hess created the hypothesis on seafloor spreading. He believed that the seafloor widens at the great global rift system beneath the Atlantic Ocean where hot magma appears. Due to the high pressures along the ridge as the hot magma cools and expands, it forces new ocean crust to move away from the ridge. At the end of moving away are subduction zones, areas where the crust returns to the mantle, recycling the Earth's crust.

In the early 1960s, it was found out through dating (the process of attributing an object or event to a date in the past) that the ocean floor was younger at the Mid-Atlantic Ridge and the older rocks were found further down in either direction. Furthermore, the seafloor crust close to the ridge was warmer in temperature as compared to its surroundings.

The Earth's magnetic field is an invisible force field that protects us from harmful solar radiation. This field, however, does not constantly point in the same direction. In 1963, geophysists discovered that Earth's magnetic field had reversed many times throughout its existence and this is proven by the minerals in the seafloor crust that took on the polarity of the Earth's magnetic field at that particular time when it was made. They found a series of symmetrical invisible bands of normal and reversed polarity on either sides of the ridge.

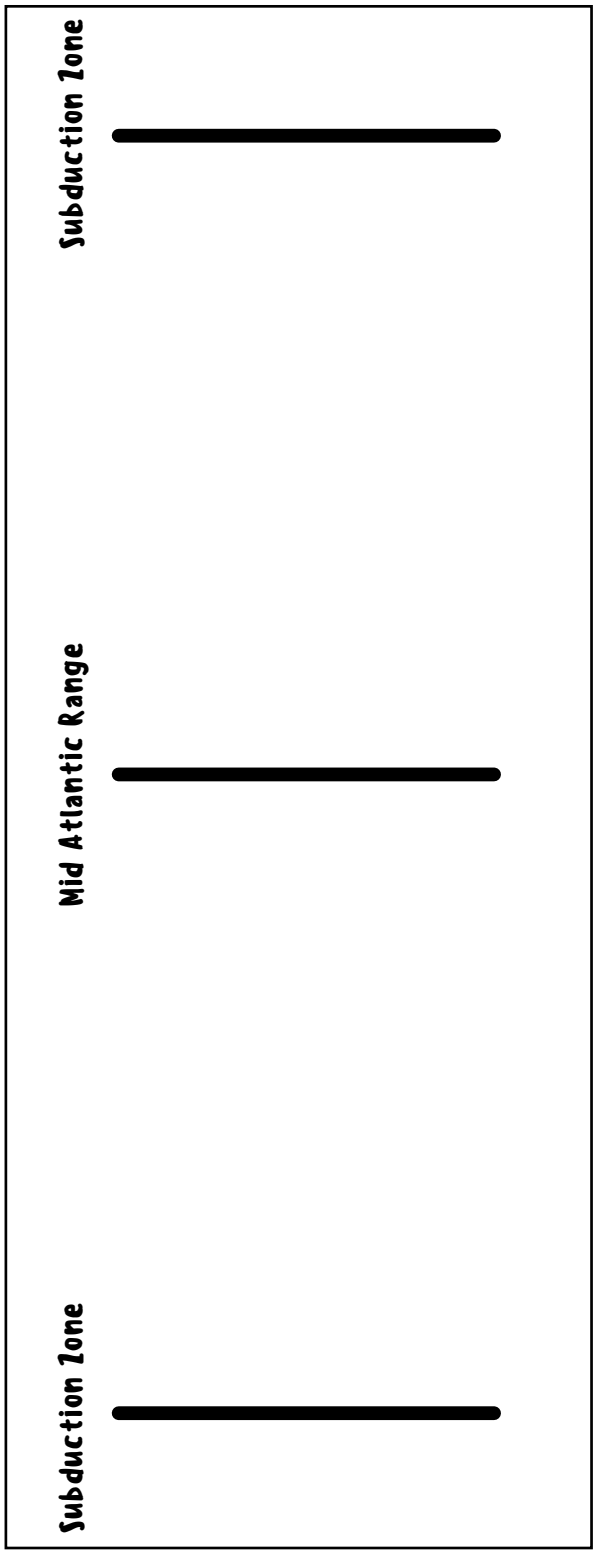
All this evidence supported Hess' seafloor spreading and explains to us how continents drift apart from each other.

Discussion Questions:

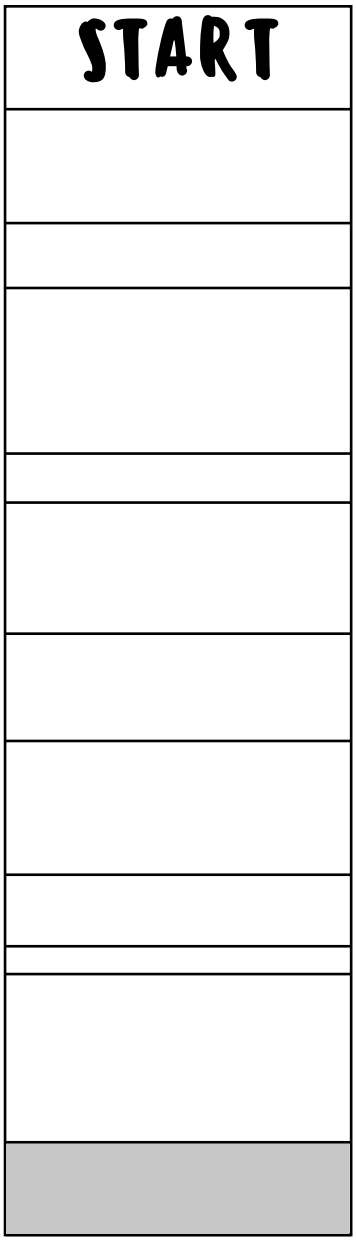
1. What kind of crust do Sheets B and C represent? (continental crust or oceanic crust)
2. What do the arrows on the boxes represent?
3. Describe the pattern seen on the glued Sheets B and C. How does the model explain seafloor spreading?
4. What happens at the subduction zone?
5. How will the size of Atlantic Ocean change over time due to this seafloor spreading?

Model the Seafloor Spreading!

Sheet A



Sheet B



Sheet C

Materials:

- scissors
- pencil
- colour pencils

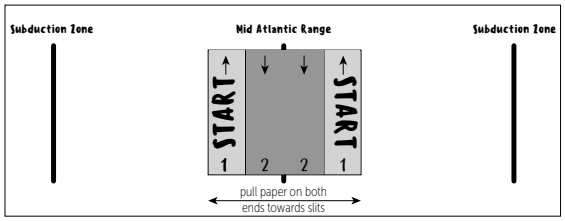


Figure 1

Instructions:

1. Cut out sheets A, B and C.
2. With scissors, carefully make three slits on sheet A along the labelled thick lines.
3. Glue sheets B and C on top of each other such that the grey boxes overlap each other.

4. Fold this glued sheet into half (with words facing in) and insert it from the bottom (side with no words) through the Mid Atlantic Range slit on Sheet A.
5. Pull the glue sheet so that each end moves out of the slit towards the two slits on the respective ends of the Sheet A, inserting them when they reach the slits on the end.
6. Colour each pair of boxes with a different colour.
7. Number the boxes in the order that they come out of the slit.
8. Draw an arrow pointing in the same direction for each pair of boxes. (Your experiment should look like the Figure 1 on the left.)

Earthquakes

LAB LESSON

OBJECTIVES

In this lesson, students will learn about earthquakes and their effects on communities.

ACARA CONTENT DESCRIPTIONS

The theory of plate tectonics explains global patterns of geological activity and continental movement (ACSSU180)

- relating the occurrence of earthquakes and volcanic activity to constructive and destructive plate boundaries

Use and influence of science:

Values and needs of contemporary society can influence the focus of scientific research (ACSHE228)

- investigating contemporary science issues related to living in a Pacific country located near plate boundaries, for example New Zealand

Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

- using internet research to identify problems that can be investigated
- evaluating information from secondary sources as part of the research process

LESSON PLAN

Activities	Resources
Activity 1: Where Do Earthquakes Happen? Give out the *Where Do Earthquakes Happen?* worksheet to each pair of students. Allow each pair to research the word "earthquakes" on Google to learn about the 10 most recent earthquakes. After students have finished, ask students what they have realised about where the earthquakes are found (along fault lines). Play Chapters 3 and 4 of the video as an introduction to the topic. Give out the *Where Do Earthquakes Happen? 2* worksheet to students and give them some time to finish the worksheet. Review answers when they have finished. 20	• Photocopies of the *Where Do Earthquakes Happen?* and *Where Do Earthquakes Happen? 2* worksheets • ClickView video *The Christchurch Earthquake: A Case Study* Chapter 3 Chapter 4
Activity 2: The Impacts of Earthquakes Give out the *The Impacts of Earthquakes* worksheet to students. Play Chapters 5 and 6 of the video and ask students to fill in the relevant information as they are watching the video. Allow students to share their answers. Have a discussion with students and ask them if they could imagine themselves caught in an earthquake. >45	• Photocopies of the *The Impact of Earthquakes* worksheet • ClickView video *The Christchurch Earthquake: A Case Study* Chapter 5 Chapter 6

ANSWERS

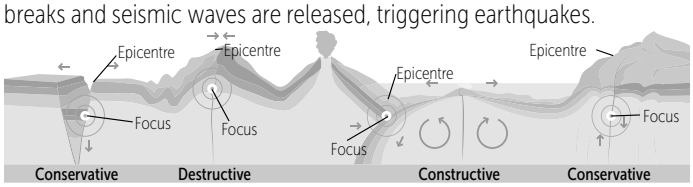
Where Do Earthquakes Happen?

Students' answers may vary.

Where Do Earthquakes Happen? 2

Possible answers:

Plates move in different directions at different rates. An earthquake happens at the location two plates interact with each other known as the fault plane. When the edges at fault planes are stuck together while the rest of the block at moving, it stores energy. When this accumulation of stored energy exceeds the frictional strength of the fault, the fault breaks and seismic waves are released, triggering earthquakes.



The Impacts of Earthquakes

Students' answers may vary.

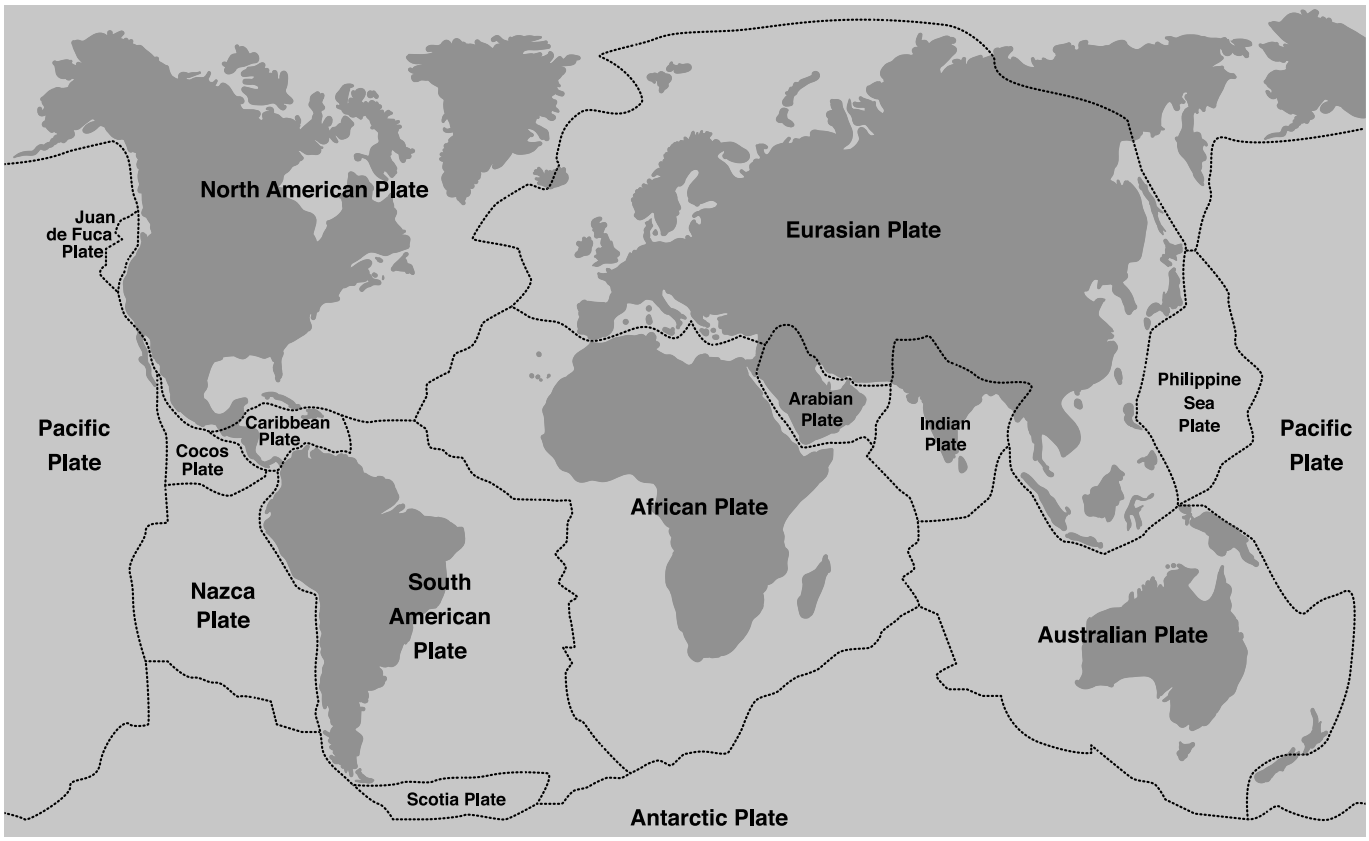
Possible answers:

