10

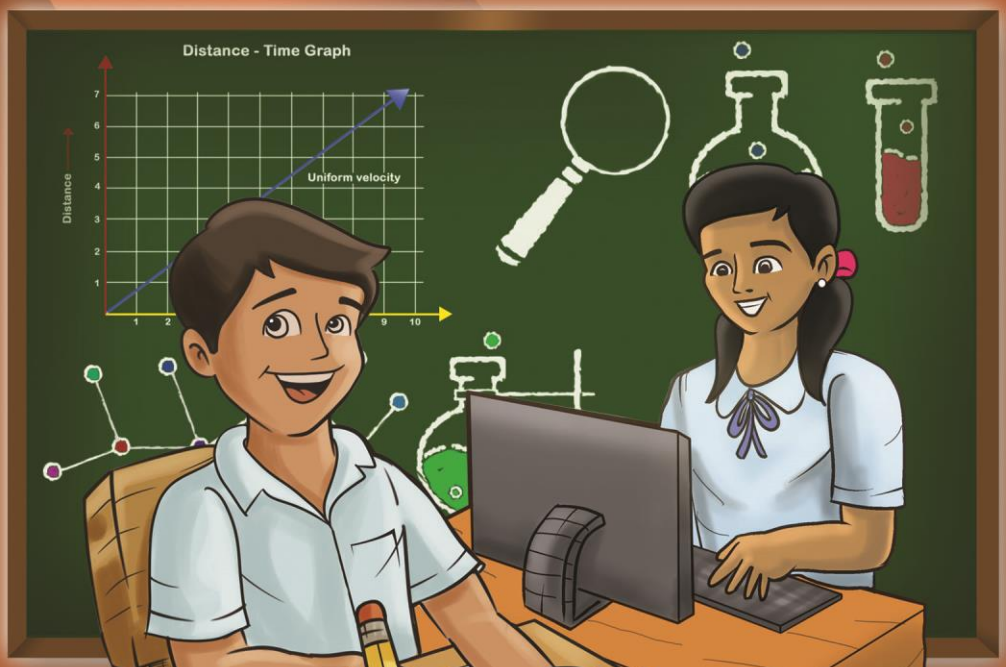
NATIONAL LEARNING CAMP

DepED DEPARTMENT OF EDUCATION

Science

Enhancement Learning Camp

Student Workbook



Enhancement Learning Camp
Student Workbook

Science Grade 10

Weeks 1 to 3

Contents

Introduction for Students

Welcome to the National Learning Camp. You are probably aware that this Camp is only open to students like you who have just completed Grade 9 or Grade 10 across the country.

You have chosen to be part of this important national program. Our focus this year is on: English, Mathematics, and Science.

The Plan

You are to attend school for three days each week: Tuesday, Wednesday, and Thursday.

You will take part in six special lessons each day. These lessons review subject content you have completed. This will help you further strengthen your learning.

There will be opportunities in each lesson for you to practice talking with other students and your teacher, and applying the knowledge you have gained in:

- understanding (comprehending) what you are reading in *English*,
- solving *Mathematics* problems, and
- interpreting the natural world through applying *Science* evidence.

Time in Class

How you use your time in lessons is very important. Every minute is valuable. It is critical that you work with the teacher and your classmates as closely as you can.

This means you will be expected to:

- start each lesson as quickly as possible,
- recognize the lesson pattern and help the teacher as you move from one part of the lesson to another,
- pay attention when the teacher or students in your class are talking about work, and
- try your best with all the different activities that make up the lesson.

You will have opportunities to write your answers down, explain to the teacher or classmates your reasons for your responses or thinking. There will be time to work on your own and at other times you will work with your classmates and report to the class.

Mistakes

One important fact drawn from brain research on learning concerns making mistakes. **It might surprise you!**

Making mistakes while learning and trying to improve your skills and understanding is *part of the brain's process*. So, learning from mistakes is an important pathway of our learning journey. When a genuine mistake is made:

- do not be ashamed or embarrassed,
- do try to learn from your mistake,
- be willing to talk about your mistakes,
- try to understand why you committed a mistake, and
- find out how to correct the mistake.

Too often learners are embarrassed or feel they have failed because of errors/mistakes. **This should not be the case.** Everyone makes mistakes as they learn new material – **everyone.**

A very famous scientist, Niels Bohr, who won a Nobel Prize for Physics, said:

An expert is a person who has made all the mistakes that can be made in a very narrow field.

Everyone makes mistakes, even experts. **It is a vital part of learning.** If you make mistakes, it is a sign that you are moving your learning forward. You may need to return to earlier learning and fill in some gaps.

Mistakes and/or errors tell **you** and your **teacher** about your thinking and where you need help or practice (we call it deliberate practice) to do better. The **teacher** and **you** should celebrate finding the mistake as it will help you both know what new learning is needed.

You might be surprised, but if you do not make genuine mistakes and fix them, your learning will not move forward efficiently.