Location of epicentre
Lyttelton (Exact epicentre: 2 km west of Lyttelton and 10 km SE of Christchurch)
Magnitude and depth
Magnitude of 6.3, depth of 5 km
Casualties
185 dead, several thousands injured
Physical impact
• liquefaction causes uneven ground • breakages of landslides • pipes bursting • buildings destroyed
Economical impact
• maintain and repair services such as water and power • demolish and rebuild buildings • reconstruction of city
Social impact
• disruption to daily lives • concern for future safety • brought local communities together • victims emotionally and physically tired

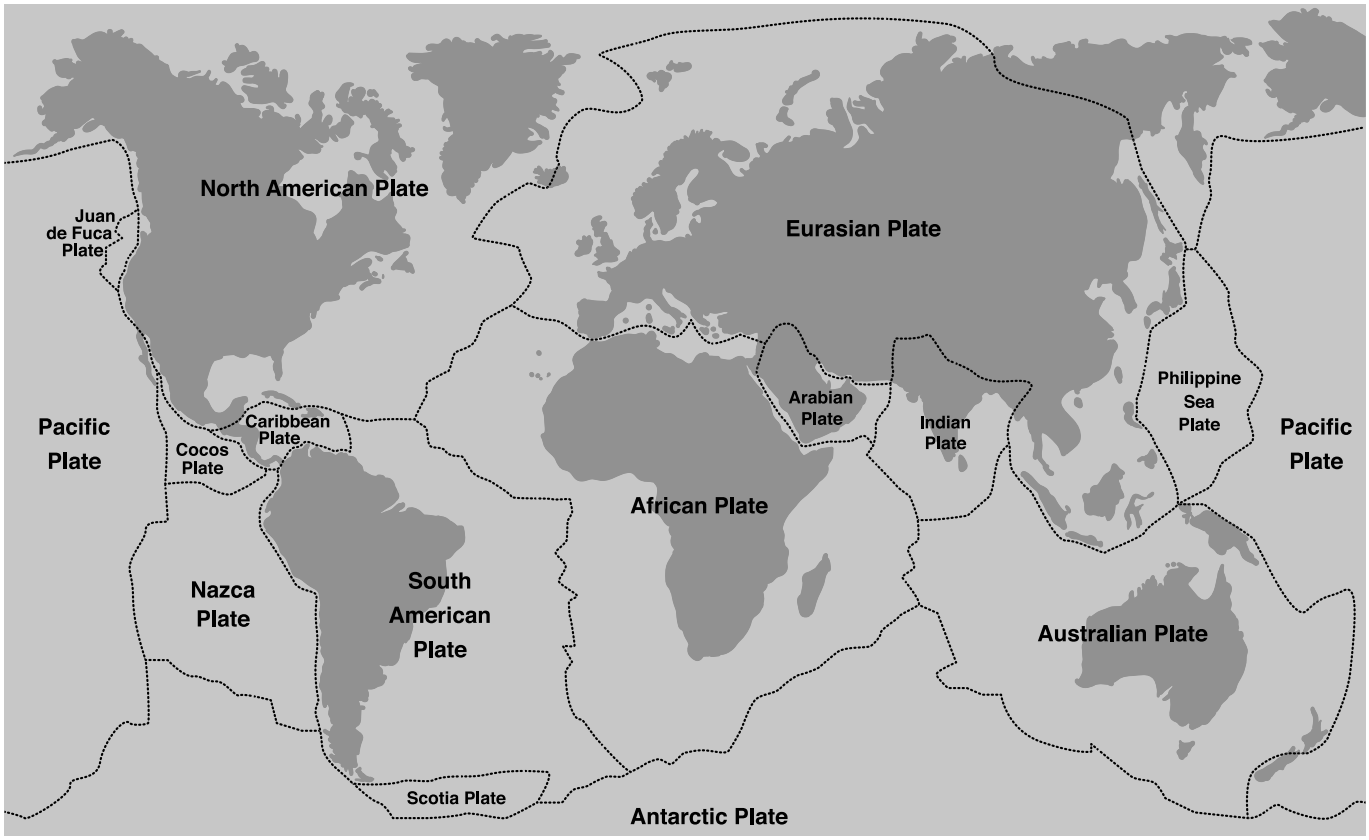
EARTH AND SPACE SCIENCES

Where Do Earthquakes Happen?

On your laptop, Google the word "earthquakes" and mark out 10 of the most recent earthquakes.

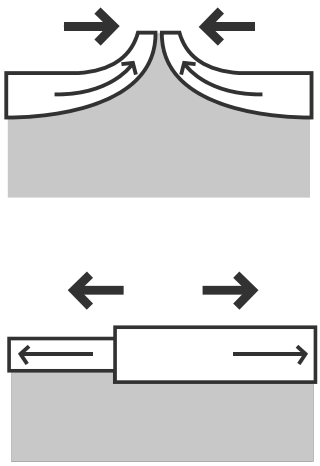


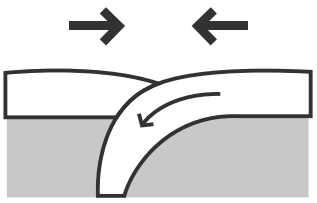
On your laptop, Google the word "earthquakes" and mark out 10 of the most recent earthquakes.

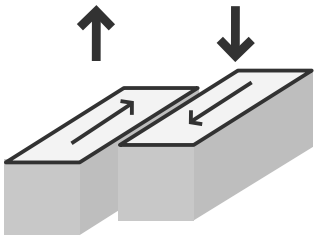


EARTH AND SPACE SCIENCES

EARTHQUAKES







stress fault plane stored energy release

Earthquakes are caused by rocks breaking under stress. The underground surface along which the rock breaks is known as the fault pane. There are three types of fault boundaries where earthquakes can occur: constructive plate boundary, destructive plate boundary and conservative plate boundary.

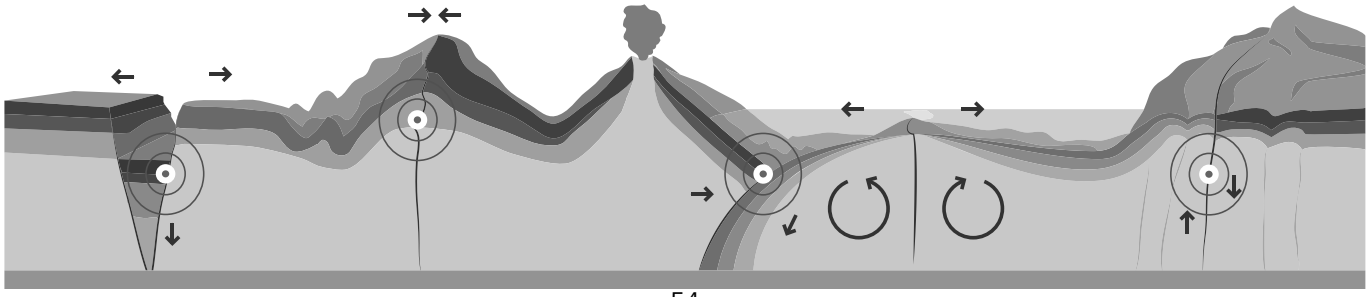
Research how earthquakes are formed and write a paragraph to explain their formation. You may use the words found in the box above.

FEATURES

Focus - the point at which plates slip, causing a release of energy (the point of origin of an earthquake)

Epicentre - the point above the focus on Earth's surface

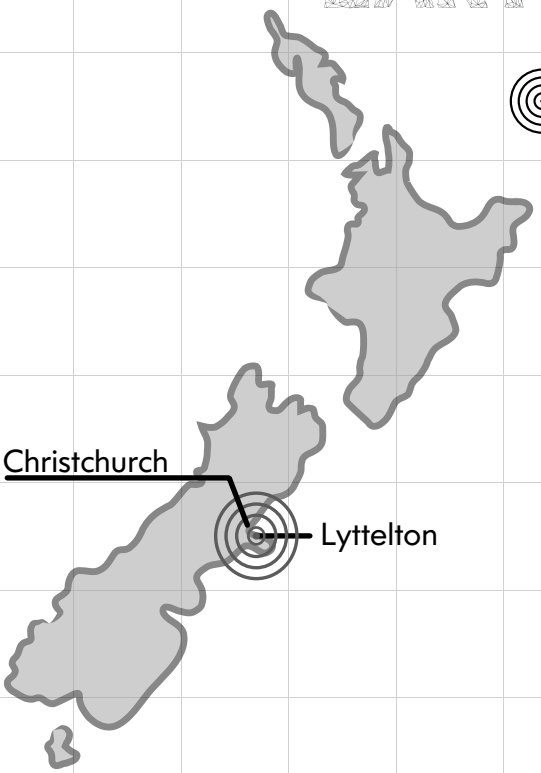
The diagram below shows 4 earthquakes.
Complete the following tasks:
1. Mark the focus of each earthquake.
2. Mark the epicentre of each earthquake
3. State the type of plate boundary (constructive, destructive or conservative)



The Impacts of Earthquakes

Fill in the diagram below with information from the video. Research online to complete the worksheet with extra information.

THE 2011 CHRISTCHURCH EARTHQUAKE



LOCATION OF EPICENTRE

MAGNITUDE & DEPTH

CASUALTIES

PHYSICAL IMPACT

ECONOMICAL IMPACT

SOCIAL IMPACT

EARTH AND SPACE SCIENCES

Volcanoes

OBJECTIVES

In this lesson, students will learn about volcanoes, their formation, location and why people still choose to live close to them.

ACARA CONTENT DESCRIPTIONS

The theory of plate tectonics explains global patterns of geological activity and continental movement (ACSSU180)

- relating the occurrence of earthquakes and volcanic activity to constructive and destructive plate boundaries

Use and influence of science:

Values and needs of contemporary society can influence the focus of scientific research (ACSHE228)

- investigating contemporary science issues related to living in a Pacific country located near plate boundaries, for example Japan, Indonesia, New Zealand

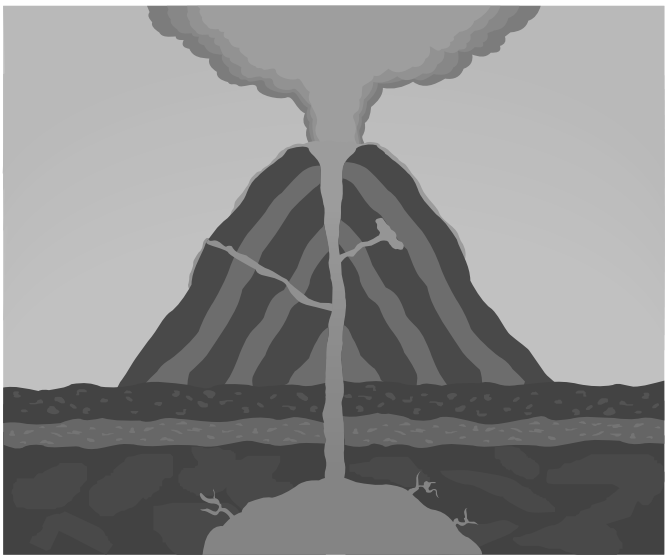
Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

- evaluating information from secondary sources as part of the research process

LESSON PLAN

Activities	Resources
Activity 1: The Ring of Fire Give out the *Volcanoes and Their Eruptions* worksheet to students. Play Chapter 7 of the video and ask students to complete the first section of the worksheet. Give time for students to research the answers not found in the video. Depending on the ability of the students, you may need to play the video more than once. Review answers when they have completed the task. 20	• Photocopies of the *Volcanoes and Their Eruptions* worksheet • ClickView video *Natural Disasters* Chapter 7 • Laptops
Activity 2: The Volcanic People Allow students to work in pairs to complete The Volcanic People on the same worksheet. Play Chapter 8 of the video when students have finished to allow an introduction to answering the question. Allow students to present their answers to the class. End the lesson by holding a discussion to ask students if they would live near a volcano and the reasons why. 40	• *Volcanoes and Their Eruptions* worksheet • Laptops • ClickView video *Natural Disasters* Chapter 8

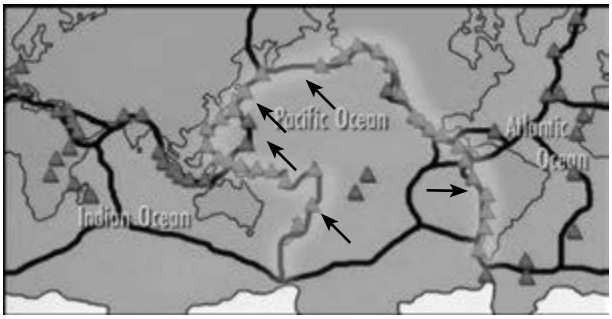


ANSWERS

Volcanoes and Their Eruptions

1. They are found at the ring of fire

2. & 3.



4.

Hot spots	Constructive plate boundaries	Destructive plate boundaries
Magma seeps through cracks in the crust to form volcanoes. E.g. Mount Kilauea	When plates move apart, magma fills the gap between the two plates. E.g. Mid-Atlantic Ridge	When an oceanic plate is forced under the continental plate, it melts due to friction in the subduction zone. This melted crust becomes magma and is forced to the surface of the Earth through an eruption. E.g. Mount Vesuvius

The Volcanic People

Students' answers may vary.

Refer to poster for an example: Link

The Volcano Daily

The Fire Mountain of Java, Indonesia

Out of all the volcanoes in Indonesia, Gunung Merapi or Mount Merapi, is the most active volcano, found on the border between Central Java and Yogyakarta, Indonesia. It has been erupting regularly since 1548 and its most recent eruptions were between March to April 2014.

Standing at 2,911 metres tall, Gurung Merapi is found at the subduction zone where the Indo-Australian Plate is sliding beneath the Eurasian Plate. This volcano found on a destructive plate boundary is also part of the Ring of Fire.

Mount Merapi is a stratovolcano, also known as composite volcano, which is a conical volcano built up of alternating layers of lava and ash. Explosive eruptions accompanies such volcanoes, and the deadliest eruptions happened in 2010, where about 353 people lost their lives. Even with its frequent eruptions, about 70,000 people still choose to live in the immediate vicinity of the volcano.

Spiritually, the volcano is considered sacred to the local villagers. They believe a supernatural kingdom exists on top of Merapi.

But for more practical reasons, people choose to live close to Merapi for its fertile soil. Ash from eruptions has made the soil some of the most agricultrally productive spots in the world. This makes up people's livelihood, which explains why people are reluctant to move away despite the destruction living near a volcano can bring.

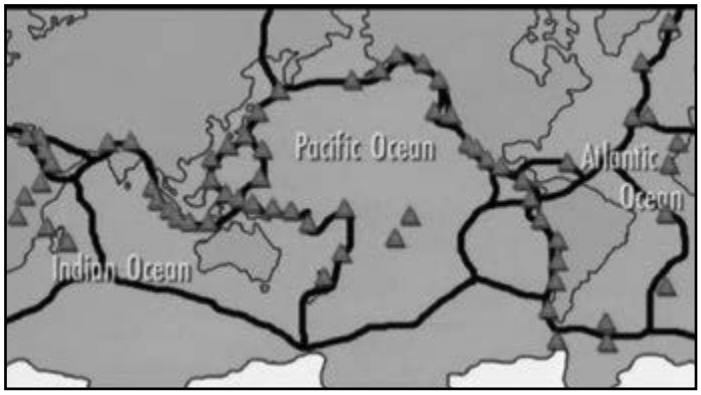
Furthermore, the volcanoes attract mountaineering daredevils to hike it as well as people interested in the flora of the nearby rain forests and to see the active volcano in action. This tourism brings about advantages such as money and business to the local economy.

EARTH AND SPACE SCIENCES

Volcanoes and Their Eruptions

After watching the video, research online to answer the following questions and complete the tasks.

THE RING OF FIRE



The triangles show the locations of major volcanoes in the world.

1. Where are these volcanoes mostly found?

   _____

   _____

2. Research and highlight on the diagram where the Ring of Fire is located.
3. Draw the movement of plates around the Ring of Fire.
4. Determine how volcanoes can form in the following plate boundaries and give an example of a real volcano for each boundary.

Hot spots	Constructive plate boundaries	Destructive plate boundaries

THE VOLCANIC PEOPLE

Since ancient times, even though volcanoes are very dangerous landforms to be around, people still choose to live close to them. Why is that so?

Below are four volcanoes that are near densely populated areas. Choose one of the volcanoes to research and create a newspaper article to organise your information.
Your answers should include:
- Where the volcano is
- On which plate(s) the volcano is found
- What kind of plate boundary (if any)
- What kind of volcano it is
- When the last eruption was
- What the population is around the volcano
- Why people still choose to live near that volcano

TAUPO VOLCANO

GUNUNG MERAPI

KILAUEA

SAKURAJIMA

EARTH AND SPACE SCIENCES

The Two Types of Waves

LAB LESSON

OBJECTIVES

In this lesson, students will learn about the two different types of waves and their properties.

ACARA CONTENT DESCRIPTIONS

Energy transfer through different mediums can be explained using wave and particle models (ACSSU182)

- exploring how and why the movement of energy varies according to the medium through which it is transferred
- exploring the properties of waves, and situations where energy is transferred in the form of waves, such as sound and light

Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

- using internet research to identify problems that can be investigated
- developing ideas from students own or others' investigations and experiences to investigate further

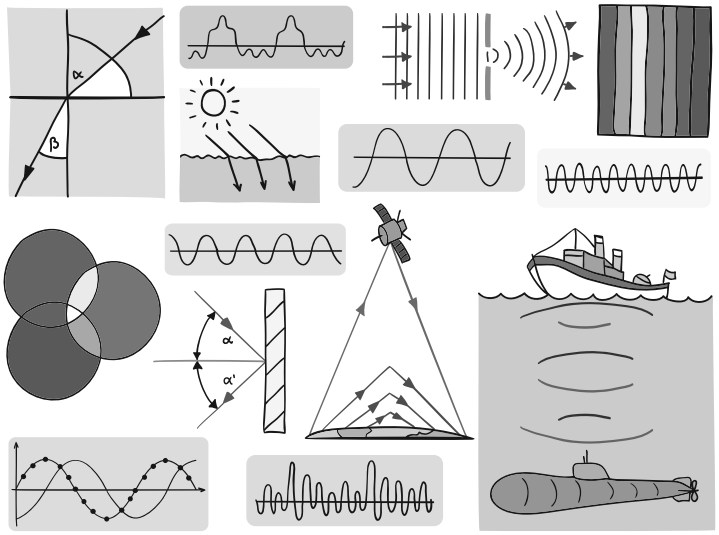
Processing and analysing data and information:

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)

- comparing conclusions with earlier predictions and reviewing scientific understanding where appropriate

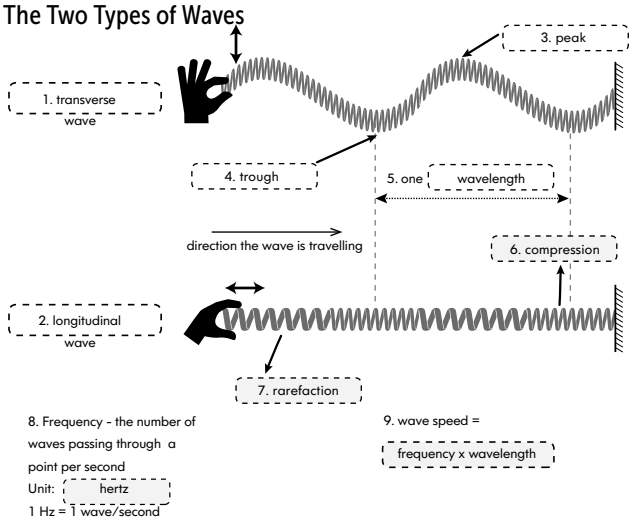
LESSON PLAN

Activity	Resources
Activity 1: The Two Types of Waves Give out *The Two Types of Waves* worksheet to students. Ask students to complete Part A of the worksheet as they watch Chapter 3 of the video. Give time to students to complete the accompanying tasks. Divide students into groups of 3-4 and give out the materials to each group to complete the challenge in Part B. Review the answers with students when they have finished. 45	• Photocopies of *The Two Types of Waves* worksheet • ClickView video *Light and Sound* Chapter 3 • For each group of 3-4: slinky spring, camera that records videos, laptop
Activity 2: Properties of Waves Give out the *Illustrated Guide to Waves* and *Properties of Waves* worksheets to students. Ask students to complete the questions of *Properties of Waves* worksheet with information from the poster. Allow students time to share their answers with the class when they have finished. 25	• Photocopies of the *Illustrated Guide to Waves* poster and *Properties of Waves* worksheet



ANSWERS

The Two Types of Waves



1. Refer to diagram above.
2. 0.056 m (5.6 cm)
3. 0.5 Hz
4. 0.028 m/s

Properties of Waves

1. b
2. Suggested answer:

Transverse waves	Longitudinal waves
microwave radio light	sound earthquake (p-wave) ultrasound earthquake (s-wave)

3. Possible answers:

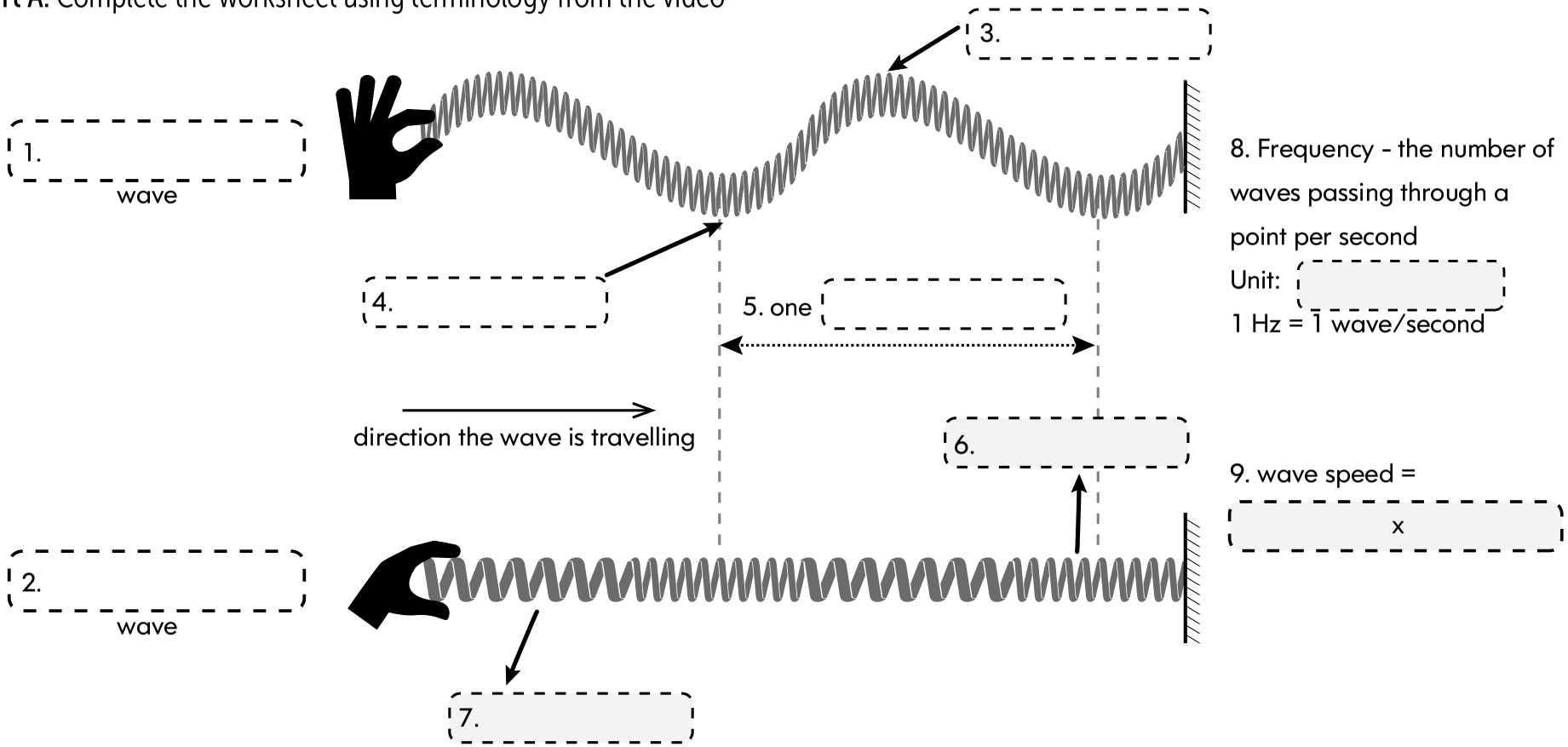
   a. The noises heard in the cave are echoes. Echoes are formed when sound waves are reflected from the walls of the caves, back to our ears.

   b. Ripples are standing waves as the waves are being continuously reflected superposed. Large ripples indicate that the waves are combining because they are in phase, and therefore forming waves of greater size. Areas with no ripples have waves that are out of phase, cancelling each other out.

PHYSICAL SCIENCES

The Two Types of Waves

Part A: Complete the worksheet using terminology from the video



Task 1	Task 2	Task 3	Task 4
Draw arrows to indicate the direction each hand has to move to produce the waves above. **Answer:**	Using a ruler, measure the wavelength of the transverse wave. Express your answer in metres (m). **Answer:**	Two waves are produced every 4 seconds. Calculate the wave's frequency. **Answer:**	What is the wave speed of the transverse wave? **Answer:**

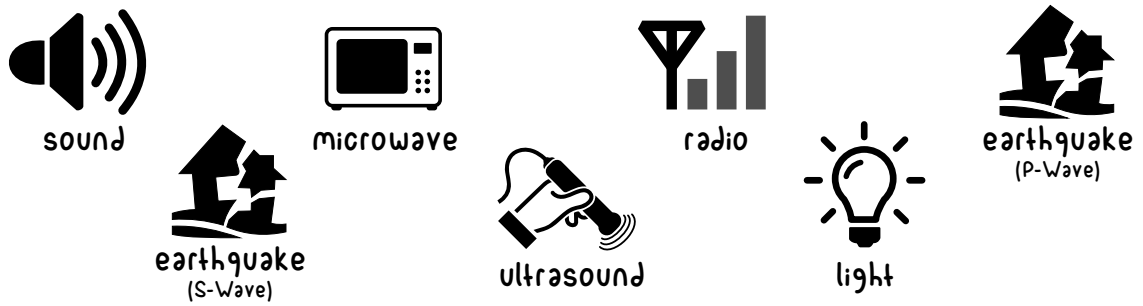
Part B: Challenge

In your groups, create both transverse and longitudinal waves using the slinky provided. Record a video as you make each wave. Using your laptops, grab a video frame of each wave and label their features. Then, measure the wavelength, wavespeed and frequency of your waves.