Practice

If you want to be good at something you must practice it. Practice alerts the brain that the information needs to be known and to store the information in your head.

This is the way the brain works; this is the way the brain learns. Learning, anything from sport, about your peers, and to learning subjects in school, requires effort and that means practice.

Effort requires persistence, but it is not supposed to be difficult and punishing. It may be continued until one learns. There are no tricks. This is what the brain needs to learn.

It is important that you try and try again

Learning is not a race but a journey of self-improvement. It is recognizing your efforts to do better and to be better. Your potentials will be revealed only if you try.

The Extensive Team of Educators and Teachers involved in the National Learning Camp wish you the very best in your education future. For the Learning Camp, and your work when you return to school, our hope is for you to take any new knowledge, skills and understandings you have acquired to learn more, and to use this knowledge to want to learn more.

Best Wishes

Science Grade 10 Lesson No. 1

Volcanoes, Earthquakes and Mountain Chains – Evidence for Plate Tectonics

Component 1: Short Review

Q1a. What is a 'chain'?

Q1b. What is a 'belt?

Q2. What are some features of a *Mountain* and a *Mountain chain*?

Q3. What might cause the big mountain chains of the Philippines to be long and narrow?

Component 2: **Lesson Purpose**

This lesson is about how the location of volcanoes, earthquakes and mountains of the Philippines provide good evidence for tectonic plates.

Component 3: Lesson Language Practice

Key words/terms:

Mountain chains; Earthquake belts; Tectonic plates

This lesson has lots of terms, including *plates*, *belts* and *chains,* that have both ***everyday meanings*** and ***scientific meanings!*** Why might this be so?

Component 4*:* Lesson Activity

Component 4A

The following main lesson stimulus includes a legend to help people interpret what is being shown on the map. Can you mark on the location of the school you are in today?

Philippine Volcanoes, Earthquakes and Mountains – Evidence for Tectonic Plates

The Philippine Archipelago has numerous of long mountain chains or belts, active volcanoes and earthquake zones which provide scientists with compelling evidence for the Theory of Plate Tectonics. The distribution or patterns observe in these features, especially the alignment with the islands of the Philippines provides the most critical form of evidence that can be observed from the ground. The following map highlights the location of some of the chain mountains and active volcanoes – these features also align with areas of high earthquake activity.

Main Volcanoes and Chain mountains of The Philippines

Component 4B

Q1. Which volcano is associated with the Zambales mountains?

Q2. Write down the names of some volcanoes that form a line or a chain of volcanoes?

Q3. The Sierra Madre chain mountains are located on the big island of Luzon. Describe how these mountains relate to the coastline of Luzon Island.

Component 4C

Q1. On which side of Luzon Island is Mount Pinatubo located?

Q2. Describe the general ways the chain mountains and/or the volcanoes are located in the Philippines?

Q3. **(Optional)** How do the patterns or distribution of the volcanoes and the chain mountains related to the arrangement of islands of the Philippines and what does this suggest about how the islands have formed?

Component 5: Lesson Conclusion

1. What did you learn from this lesson?

2. What are some things you enjoyed about the lesson?

3. What is something you would like to learn more about in this lesson?

Science Grade 10 Lesson No. 2

Plate Boundaries – Where the Action Is!

Component 1: Short Review

Q1. What is a cross-sectional diagram?

Q2. How two tectonic plates interact each other at a convergent boundary (i.e. when two plates come together)?

Q3. How can we explain the frequent occurrence of earthquakes in the Philippines?

Component 2: **Lesson Purpose**

This lesson is about the nature of the highly active plate boundaries that are located near the Philippines.

The lesson may also help you to explain the distribution of volcanoes, earthquake epicenters and major mountain belts of the Philippines.

Component 3: Lesson Language Practice

Keywords/terms:

Continental crust; Oceanic Crust; Lithosphere; Asthenosphere; Mantle

These are ***geologic*** terms (from the study of ***Geology***). Practice saying the terms.

Component 4*:* Lesson Activity

Component 4A

The main lesson stimulus includes *text and diagrammatic information* about the tectonic forces that are shaping the Philippines. The cross-section is provided to help you to visualize in three dimensions what is happening in the Philippines Archipelago.