THE ILLUSTRATED GUIDE TO

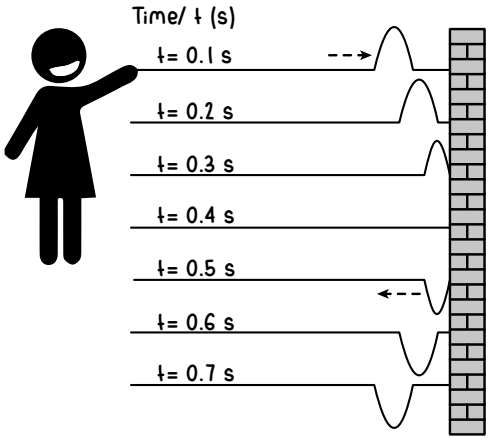
WAVES

WAVES IN OUR DAILY LIVES



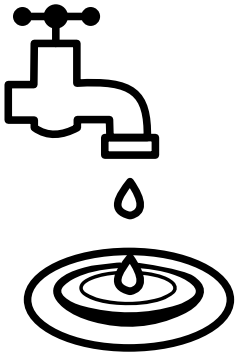
REFLECTION OF WAVES

When waves reach an object, they get reflected and bounce off it. Think of a mirror!



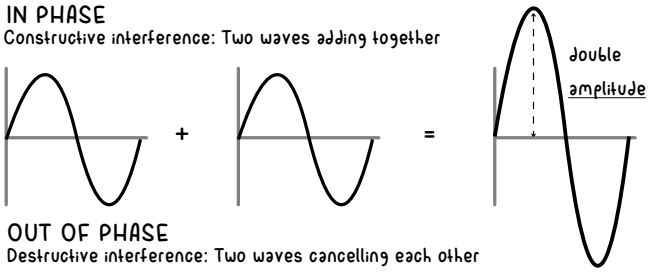
SUPERPOSITION OF WAVES

Waves are overlapping in the same place at the same time



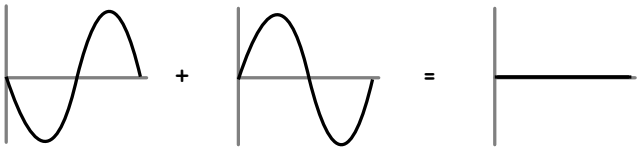
IN PHASE

Constructive interference: Two waves adding together



OUT OF PHASE

Destructive interference: Two waves cancelling each other



When waves meet, they interact with each other. The waves combine when they are in phase (sychronised). When they meet out of phase, they cancel each other.

PHYSICAL SCIENCES

Properties of Waves

Answer the following questions using your own knowledge and the information from the 'Illustrated Guide to Waves' poster. Research terminology if required.

1. Pick the correct set of answers to fit in the blanks.

   If the particle displacement of a wave is perpendicular to the direction the wave is moving, the wave is a _____ wave. If the particle displacement of a wave is parallel to the wave is moving, the wave is a _____ wave.

   a) transverse; transverse
   b) transverse; longitudinal
   c) longitudinal; transverse
   d) longitudinal; longitudinal

2. Waves are everywhere in our daily lives. Research to find out if each of the wave examples on the poster is a transverse or longitudinal wave. Record your findings below. Then search for more examples of waves in your daily lives and record them in the table too.

Transverse waves	Longitudinal waves

3. Explain the following scenarios:

   a. You are chatting with a friend as you walk into a cave. As you walk deeper into the cave, your friend begins to say that he's hearing voices and starts to panic. Using your knowledge of the reflection of waves, explain to him what those voices are, and why he is hearing them.

   _____

   _____

   _____

   _____

   b. It's raining! When rain falls, waves can form when raindrops hit the surface of a puddle. The waves often interact with each other, forming ripples of different sizes. Using your knowledge of the superposition of waves, explain why ripples of different sizes can be observed.

_____

_____

_____

_____

_____

_____

_____

_____

_____

Sound Waves

OBJECTIVES

In this lesson, students will learn about sound waves and their properties.

ACARA CONTENT DESCRIPTIONS

Energy transfer through different mediums can be explained using wave and particle models (ACSSU182)

- exploring how and why the movement of energy varies according to the medium through which it is transferred
- exploring the properties of waves, and situations where energy is transferred in the form of waves, such as sound waves

Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

- using internet research to identify problems that can be investigated
- evaluating information from secondary sources as part of the research process

Processing and analysing data and information:

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)

- comparing conclusions with earlier predictions and reviewing scientific understanding where appropriate

LESSON PLAN

Activity	Resources
Activity 1: Properties of Sound Waves Give out the *Properties of Sound Waves* worksheet to each pair of students. Ask students to complete the worksheet as they watch Chapter 9 of the video. Review the answers with students when they have finished. 15	• Photocopies of the *Properties of Sound Waves* worksheet • ClickView video *Light and Sound* Chapter 9
Activity 2: Echoes in Our Daily Lives Give out the *Echoes in Our Daily Lives* worksheet to students. Give time to students to complete the questions, researching online if needed. Allow students to share their answers with the class when they have finished. 20	• Photocopies of the *Echoes in Our Daily Lives* worksheet • Laptops
Activity 3: Oscilloscopes and Sound Graphs Play Chapter 10 of the video. Give out the *Oscilloscopes and Sound Graphs* worksheet to students. Ask students to complete the worksheet in groups of 3 after they watch the video. Allow students to peer mark when they are finished. 25	• Photocopies of the *Oscilloscopes and Sound Graphs* worksheet • ClickView video *Light and Sound* Chapter 10

ANSWERS

Properties of Sound Waves

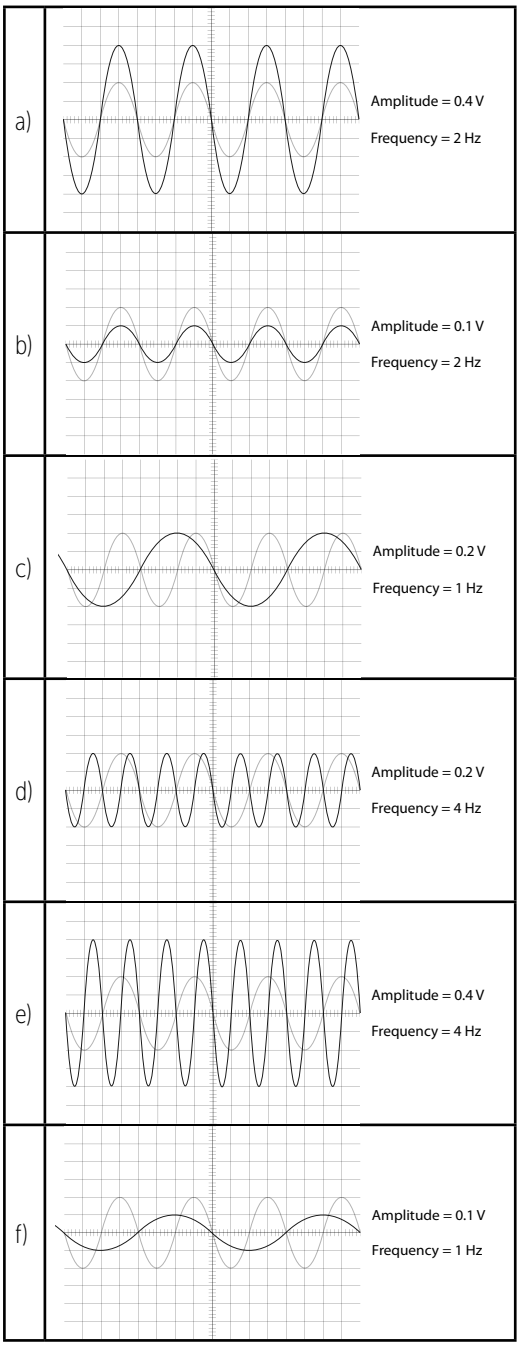
longitudinal
vibrate
ears, recognised, trachea
media
frequency, pitch
reflected, echoes
Hard, soft
tightly
oscilloscope

Echoes in Our Daily Lives

1. Speed = 1200/3.75 = 320 m/s
2. Distance = 1500 x 8.79 = 13 185 m = 13.2 km
3. Possible answer:
   Bats use echolation to navigate and to hunt for insects in the dark.
   Toothed whales use echolation to sense objects when it bounces off the object.

Oscilloscopes and Sound Graphs

1. 0.2 dB
2. 2 waves/sec
3.



PHYSICAL SCIENCES

Properties of Sound Waves

Complete this worksheet using information found in the video.

ALL ABOUT SOUND

Sound travels in ☐☐☐☐☐☐☐☐☐☐☐☐ waves. These waves cause air molecules to ☐☐☐☐☐☐☐. We hear because the vibrating air molecules enter our ☐☐☐☐ and are ☐☐☐☐☐☐☐☐☐☐ by our brain. When we speak, the ☐☐☐☐☐☐☐ (wind pipe) vibrates, causing the air passing over our vocal chords to vibrate and create sound.

Sounds can move through different ☐☐☐☐☐, such as solids, liquids and gases. Sound does not travel through a medium indefinitely because eventually all of the energy of the vibrating particles is used up. When the ☐☐☐☐☐☐☐☐☐ changes, the ☐☐☐☐☐ of the sound also changes. A high frequency sound wave produces a high pitch sound. A low frequency results in a low pitch sound.

Sound waves can be ☐☐☐☐☐☐☐☐☐ and they are known as ☐☐☐☐☐☐. ☐☐☐☐ substances reflect sounds a lot more than ☐☐☐☐ substances. Soft substances are ideal sound absorbers, which is why foam is used to soundproof rooms. Sound travels more quickly through liquids than air because particles in a liquid are packed more ☐☐☐☐☐☐☐ together.

Rearrange the letters found in the grey boxes above to find out the name of the instrument used to visualise sound waves.

☐☐☐☐☐☐☐☐☐☐☐☐

Complete this worksheet using information found in the video.

ALL ABOUT SOUND

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Rearrange the letters found in the grey boxes above to find out the name of the instrument used to visualise sound waves.

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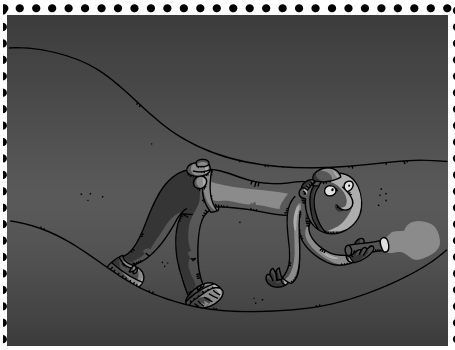
Echoes in Our Daily Lives

Read the 3 scenarios before answering the questions that follow below.

Scenario #1

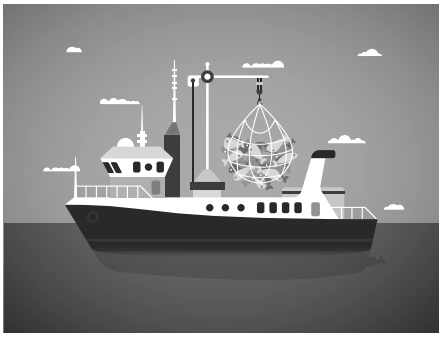


Mike, an avid traveller was walking in a cave 600 m in length. He wanted to know the speed that sound was travelling in that cave so he decided to use his knowledge of echoes. He recorded the time taken for the sound of a clap to be heard again as an echo. The results can be seen in the table below.

Results

Length of cave	600 m
Time to hear clap as an echo	3.75s

Scenario #2

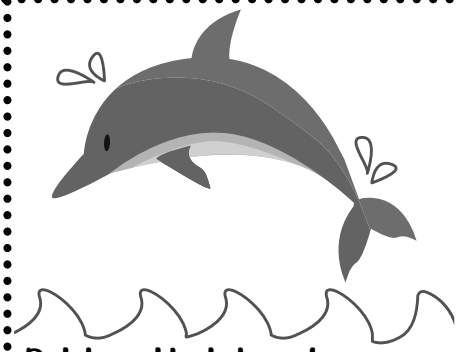


Nathaniel is a fisherman who often depends on echoes to determine the distance of the seabed from his boat. He does this to make sure the boat doesn't get stuck. Sonar systems in boats measure the time taken for echoes to return, the machine calculates distances between objects. The table below shows the time taken for the echo to return.

Results

Speed of sound in the sea	1500 m/s
Time to hear an echo	0.3s

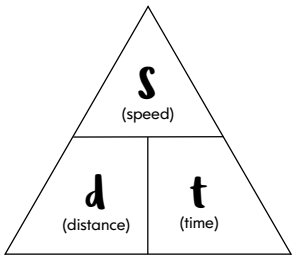
Scenario #3



Dolphins, like bats and some whales, have in-built sonar systems. The characteristic clicks and squeaks that dolphins make are at frequencies too high for human ears to detect. Echolation is used by dolphins when they produce sound waves in order to identify objects and locate food. Dolphins produce sound waves through their nasal passages when the sound waves hit an object they bounce back echo vibrations. Dolphins are able to estimate distance of objects by the time it takes the vibrations to return.

Questions:

$$\text{Speed of sound} = \frac{\text{distance travelled}}{\text{time taken to hear an echo}}$$



1. Calculate the speed sound is travelling in the cave in Scenario #1. (Use the equation given)

2. Calculate the distance of the seabed from Nathaniel's boat in Scenario #2. (Use the equation given)

3. Research online to find what and how other animals use echolation in their lives.

_____

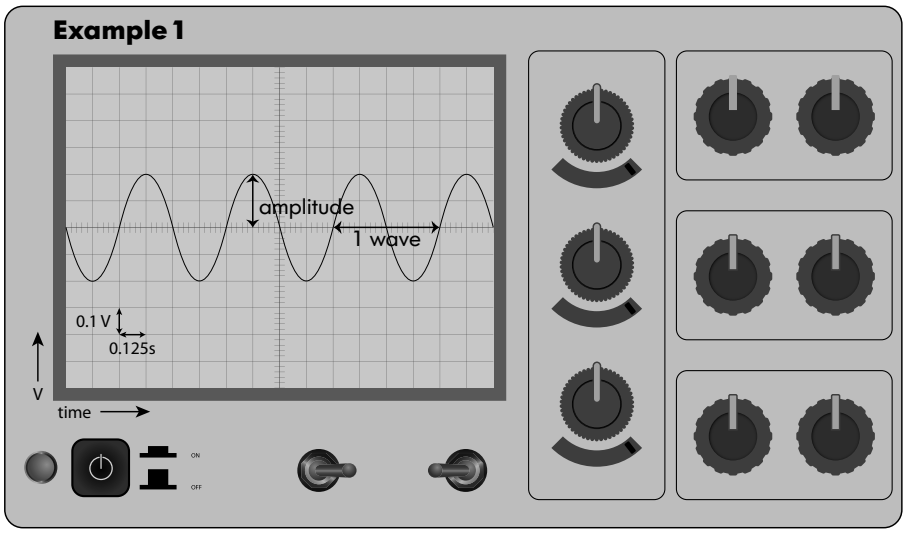
_____

PHYSICAL SCIENCES

Oscilloscopes and Sound Graphs

After watching the video, use the information below to answer the following questions.

An oscilloscope



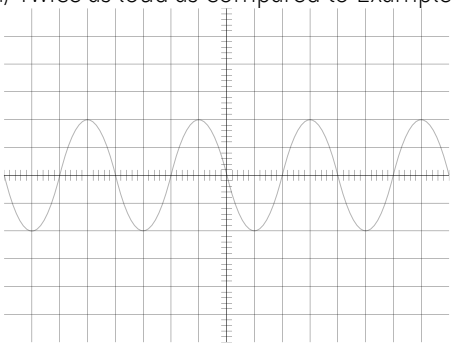
How a sound wave translates onto the graph:

The loudness is shown by the amplitude. This voltage (V) is used to show loudness.
A louder sound produces a graph with bigger amplitude (higher voltage).

The pitch is represented by the frequency.
Frequency is the number of waves produced in 1 second. It has a unit of hertz (1 Hz = 1 wave/sec)
A sound with a higher pitch produces more waves per second.

1. What is the amplitude of the sound wave shown in Example 1? _____ V
2. How many waves were produced in 1 second? _____ Hz (frequency)
3. In your groups, use the clues to draw sound graphs for the following scenarios.

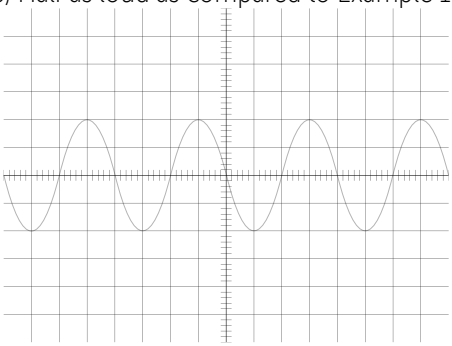
a) Twice as loud as compared to Example 1



Amplitude =

Frequency =

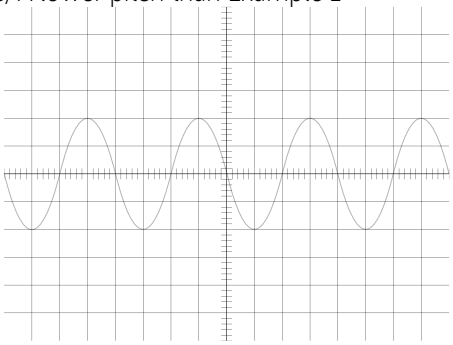
b) Half as loud as compared to Example 1



Amplitude =

Frequency =

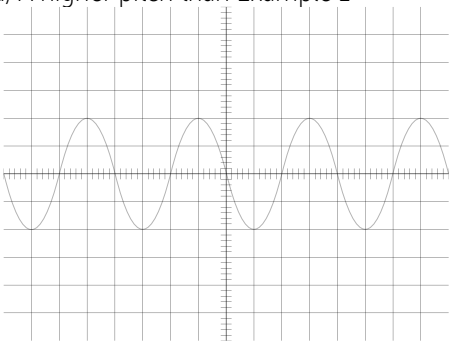
c) A lower pitch than Example 1



Amplitude =

Frequency =

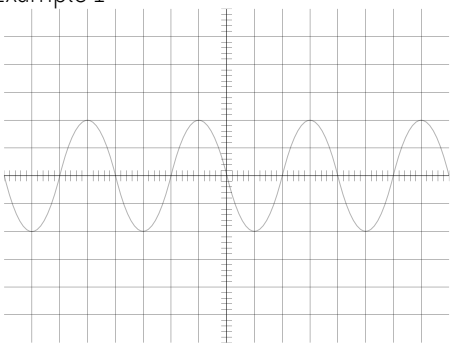
d) A higher pitch than Example 1



Amplitude =

Frequency =

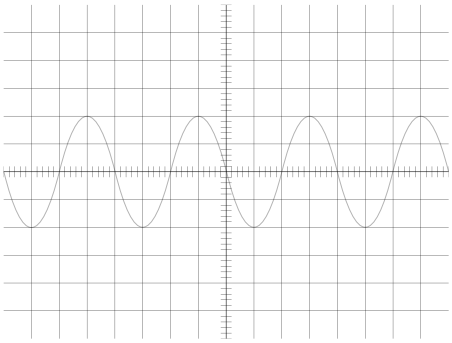
e) Twice as loud, and a higher pitch compared to Example 1



Amplitude =

Frequency =

f) Half as loud, and a lower pitch compared to Example 1



Amplitude =

Frequency =

Light Waves

LAB LESSON

OBJECTIVES

Students will learn about light waves and their properties.

ACARA CONTENT DESCRIPTIONS

Energy transfer through different mediums can be explained using wave and particle models (ACSSU182)

- exploring how and why the movement of energy varies according to the medium through which it is transferred
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Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

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- developing ideas from students own or others' investigations and experiences to investigate further

Processing and analysing data and information:

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)

- comparing conclusions with earlier predictions and reviewing scientific understanding where appropriate

LESSON PLAN

Activity	Resources
Activity 1: Properties of Light Waves Give out the *Properties of Light Waves* worksheet to each pair of students. Ask students to complete Part A of the worksheet as they watch Chapter 5 of the video. Review the answers with students when they have finished. Give students time to complete Part B of the worksheet. 20	• Photocopies of the *Properties of Light Waves* worksheet • ClickView video *Light and Sound* Chapter 5
Activity 2: The Law of Reflection Give out the *The Law of Reflection* worksheet to students. Give time to students to complete the questions. Allow students to share their answers with the class when they have finished. 20	• Photocopies of the *The Law of Reflection* worksheet • For each student: A protractor
Activity 3: Flat Surfaces: Plane Mirrors Divide students into pairs and give out the *Flat Surfaces: Plane Mirrors* worksheet to students. Ask students to complete the experiment and to attempt the challenge. Review the answers with students when they have finished. 25	• Photocopies of the *Flat Surfaces: Plane Mirrors* worksheet • For each pair: a plane mirror, ruler, protractor
Activity 4: Convex and Concave Mirrors Give out the *Convex and Concave Mirrors* worksheet to students. Give time to students to complete the questions. Go through the answers with students when they have finished. 20	• Photocopies of the *Convex and Concave Mirrors* worksheet • Protractor, ruler
Activity 5: Refraction Divide students into pairs and give out the *Refraction* worksheet to students. Ask students to complete the investigation and accompanying questions. Review the answers with students when they have finished. 30	• Photocopies of the *Refraction* worksheet • For each group of 2: Perspex block, A4 paper, pencil, protractor, LED ray box

ANSWERS

Properties of Light Waves

Part A:

1	dark blue	6	black	11	black
2	black	7	yellow	12	yellow
3	light green	8	black	13	dark blue
4	grey	9	light green	14	yellow
5	orange	10	grey	15	dark green

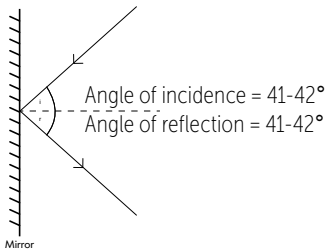
Part B:

Answers can be found here.

It is a firefly.

The Law of Reflection

a)

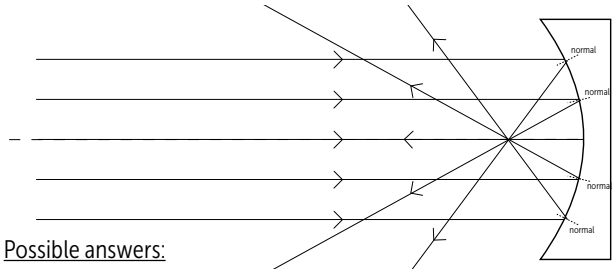


b) Students' answers will vary.

Flat Surfaces: Plane Mirrors

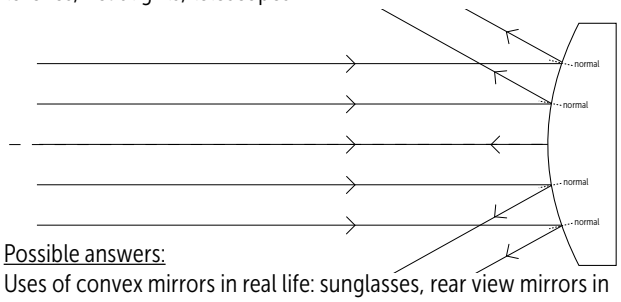
1	upright
2	yes
3	same size
4	virtual
5	same as distance of object to mirror

Concave and Convex Mirrors



Possible answers:

Uses of concave mirrors in real life: flashlights, mirrors in cameras, torches, headlights, telescopes



Possible answers:

Uses of convex mirrors in real life: sunglasses, rear view mirrors in cars, mirrors at corners of intersections and in shops

Refraction

1. Students' answers may vary.
2. Students' answers may vary.
3. Light travels **slower** through Perspex than in air. This means that Perspex has a **higher** optical density than air. When light travels through from a less dense to a denser medium, the refracted ray bends **towards** the normal, causing the refracted angle to become **smaller** than the angle of incidence.

PHYSICAL SCIENCES

Properties of Light Waves

Part A: As you watch the video, choose the correct answer for each **statement.**

	Statement	True	False
1	Light can be explained by both wave theory and particle theory.	dark blue	yellow
2	Light rays travel in curly lines.	white	black
3	Light can pass through an opaque object.	dark green	light green
4	Light can pass through transparent and translucent materials.	grey	black
5	Light cannot be reflected.	red	orange
6	The Law of Reflection states that the angle of incidence is equal to the angle of reflection.	black	grey
7	A plane mirror absorbs light rather than reflecting it.	orange	yellow
8	There are many different types of mirrors.	black	dark blue
9	A concave mirror is outwardly curved.	yellow	light green
10	A convex mirror is outwardly curved.	grey	red
11	A convex mirror gives a wide angle reflection, the rays are spread out when they are reflected.	black	grey
12	Convex mirrors are also called diverging mirrors.	yellow	red
13	Concave mirrors reflect a ray inwards.	dark blue	light blue
14	Concave mirrors are known as diverging mirrors.	orange	yellow
15	On a non-reflective surface, light is scattered and not reflected.	dark green	dark blue

Part B: Use the answers from Part A to help you. Colour the grid below with the correct colours. For example, if statement 1 is true, colour all the boxes containing the number '1' dark blue. If it was false, colour the boxes yellow. The picture below reveals an abstract picture of something found in our world that has the ability to produce light without giving off heat. Find out what it is!