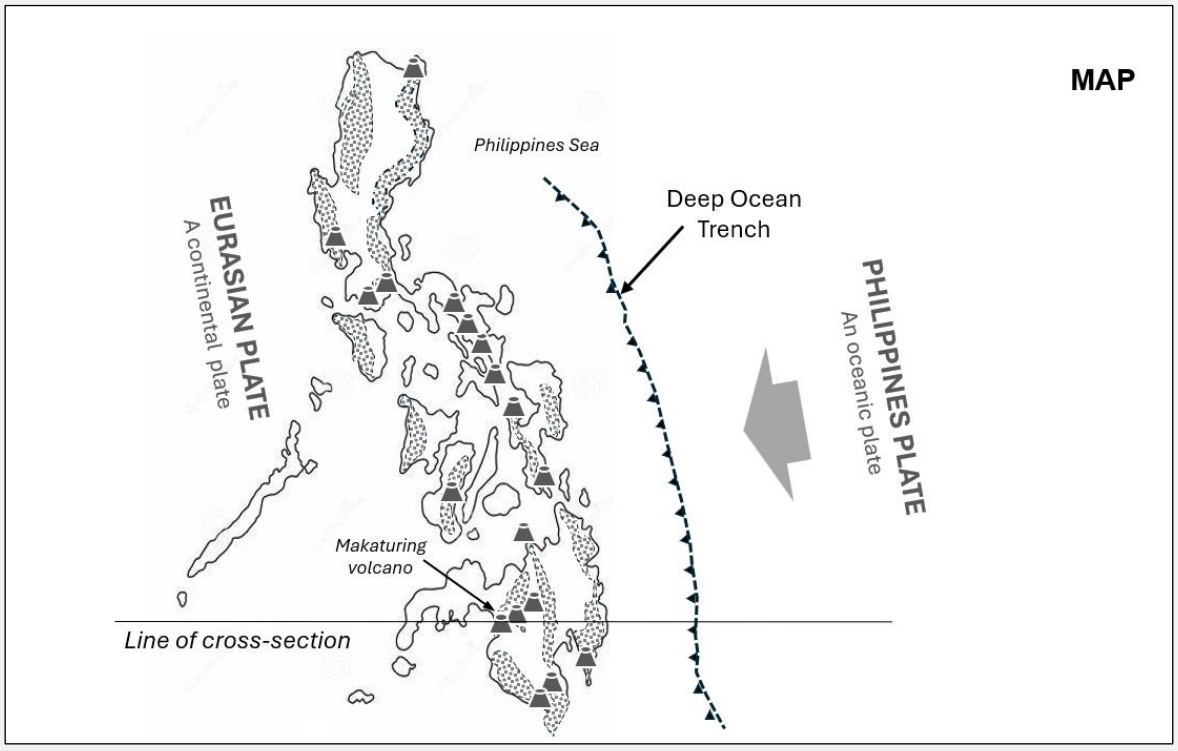
Is the Philippines Being Shaped by *Plate Tectonics*?

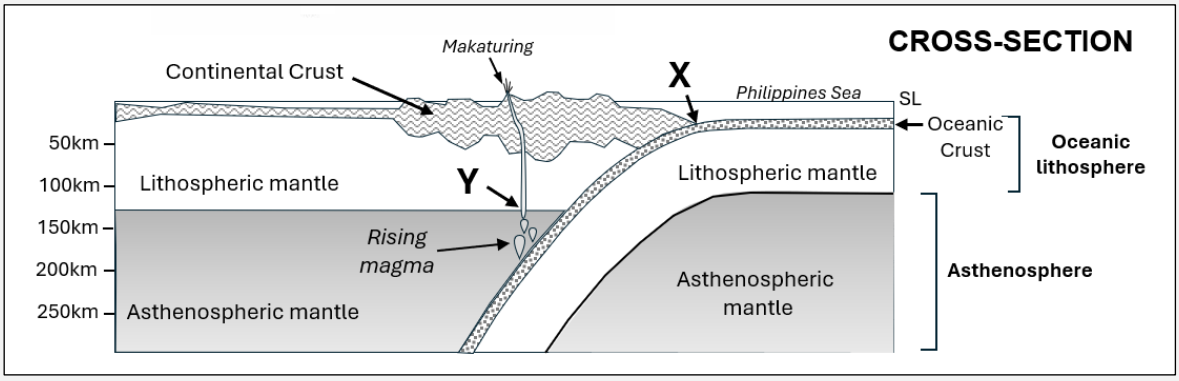
According to the ***Theory of Plate Tectonics***, the Earth's outermost layer, called the ***lithosphere,*** is made up of solid *crust* and solid *lithospheric mantle*.

The lithosphere forms large plates, called ***tectonic plates,*** which move relative to each on a partially molten layer of the mantle, called the ***asthenosphere***. Due to convection currents in the asthenosphere and push and pull forces acting on the lithospheric plates, they slowly move around the Earth at rates of between 2-15 centimeters per year. The interaction of the tectonic plates is responsible for many different geological features, such as the volcanoes, earthquake epicenters and mountain belts of the Philippines. The volcanoes and the long mountain chains that form the Philippine Archipelago all align in a North-South direction.

Scientists now detect features of the ocean floor and structures in the Earth's crust that add more evidence for Plate Tectonics, including *ocean rifts* and *mid ocean ridges* (MORs) at ***divergent plate boundaries*** and *deep ocean trenches* at ***convergent plate boundaries***.