13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	11	11	13	13	13	13	11	13	13	13	13	13	13	13	13	13	13	13	13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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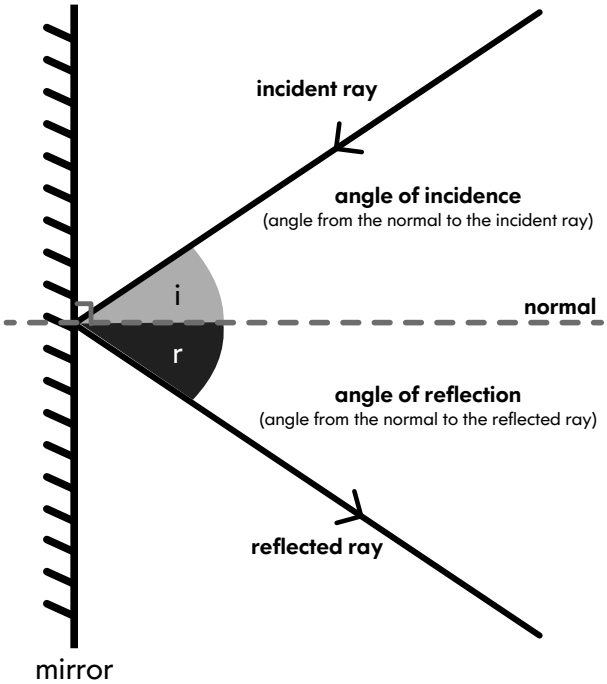
The Law of Reflection



Light rays are reflected when they reach a smooth surface.

The light ray going towards the mirror is known as the **INCIDENT RAY**. The light ray leaving the mirror is known as the **REFLECTED RAY**.

The **NORMAL** is an imaginary line drawn perpendicular to the point where the incident ray meets the surface of the mirror.

Law of Reflection

The incident ray, reflected ray and the normal all lie in the same plane (same side of the mirror).

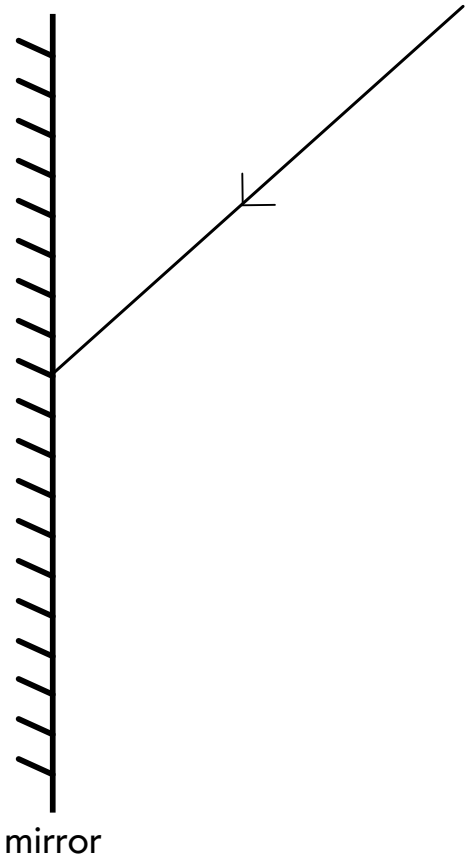
angle of incidence = angle of reflection

Steps to draw a reflected ray

1. Draw the normal at the point where the incident ray meets the mirror.
2. Use a protractor to measure the angle of incidence (i).
3. Mark out the reflected ray using the angle of incidence as a guide.
   (Hint: Refer to the law of reflection for the angle of reflection.)
4. Draw the reflected ray with an arrow to show direction.

Complete the following diagrams with the help of the information found above.
For Question (b), draw your own incident ray to begin the diagram.

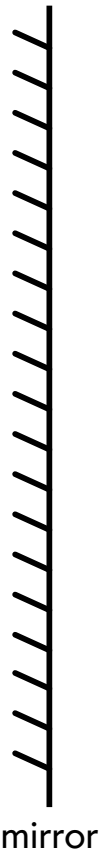
(a)



Angle of incidence = _____°

Angle of reflection = _____°

(b)



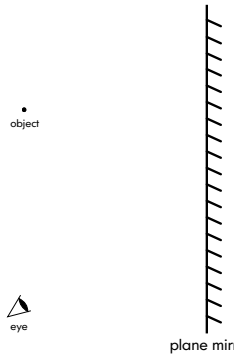
Angle of incidence = _____°

Angle of reflection = _____°

Flat Surfaces: Plane Mirrors

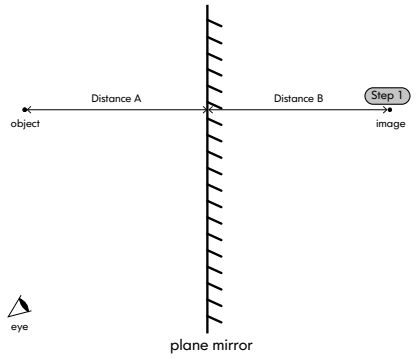
Drawing ray diagrams for plane mirrors

Step 1: Place object in front of a plane mirror.



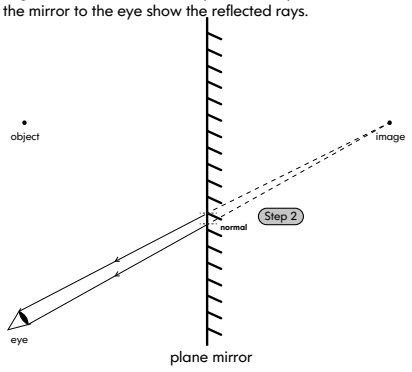
Step 2: Measure the distance between the object and the mirror. The distance between the object and the mirror should be the same as the distance between the image formed and the mirror.

Draw the image of the object on the other side of the mirror.



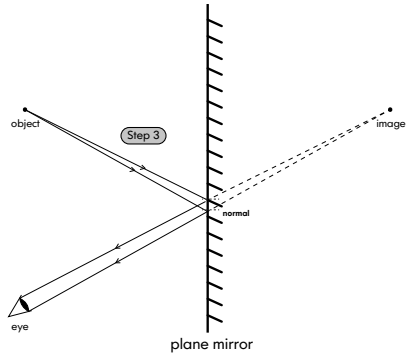
Step 3: Draw **2** light rays from the image to the corners of the eye (together with the 2 normals).

Because it is a virtual image, any rays on the side of the mirror where the image is located need to be represented by dotted lines. Solid lines from the mirror to the eye show the reflected rays.



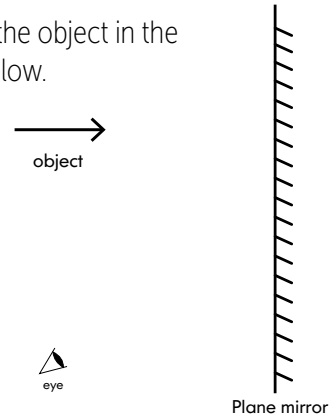
Step 4: Draw **2** light rays from the object to the mirror, meeting the reflected rays.

These light rays represent the incident rays.



It's a Challenge!

Can you draw the image formed by the object in the mirror? Complete the ray diagram below.



Follow the instructions and highlight the correct box for each property you observe. Research online if you do not understand any of the terms used.

Materials:

- mirror

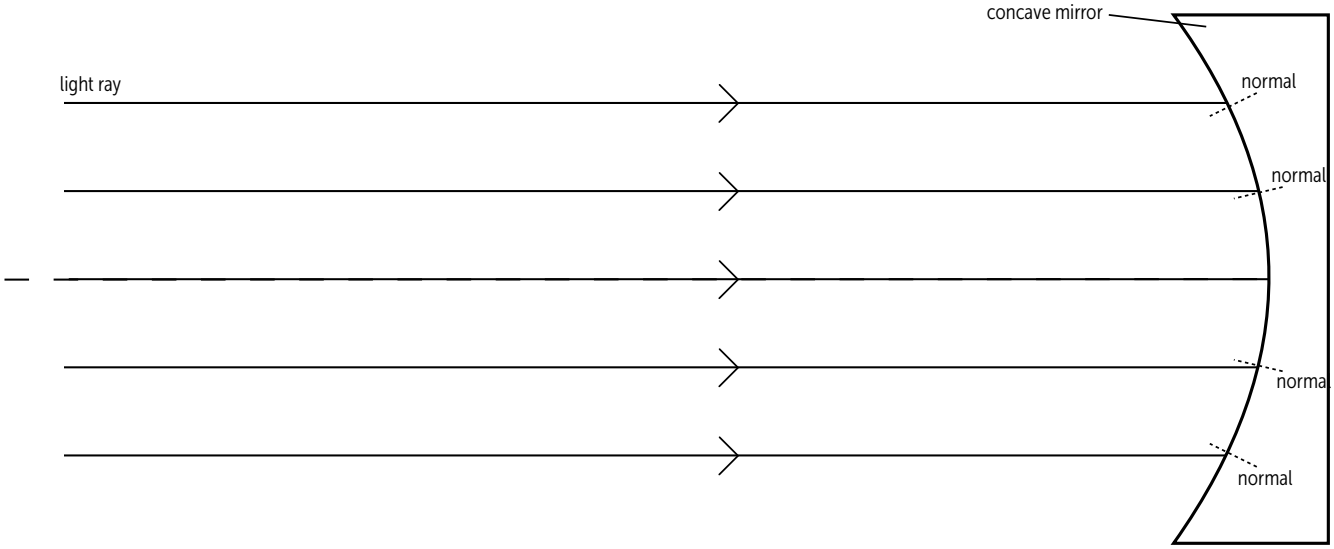
Instructions: Look in the mirror and observe the image formed. What kind of characteristics does the image have?

	Property	Choose the correct answer.	
1	Vertical image orientation	upright	upside down
2	Laterally inverted (Does 'a' appear as 'ɐ'?)	yes	no
3	Size of image formed	significantly reduced	same size
4	Type of image formed	real	virtual
5	Distance of image to mirror	same as distance of object to mirror	different from distance of object to mirror

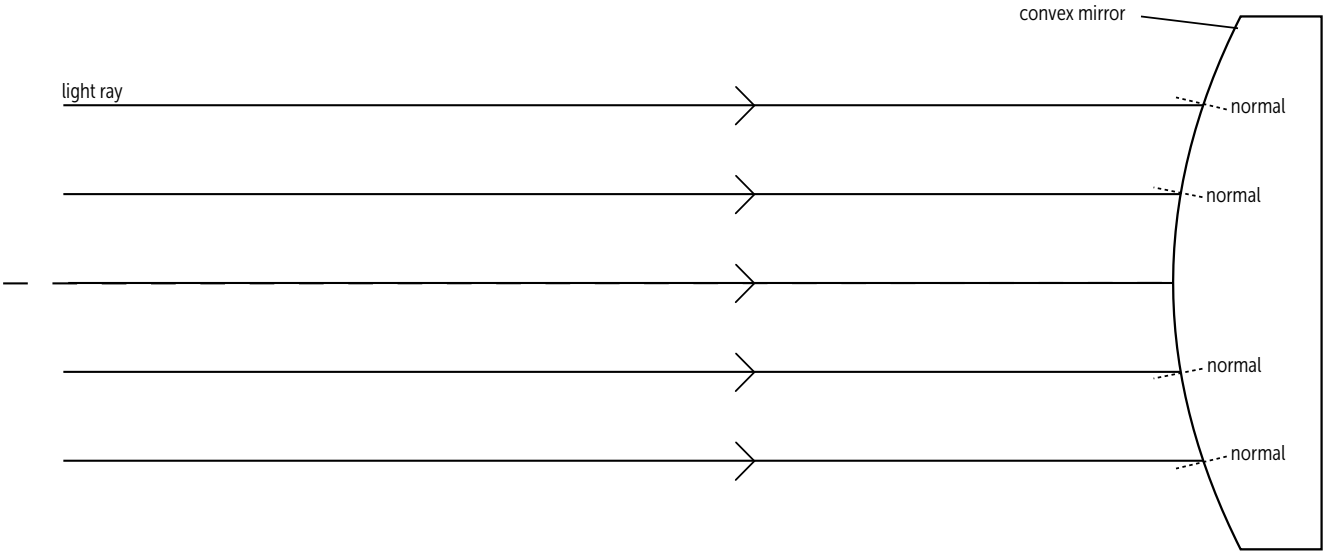
Convex and Concave Mirrors

Convex and concave mirrors produce different types of images due to their different surfaces. Use your knowledge of mirror reflections and the law of reflection to complete the ray diagrams below.

(Hint: The normal divides the angle equally between the incident ray and the reflected ray.)



Uses of concave mirrors in real life:	



Uses of convex mirrors in real life:	

PHYSICAL SCIENCES

Refraction

Carry out the refraction experiment in pairs after reading the following passage. Then answer the questions using information from the passage.

Look at this glass of water. What do you notice about the straw submerged in the liquid? That's right, it looks bent!

It looks like magic, doesn't it?

What you are looking at is an example of refraction. Light travels at different speeds, in different mediums. The denser the medium, the slower light travels through it. Refraction is the bending of a wave when it enters a different medium due to a change in speed. In this example, the mediums are air and water.

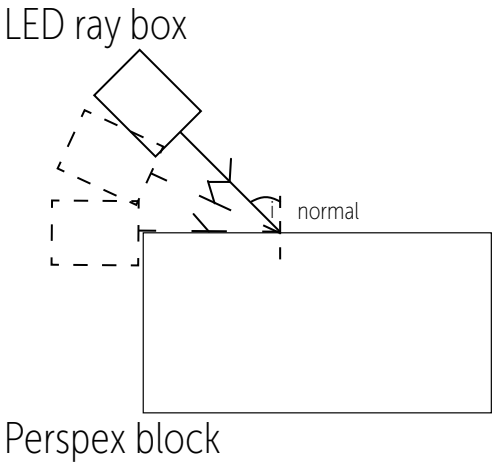
Refraction is everywhere in our daily lives.

Experiment

Let's find out how refraction occurs!

Materials:

- Perspex block
- A4 paper
- pencil
- protractor
- LED ray box



Instructions:

1. In pairs, place the Perspex block on the A4 paper and outline the shape of the block with a pencil.
2. Shine the LED ray box on the block as shown at least 5 different angles of incidence from 0° to 90°.
3. Observe the light ray as it passes through the Perspex block.
4. Trace the path of the light ray on the paper (with arrows).

Questions:

1. The ray passing through the Perspex block is known as the refracted ray. For an angle of incidence of 30°, what is the angle between the refracted ray and the normal? _____°
2. Which is the bigger angle: the angle of incidence or the angle of refraction? _____
3. Refer to the information in the table below and circle the correct answers in the statement found in the box.

Medium	Refractive index
air	1.000
Perspex block	1.495

The greater the refractive index, the greater the optical density.

Light travels **faster/slower** through Perspex than in air. This means that Perspex has a **higher/lower** optical density than air. When light travels through from a less dense to a denser medium, the refracted ray bends **away/towards** the normal, causing the refracted angle to become **smaller/bigger** than the angle of incidence.

Methods of Heat Transfer

OBJECTIVES

In this lesson, students will learn about the different methods of heat transfer and identify these methods in their lives.

ACARA CONTENT DESCRIPTIONS

Energy transfer through different mediums can be explained using wave and particle models (ACSSU182)

- investigating the transfer of heat in terms of convection, conduction and radiation, and identifying situations in which each occurs

Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

- using internet research to identify problems that can be investigated
- evaluating information from secondary sources as part of the research process
- developing ideas from students own or others' investigations and experiences to investigate further

Processing and analysing data and information:

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)

- comparing conclusions with earlier predictions and reviewing scientific understanding where appropriate
- suggesting more than one possible explanation of the data presented

LESSON PLAN

Activity	Resources
Activity 1: The Travels of Heat Play Chapter 2 of the video to the whole class. Divide students into groups of 3 and give out the *The Travels of Heat* worksheet to each group. Assign a method of heat transfer to each student. Ask students to watch the chapter containing their assigned method and complete the relevant section in their worksheet. After they have watching and finished their own individual chapters, allow the students within the group to discuss their answers with each other. Ask students to list out the main differences between each method of heat transfer. 15	• Photocopies of *The Travels of Heat* worksheet • ClickView video *Methods of Heat Transfer* Chapter 2 Chapter 4 (Conduction) Chapter 6 (Convection) Chapter 7 (Radiation) • Laptops
Activity 2: Summarising the Travels Give out the *Summarising the Travels* worksheet to students. Give them some time to complete the worksheet based on previous discussion from Activity 1. Allow them to discuss with a partner if they have difficulties. Have students discuss and share their answers to the worksheet. Play the relevant chapters once again for students for review. 20	• Photocopies of the *Summarising the Travels* worksheet • ClickView video *Methods of Heat Transfer* Chapter 2 Chapter 4 (Conduction) Chapter 6 (Convection) Chapter 7 (Radiation)
Activity 3: Heat Transfer in Our Lives Give out the *Heat Transfer in Our Lives* worksheet to students. Ask students to access the following website on the top of their worksheet. Random pictures/videos will pop up when students refresh the page and students are to identify the relevant method of heat transfer found in two examples. Ask students to complete their answers on the worksheet. 25	• Photocopies of the *Heat Transfer in Our Lives* worksheet • Laptops

ANSWERS

The Travels of Heat

Conduction	Convection	Radiation
A diagram showing vibrations of molecules	A diagram showing the convection current	A diagram showing beam of light without particles involved
As a solid is heated, its particles gain kinetic energy and move more vigorously. As each particle's KE increases, it passes on this energy to its slower moving neighbouring particles.	When particles in a fluid are heated, they move faster and further apart. This decreases their density and they rise. Cold, denser fluid sinks to replace the rising fluid, setting up a convention current.	Radiation happens when heat moves as infrared waves from a source to something else without requiring any contact.
It occurs best in solids and the ability to conduct heat of different materials depends on the bonding in it.	It occurs in fluids (liquids and gases).	Shiny and light surfaces do not absorb and radiate heat well. Black and dull surfaces radiate heat well.

Summarising the Travels

1. Heat is energy transfer as a result of energy difference. Temperature measures the average kinetic energy of the molecules of an object.
2. A conductor allows heat to pass through it easily. An insulator does not allow heat to pass through it easily.
3. The particles vibrate quicker and more vigorously.
4. a)
5. It expands.
6. When molecules are heated, they vibrate faster and move further apart. The area they are in becomes less dense therefore causing the molecules to rise.
7. rises; sinks
8. Unlike conduction and convection, heat radiation can occur in any material without a medium.
9. a)

Heat Transfer in Our Lives

Refer to PDF for possible answers. There may be one or more correct answer depending on different scenarios.

The Travels of Heat

Watch the chapter containing your given mode of heat transfer on your computer. Write down the relevant information from the video. Research additional information if required. After you have finished, share your answers with your group members.

CONDUCTION

Diagram

Process

Other Features

CONVECTION

Diagram

Process

Other Features

RADIATION

Diagram

Process

Other Features

Summarising the Travels

Answer the following questions using your own knowledge and information from the video. Research and discuss with a partner if required.

1. Heat and temperature are two very different concepts. Look up the definitions of heat and temperature and explain how they are different.

   Heat: _____

   Temperature: _____

   _____

   _____

CONDUCTION

2. What is the difference between a conductor and an insulator?

   _____

   _____

3. How do particles behave when they possess more energy?

   _____

   _____

4. In which direction does heat travel?

   a) hot to cold

   b) cold to hot

CONVECTION

5. Thermal expansion/contraction is when materials grow/shrink when they are heated/cooled. When something is heated, does it usually expand or contract?

   _____

6. Why do molecules rise when they have more energy?

   _____

   _____

7. Complete the following sentence.

   Hot air _____, cool air _____.

RADIATION

8. How does radiation differ from conduction and convection?

   _____

   _____

9. Which of the following surfaces radiate heat best?

   a) black and polished

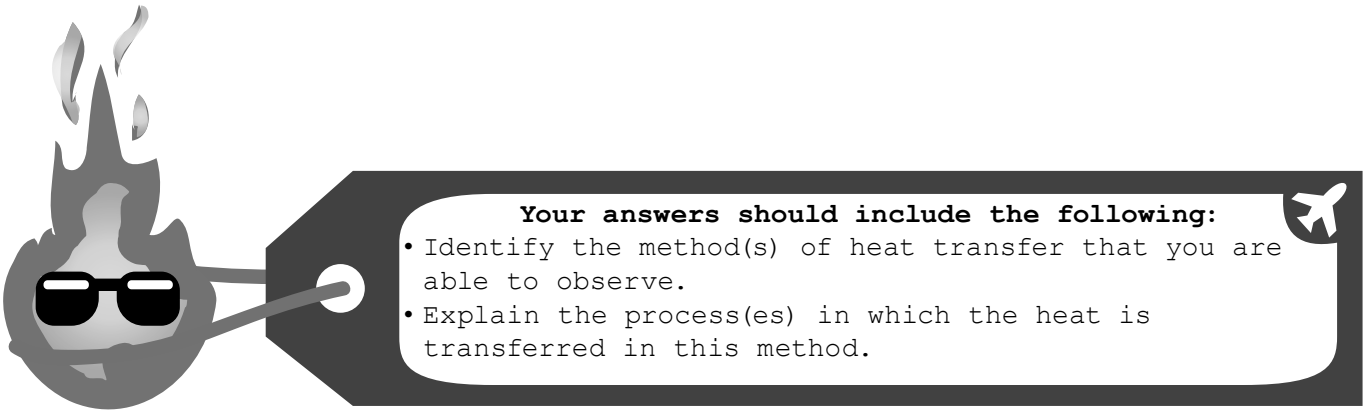
   b) white and polished

   c) black and rough

   d) white and rough

Heat Transfer in Our Lives

Conduct research on your two given examples and identify which mode(s) of heat transfer is/are involved. Write down a description of each example.



Example 1

Example 2

Current Electricity

LAB LESSON

OBJECTIVES

In this lesson, students learn about current electricity, electrical symbols as well as learn about the differences between series and parallel circuits.

ACARA CONTENT DESCRIPTIONS

Energy transfer through different mediums can be explained using wave and particle models (ACSSU182)

- investigating factors that affect the transfer of energy through an electric circuit

Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

- evaluating information from secondary sources as part of the research process
- developing ideas from students own or others' investigations and experiences to investigate further

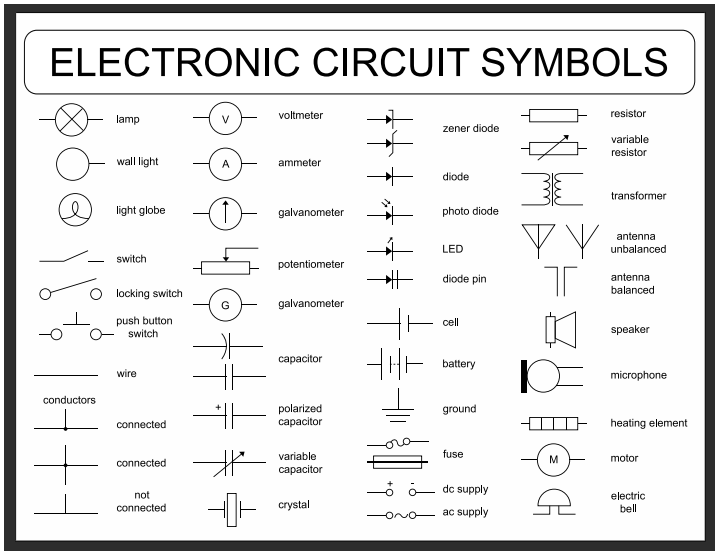
Planning and conducting:

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)

- explaining the choice of variables to be controlled, changed and measured in an investigation
- combining research using primary and secondary sources with students' own experimental investigation

LESSON PLAN

Activity	Resources
Activity 1: Current News Give out the *Current News* and *All about Currents* worksheets to students. Allow time for students to read through *Current News*. Play Chapter 5 of the video and ask students to complete the tasks after watching the video. Give time to students to finish the worksheet. Review answers once students have finished. 25	• Photocopies of *Current News* and *All about Currents* worksheet • ClickView video *Introduction to Electricity* Chapter 5
Activity 2: Series and Parallel Circuits Give out the *Series and Parallel Circuit* worksheet to students. Divide students into groups of 3 and give out the materials required for the experiment. Give time for students to work on the experiment and complete the worksheet. Ask students to share their answers once they have finished. 35	• Photocopies of the *Series and Parallel Circuits* worksheet • For each group: 3 identical light globes, 2 cells, wires, multimeter (or ammeter and voltmeter)



ANSWERS

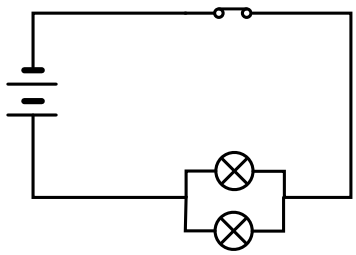
All about Currents

Task 1

1. electrons are able to move freely.
2. electricity is able to flow as the conducting wires allow electrons to flow continuously through them.

Task 2

cell	battery	light bulb	open switch	resistor
fuse	ammeter	voltmeter	closed switch	variable resistor



Task 3

1. V = IR
2. R = V/I

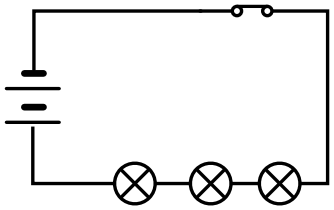
Task 4

1. I = V/R = 12 / 4 = 3 A

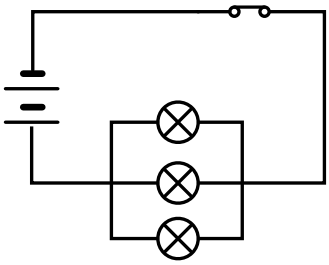
Series and Parallel Circuits

Students' answers may vary for ammeter and voltmeter readings, depending on the bulbs and cells used.

Series:



Parallel:

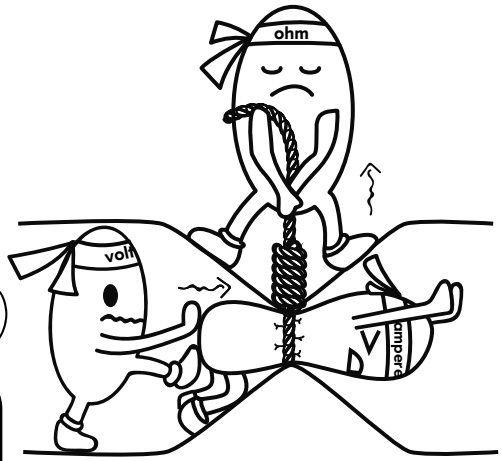


PHYSICS

CURRENT NEWS

THE ENERGETIC ELECTRICITY

Electricity is a form of energy. It is the flow of electrical charges (electrons). Electricity flows through a **closed** circuit because the conducting wires allow electrons to flow continuously through them.