Map and Cross-section views of The Philippines





Component 4B

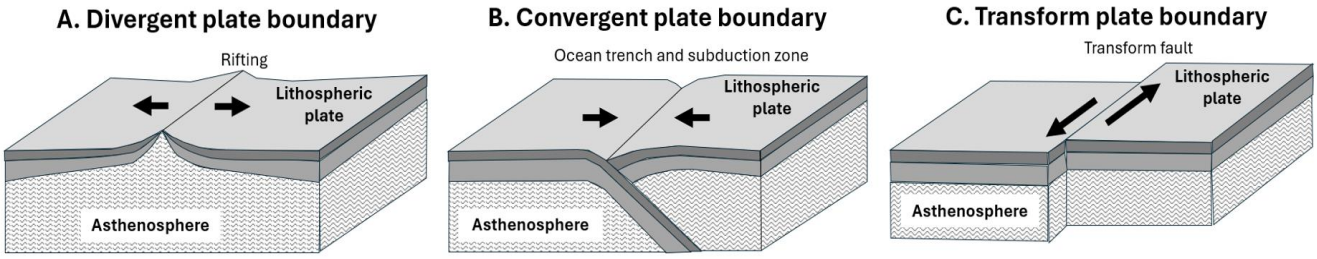
Q1. What is the name of the feature shown at point **X** in the cross-section of the Philippines?

Q2. What are the names of the layers that can be seen in the cross section of the Philippine Archipelago?

Q3. The lithosphere in the Philippines is found in two forms – the *Continental lithosphere* and the *Oceanic lithosphere*. What makes up the *Oceanic lithosphere*?

Component 4C

Q1. Here are three ways that tectonic plates interact with each other at their plate boundaries:



Which of these three plate boundaries match the type that are shown in the stimulus diagram?

Q2. What does the structure marked as '**Y'** in the cross-section connect together?

Q3. **(Optional)** How does the location of the ocean trench to the eastern side of the Philippine Archipelago provide evidence that the archipelago is being shaped by Plate Tectonics?

Component 5: Lesson Conclusion

The focus of this lesson was on understanding how plate tectonics impacts on the Philippines.

Q1. Has this lesson helped you to better understand Plate tectonics? If so, how?

Q2. Has this lesson helped you to remember the names of the crustal and mantle layers of the Earth? If so, how?

Q3. What was hard to do or understand in the lesson?

Science Grade 10 Lesson No. 3

Evidence for the Movement of Tectonic Plates

Component 1: Short Review

Q1. What is a jigsaw puzzle?

Q2. What are the names of some large present-day continents?

Q3. What do you think a 'supercontinent' might mean?

Component 2: **Lesson Purpose**

This lesson is about further evidence for the theory of Plate Tectonics. The lesson is focused on the ways that the continents may have been in a supercontinent that split up and drifted apart.

Component 3: Lesson Language Practice

Keywords/terms:

Reconstruction; Triassic; Permian; Gondwana; Gondwanaland

Practice saying the words.

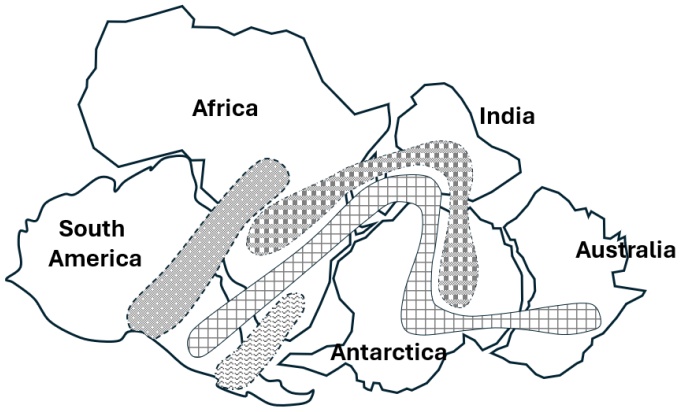
What does r*econstruction* mean in the context of scientist testing models and theories for plate tectonics?

Component 4*:* Lesson Activity

Component 4A

This main lesson stimulus includes *two maps* that show the same fossils and rock types on both maps.