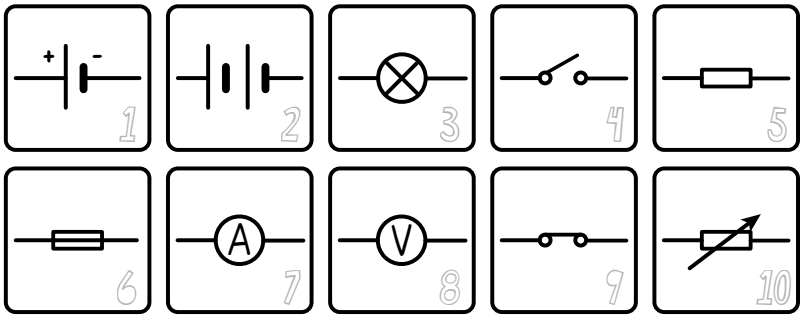
V.I.R (VERY IMPORTANT RULES)

V	I	R
Potential Difference	Electric Current	Resistance
Energy needed to move a unit charge to flow between two points *(more energy = charges move quicker in a circuit)*	Rate at which the electric charges flow *(how fast charges flow in a circuit)*	Opposition to the flow of electric charges
UNIT: **Volt (V)**	UNIT: **Ampere (A)**	UNIT: **Ohm (Ω)**

OHM'S LAW

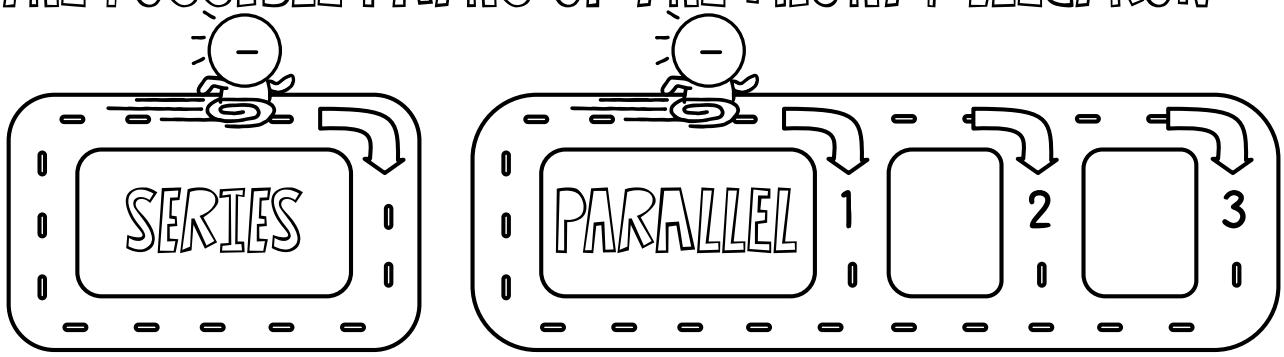
$$I = \frac{V}{R}$$

SPEAKING ELECTRICITY IN SECRET CODE



Scientists have developed an easy and convenient way to represent **electrical components** on diagrams - by using symbols. This makes reading and representing electric circuit diagrams quick and easy for scientists. Can you imagine if you had to draw and sketch every single electrical component? I think it would take us a very looonng time...

THE POSSIBLE PATHS OF THE MIGHTY ELECTRON



All about Currents

Complete the tasks using information from the video and 'Current News'.

Task 1

Complete the following sentences with relevant information.

1. Metals are able to conduct electricity because...

2. When a circuit is closed...

Task 2

Find out what each of the 10 symbols mean on the *Current News* poster.

Draw the circuit in the picture using the symbols from the table above.

Task 3

The relationship between resistance, electric current and potential difference can be expressed using the equation in Ohm's law.

1. Express potential difference in terms of electric current and resistance.

$V =$

2. Express resistance in terms of electric current and potential difference.

$R =$

Task 4

Calculate the answer for the following scenario.

The potential difference across a resistor of 4Ω in a circuit was found to be 12V. What is the current flowing through?

PHYSICS

Series and Parallel Circuits

In this experiment, you will set up the circuit in the two scenarios below and measure the current and voltage passing through each of the globes using the multimeter.

A multimeter is an equipment that can be used to measure both voltage and current depending on the settings it is put at and the position it is placed in a circuit. The red lead is the positive termial and the black lead is the negative terminal of the equipment.

USING THE MULTIMETER AS AN AMMETER

An ammeter measures the current of a circuit.

It must be connected **in series** (single loop) with the circuit.

The positive terminal of the ammeter is connected to the positive terminal of the cell, and vice versa for the negative terminal of the cell.

USING THE MULTIMETER AS A VOLTMETER

A voltmeter measures the potential difference across two points in a circuit.

It must be connected **in parallel** across the two points of the cell or electrical component to be measured.

Materials:

- 3 identical light globes: A, B and C
- 2 cells
- wires
- multimeter or ammeter and voltmeter

Scenario 1: Form a closed circuit with the globes, wires and cells. Arrange all the light globes in a **series** circuit. Draw the circuit using electric symbols.

Measure the current passing through each globe.

Globe A: _____

Globe B: _____

Globe C: _____

Measure the voltage passing through each globe.

Globe A: _____

Globe B: _____

Globe C: _____

Form a closed circuit with the globes, wires and cells. Arrange all the light globes in a **parallel** circuit. Draw the circuit using electric symbols.

Measure the current passing through each globe.

Globe A: _____

Globe B: _____

Globe C: _____

Measure the voltage passing through each globe.

Globe A: _____

Globe B: _____

Globe C: _____

What did you notice about the **current** in the series and parallel circuit?

What did you notice about the **voltage** in the series and parallel circuit?

PHYSICS

Static Electricity

LAB LESSON

OBJECTIVES

In this lesson, students will learn about static electricity, how it is formed and how well different materials conduct electricity.

ACARA CONTENT DESCRIPTIONS

Energy transfer through different mediums can be explained using wave and particle models (ACSSU182)

- investigating factors that affect the transfer of energy through an electric circuit

Questioning and predicting:

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

- using internet research to identify problems that can be investigated
- evaluating information from secondary sources as part of the research process
- developing ideas from students own or others' investigations and experiences to investigate further

Planning and conducting:

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)

- explaining the choice of variables to be controlled, changed and measured in an investigation
- combining research using primary and secondary sources with students' own experimental investigation

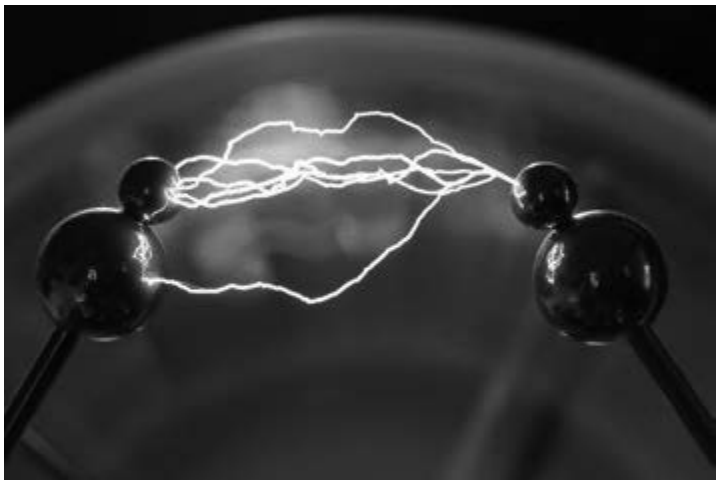
Processing and analysing data and information:

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)

- comparing conclusions with earlier predictions and reviewing scientific understanding where appropriate
- suggesting more than one possible explanation of the data presented

LESSON PLAN

Activity	Resources
Activity 1: All about Static Electricity Give out the *All about Static Energy* worksheet to students. Ask students to complete Part A of the worksheet as they watch Chapter 3 of the video. Give time for students to complete the questions. Review the answers with students when they have finished. 15	• Photocopies of *All about Static Electricity* worksheet • ClickView video *Introduction to Electricity* Chapter 3
Activity 2: Separate the Salt and Pepper Divide students into groups of 3-4 and give out the materials to each group to complete the challenge in Part B. Give time to students to write up their report. Discuss students' findings when they have finished. 45	• *All about Static Electricity* worksheet • For each group: paper plate, salt, pepper, plastic spoon, a piece of woolen cloth



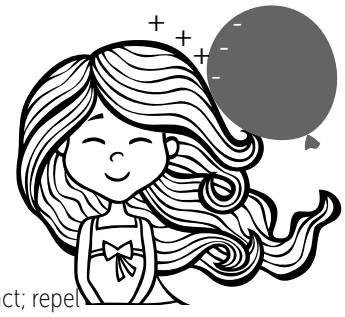
ANSWERS

All about Static Electricity

Part A:

1. Static electricity is formed when objects of two different materials are rubbed together.
2. Students' answers may vary.

Charge of atom	Protons	Electrons
neutral	12	12
positively charged	14	< 14
negatively charged	10	> 10

3. The atom has to be charged (an ion) and static electricity occurs when electrons are transferred from the negatively charged material (with more electrons) to the positively charged material (with less electrons).
4. 

5. attract; repel
6. No

Part B:

Discussion questions:

1. The pepper was more easily attracted to the spoon. The grains of pepper are lighter than the grains salt, causing it to jump up onto the balloon easier.
2. A negative charge was given to the plastic spoon, allowing it to attract the pepper grains.

PHYSICAL SCIENCES

All about Static Electricity

Part A: After you have watched the video, answer the questions with relevant information for this section.

1. How is static energy formed between two objects?

   _____

2. In the table, write down the number of electrons in a neutral, positively and negatively charged atom respectively.
3. In your own words, what is the requirement in the charge of the atom for static energy to occur?

   _____

   _____

4. Draw the final charges on the balloon and the hair of the girl after they are rubbed together.
5. Complete the following sentence:

   "Opposite charges _____, like charges _____."

6. Do you think all objects conduct static electricity? Yes/No

Charge of atom	Protons	Electrons
neutral	12	
positively charged	14	
negatively charged	10	

Part B: How well can different materials conduct static electricity?

Electricity is generated when electrons move from one place to another. With static electricity, electron movement is instantaneous and results in the collection of electrically charged particles on the surface of a material. Different materials have different tendencies of either giving up electrons and becoming positive (+) in charge or attracting electrons and becoming negative (–) in charge. Static can be used to separate a mixture of salt and pepper.

With the given materials, design an experiment to determine which spoon (a plastic spoon or a wooden spoon) can better conduct static and separate pepper from salt.

Which spoon do you think will conduct static electricity better? _____

Materials:

- paper plate
- salt
- pepper
- plastic spoon
- wooden spoon
- a piece of woolen cloth

Write a scientific report that includes the following:

- Aim of the experiment
- Method (How you are going to carry out the experiment?)
- Results (What did you observe?)
- Discussion questions
- Conclusion

Discussion questions:

1. Which of the two, the salt or the pepper, was more easily attracted to the spoon? What is the reason for it?
2. What was the resulting charge on the plastic spoon when it was rubbed onto the woolen cloth?

CURRICULUM MAPPING GRID

Strand	Substrand	Content Description	The Human Respiratory System (p6)	The Human Digestive System (p10)	The Human Nervous System (p14)	The Electromagnetic Spectrum (p18)	Energy in an Ecosystem (p22)
Understanding	Biological sciences	Multicellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment (ACSSU175)	●	●	●	●	
		Ecosystems consist of communities of interdependent organisms and abiotic components of the environment matter and energy flow through these systems (ACSSU176)					●
	Chemical sciences	All matter is made of atoms that are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms (ACSSU177)					
		Chemical reactions involve rearranging atoms to form new substances; during a chemical reaction mass is not created or destroyed (ACSSU178)					
		Chemical reactions, including combustion and the reactions of acids, are important in both non-living and living systems and involve energy transfer (ACSSU179)					
	Earth and space sciences	The theory of plate tectonics explains global patterns of geological activity and continental movement (ACSSU180)					
	Physical sciences	Energy transfer through different mediums can be explained using wave and particle models (ACSSU182)					
Human Endeavour	Nature and development of science	Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community (ACSHE157)					
		Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries (ACSHE158)				●	
	Use and influence of science	People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people's lives, including generating new career opportunities (ACSHE160)				●	
		Values and needs of contemporary society can influence the focus of scientific research (ACSHE228)					
Inquiry Skills	Questioning and predicting	Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)		●	●	●	
	Planning and conducting	Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)	●		●		
	Processing and analysing data and information	Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)				●	●
	Communicating	Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS174)					

		●					●					●			The Atom (p26)
											●				Reactants and Products (p30)
											●				Acids and Bases (p34)
	●									●					Neutralisation (p38)
●		●	●								●				Exothermic vs. Endothermic (p45)
							●		●						Plate Tectonics (p46)
			●	●					●						Earthquakes (p52)
			●	●					●						Volcanoes (p56)
	●		●					●							The Two Types of Waves (p58))
	●		●					●							Sound Waves (p62)
	●		●					●							Light Waves (p66)
	●		●					●							Methods of Heat Transfer (p72)
		●	●					●							Current Electricity (p76)
	●	●	●					●							Static Electricity (p80)

EDUCATIONAL VIDEOS FOR **SECONDARY SCHOOLS**

ABOUT CLICKVIEW

Making a Difference

As educators, we know that each student learns differently. We believe that video is the perfect way to engage with any student, despite differences in learning styles.

At ClickView, our goal is to give teachers the best opportunity to create a rich learning experience through video education for students.

From the videos we produce right here in Australia, the flipped classroom videos created by our community, to the free-to-air TV programmes we curate; ClickView is revolutionising how video can be utilised to increase student engagement and boost student outcomes.

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