Gondwanaland supercontinent reconstruction ~ 250 million years ago



Location of some Gondwanaland fossils **[mya = millions of years ago]**

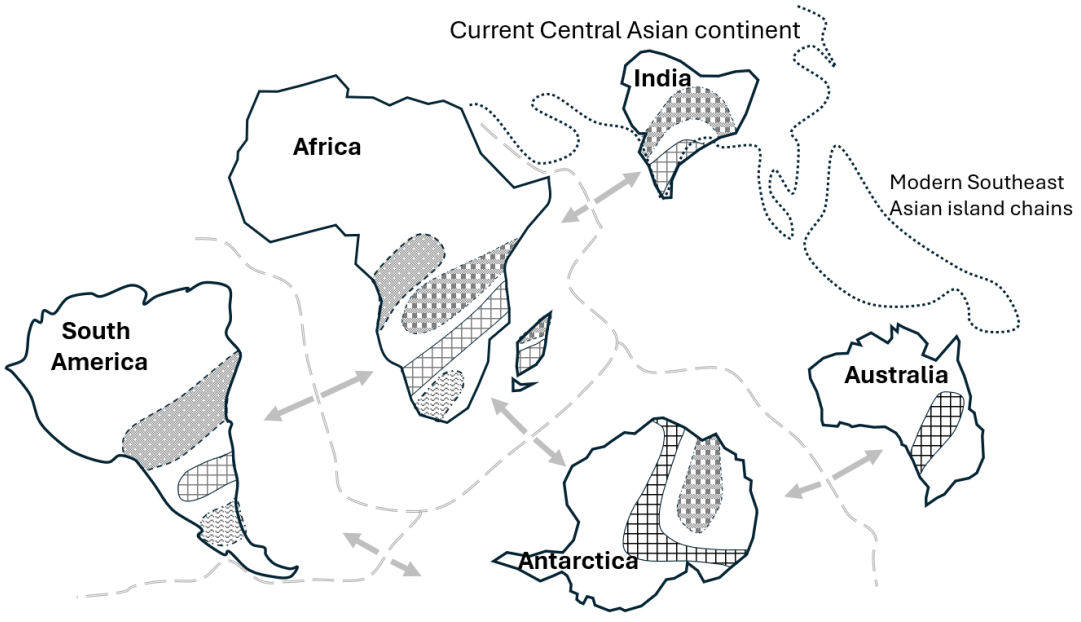
Cynognathus
A small Triassic mammal
(245 to 230 mya)
Found in shale sediments

Lystosaurus
A big Permian-Triassic mammal
(250 to 240 mya)
Found in fine sandstones

Glossopteris
A Permian seed fern
(299 to 250 mya)
Found in coal seams

Mesosaurus
A Permian aquatic reptile
(299 to 270 mya)
Found in shale rock

Current time relative locations of some major continents



Cynognathus
A small Triassic mammal

Lystosaurus
A big Permian-Triassic mammal

Glossopteris
A Permian seed fern

Mesosaurus
A Permian aquatic reptile

The lower map shows some ocean features that support the Theory of Plate Tectonics.

The dashed lines between the continents represent *Mid Ocean Ridges*, where new sea floor forms as two oceanic plates diverge or rift from each other.

Component 4B

Q1. What is the name of the supercontinent shown in the first illustration?

Q2. What continents made up the supercontinent shown in the first illustration?

Q3. If all the fossils were formed on the supercontinent, how long has it taken for the present-day continents to get to their current locations?

Component 4C

Q1. Which is the 'youngest' fossil shown. i.e. the one that had been on Earth the most recent of those presented.

Q2. Complete table 1 here to show the geographical distribution of the fossils shown on the maps.

Table 1: The distribution of fossils on the continents that formed Gondwanaland

Continent locations	**FOSSILS**			
	Cynognathus	***Lystosaurus***	***Glossopteris***	***Mesosaurus***
South America	✓			
Africa	✓			
India	×			
Antarctica	×			
Australia	×			

Q3. **(Optional)** What evidence for the *Theory of Plate Tectonics* can be seen in the maps in the Stimulus, or shown in the table you have completed above?

Component 5: Lesson Conclusion

The focus of the lesson was on understanding more deeply about *Plate Tectonics*.

1. How has the lesson helped you to better understand the evidence for current continents once being in a supercontinent that split up and drifted apart?

2. Which questions were easy to answer – the ones in Component 4B or Component 4C? Why?

3. What strategies do you use to answer the harder questions?

Science Grade 10 Lesson No. 4

Classification of Living Things

Component 1: Short Review

Q1. What does the word *classification* mean?

Q2. What are the characteristics of all living things?

Q3. Why is it important to classify living things?

Component 2: **Lesson Purpose**

This lesson deals on how biologists classify living things including human. In addition, this may also help learners better understand their role in the living world.

Component 3: Lesson Language Practice

Key words/terms:

Kingdom; domain; phylum

Some of these words can have other meanings in different learning areas. Do you know what they might be, and how the word is used in Science?

Component 4*:* Lesson Activity

Component 4A

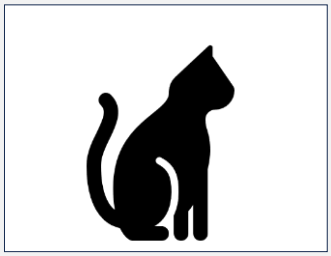
- The main lesson stimulus here includes a *classification table* that describes a way to *classify* living things.

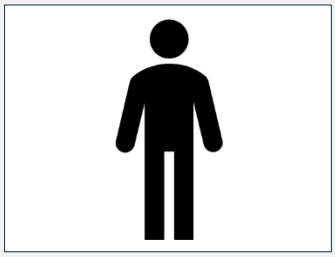
Hierarchical classification of living things

Carl Linnaeus in the 18th century carefully observed living things naming and organizing them into categories based on the observable structures. He proposed that there were three main categories of living things which he called ***kingdoms***. Linnaeus further suggested classifying living things into 5 hierarchical levels and used these levels to provide each living thing with a unique two-word name**.**

Now biologists believe that there are more classification groups needed. Biologists now use eight hierarchical levels to classify living things, and they are shown below in the Hierarchy column, along with three examples. The *human* example is missing its *Kingdom*, *Phylum* and *Class*.

	EXAMPLES		
HIERARCHY	***eggplant/talong***	***cat***	***human***
Domain	*Eukaryotes*	*Eukaryotes*	*Eukaryotes*
Kingdom	*Plantae*	*Animalia*	*?*
Phylum	*Tracheophyta*	*Chordata*	*?*
Class	*Magnoliopsida*	*Mammalia*	*?*
Order	*Solanales*	*Carnivora*	*Primata*
Family	*Solanaceae*	*Felidae*	*Hominidae*
Genus	*Solanum*	*Felis*	*Homo*
Species	*Melongena*	*Catus*	*Sapien*





Using this classification system the unique name for the eggplant would be **Solanum Melongena.**

Component 4B

Q1. What *genus* do cats belong to?

Q2. What would be the *kingdom* and *order* for the eggplant?

3. What two-word classification would be the unique name for humans?

Component 4C

Q1. What order would the *Great Apes* of the Congo in Africa belong to?

Q2. What *kingdom* and *class* would humans belong to?

Q3. **(Optional)**? Why are animals and plants in the Eukaryote domain and not in the Procaryote domain?

Component 5: Lesson Conclusion

The focus of this lesson was on the concepts behind the classification system for plants and animals by biologists.

Q1. Has this lesson helped you to better understand biological classification? If so, how?

Q2. Has this lesson helped you to remember the technical terms used to classify living things? If so, how?

Science Grade 10 Lesson No. 5

Evolution

Component 1: Short Review

Q1. Where does the term “species” fit into the classification system for living things used today?

Q2. Up until the early 19th century how old did scientists believe the Earth to be?

Q3. What was the main issue that some scientists had with the theory of evolution?

Component 2: **Lesson Purpose**

This lesson is about the concept of the evolution of living things.

The lesson may also help you to better understand that humans belong to a species whose other members are now extinct.

Component 3: Lesson Language Practice

Keywords/terms:

evolution; natural selection

Practice saying these words.

Component 4*:* Lesson Activity

Component 4A

Read the following stimulus information and use it to answer the questions main lesson stimulus.

EVOLUTION THROUGH NATURAL SELECTION

What is evolution?

It is a theory that Charles Darwin (1809-1882) proposed, which suggests that every organism on Earth is a descendent of those that lived many millions of years ago.

What concept is it based on?

It is based on the concept that the characteristics of living things change and evolve over time and that this would mean that over many millions of years some species of today would have a common ancestor.

Where is the evidence?

Charles Darwin spent most of his life looking for evidence to support his idea that nature selects the variations within a species that are most useful for survival in their habitat. He finally published his theory of evolution through natural selection in 1859 acknowledging that Alfred Wallace had come up with the same ideas**.**

Today we have evidence of how living things are connected through the study of their DNA**.**

Variation and Natural Selection

Variations often occur due to isolation of species such as the examples of the Echidna and the Platypus in Australia. The mammals and marsupials of Australia are unique. However, despite this the Australian Marsupials have common features with those found in South America.

So why do giraffes have such a long neck?

The example of the giraffe is often used to fully explain the ideas of variation and natural selection.

It is postulated that the ancestors of the giraffe lived in a habitat where the leaves i.e. their food was in the tops of very tall trees and that some members of the group of the ancestors did, by chance have longer necks than others (the variation) and so they were able to obtain food. This meant that they had a better survival rate (the natural selection). This also meant that these individuals passed down through their DNA, the genes for a long neck.

Component 4B

Q1. What does survival of the fittest mean?

Q2. Who was the other scientist who proposed the theory of evolution through natural selection?

Q3. What important comment did Darwin make that would apply to humans who are alive today?

Component 4C

Q1. On which other continent beside Australia might you find marsupials?

Q2. Are there other living things that belong to the genus Homo besides humans?

Q3. **(Optional)** Can acquired characteristics be inherited? Why? Or why not?

Component 5: Lesson Conclusion

The focus of this lesson was on the theory of evolution as proposed by Charles Darwin.

Q1. Has this lesson helped you to better understand evolution? If so, how?

Q2. What was hard to do or understand in the lesson?

Science Grade 10 Lesson No. 6

Where is the Evidence?

Component 1: Short Review

Q1. How old is Earth today, according to modern scientist?

Q2. Give a couple of examples of a living thing that once was alive but is now extinct?

Q3. How do we know that they were once alive?

Component 2: **Lesson Purpose**

This lesson is about the evidence for the theory of evolution.

The lesson may also help you to better understand the processes of variation and natural selection.

Component 3: Lesson Language Practice

Keywords/terms:

Fossils; comparative anatomy

Practice saying the words.

The meaning for possibly unfamiliar words is described in the stimulus.

Component 4*:* Lesson Activity

Component 4A

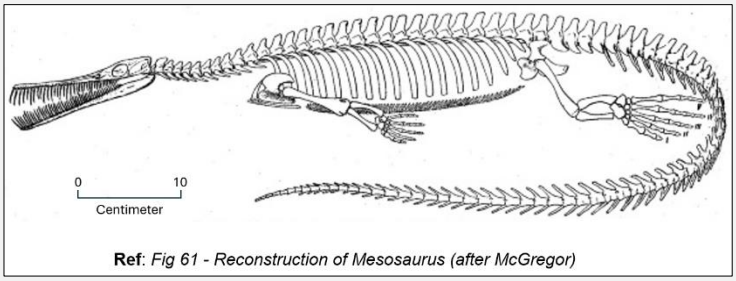
The main lesson stimulus has drawings of ancient fossils and some sketches of limbs of modern animals.

Evidence for the Theory of Evolution

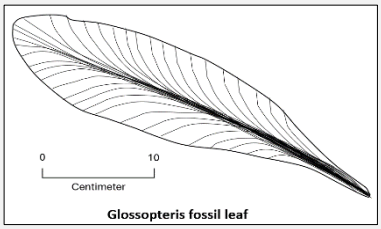
Earth is considered to be 4.5 billion years old and fossil records suggest that *prokaryote life* existed 3.5 billion years ago, but *eukaryote life* existed only around 2.7-1.8 billion years ago. The *dinosaurs* lived between 245 and 66 million years ago. They are now extinct. There is significant evidence for the theory of evolution through variation and natural selection in the fossil record as well as through the study of comparative anatomy and the study of molecular biology. Occasionally scientists come across a species they believe to be extinct but living organisms are found such as the *Wollemi pine* in Australia and the *coelacanth* in South Africa. These, when found, looked like the fossils found of them suggesting perhaps they have not changed in millions of years.

What are fossil records?

If an organism is covered by mud, silt or lava straight after death, such as in a mudslide or volcano, the microorganisms that usually bring decay can't operate because of lack of oxygen. This material will be pressed down over millions of years and become fossils, part of the rock.



Ref: *Fig 61 - Reconstruction of Mesosaurus (after McGregor)*

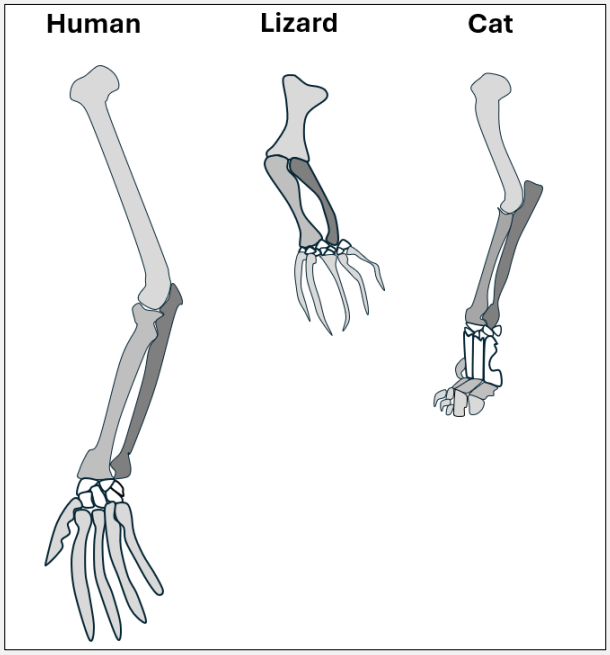


Glossopteris fossil leaf

Fossils may also be molds, casts or imprints. Many fossils have been found of dinosaurs and their footprints that show that they existed. Fossils are found in sedimentary rock and carbon dating can be used to date fossils up to 50 000 years old but other forms of radiometric dating can be used to date older rocks.

What is comparative anatomy?

It is when we compare the structural features of different species or even other classes of living things. For example: the forearms of mammals, amphibians, reptiles, and birds are remarkably similar even though these animals would not appear similar in other ways. These structures are used for different functions such as walking, swimming, or flying but have a common ancestor in the fins of fossilized fish from which early amphibians evolved.



Ref: Fig 61-Reconstruction of Mesosaurus (after McGregor)
Dinosaur Skeletal Reconstruction Prehistoric Animal Bones - Mesosaurus Skeleton Large (copyrightexpired.com)

Component 4B

Q1. How long ago did dinosaurs roam the Earth?

Q2. Which came first, the prokaryotes or the eukaryotes?

Q3. Describe one way that fossils can be formed?

Component 4C

Q1. Are there living organisms alive today that appear to have not evolved much?

Q2. How has carbon dating helped to support and confirm the theory of evolution?

Q3. **(Optional)** Why are the forearms of mammals, amphibians, reptiles, and birds so similar in structure?

Component 5: Lesson Conclusion

The focus of the lesson was on understanding more deeply about the evidence for the process of evolution.

1) How has the lesson helped you to better understand the different types of evidence for evolution?

2) Which questions were easy to answer – the ones in Component 4B or Component 4C? Why?

Science Grade 10 Lesson No. 7

Types of Waves to Transfer Energy

Component 1: Short Review

Q1. What type of wave does light used to travel?

Q2. What are some examples of compression waves (longitudinal waves)?

Q3. How do the particles move in a compression or longitudinal wave?

Component 2: **Lesson Purpose**

This lesson is about the difference between longitudinal waves and transverse waves, and how they behave to carry energy.

Component 3: Lesson Language Practice

Key words/terms:

longitudinal waves; transverse waves; energy transfer; wavelength

Practice saying the words.

Component 4*:* Lesson Activity

Component 4A

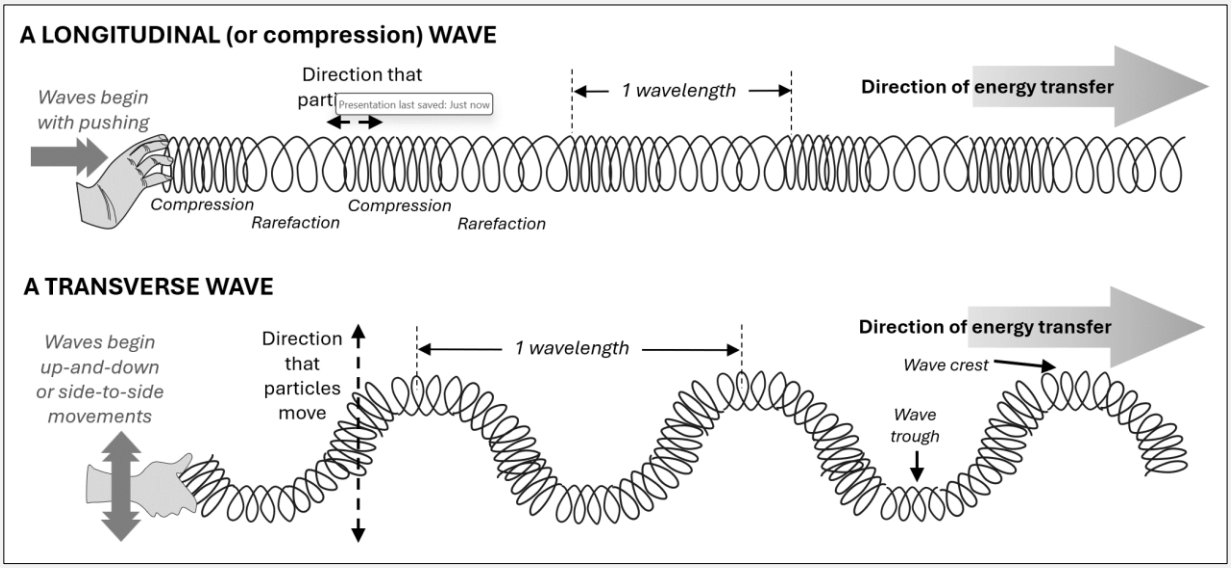
The main lesson stimulus includes *models* of the two types of waves that carry all energy in the universe. Models help us to understand science phenomena that we cannot directly observe.

TYPES OF WAVES

Longitudinal and *Transverse* waves are the two basic wave types that carry energy from one place to another.

With *Longitudinal* waves, the particles that transfer the energy move back-and-forth along the same axis as the wave. This creates *compressions* and *rarefactions* wave forms along the wave axis. Longitudinal waves always need a material medium (with solid, liquid or gas particles) to move the energy.

With *Transverse* waves, the particles move side-to-side in a perpendicular direction (90°) to the direction the energy is being transferred. This creates *crest* and *trough* wave forms along the wave axis. *Transverse* waves do not always need a material medium (solid, liquid or gas particles) to move the energy. Some transverse waves **do** need a medium, such as *waves on the ocean* using water particles to carry the energy, but some transverse waves **do not** need a medium, such as *light waves* that use oscillating electric and magnetic fields to carry the energy and they can do this in empty space or a vacuum. The features of *Longitudinal* and *Transverse* waves are modelled in the following diagrams using a slinky spring (a long, coiled metal spring).



Component 4B

Q1. Which type of wave transfers energy by its particles moving back-and-forth in the same direction that the energy is transferred?

Q2. What are some features of transverse waves?

Q3. What do light waves use to travel through empty space and why?

Component 4C

Q1. How many wavelengths can you count in the longitudinal wave model drawn in the stimulus?

Q2. What are some examples of transverse waves?

Q3. **(Optional)** Complete the table on the worksheet to show the differences between longitudinal and transverse waves.

	Differences	
Aspect	***Longitudinal waves***	***Transverse waves***
Particle movement		
Material medium needed		
Wave forms		

Component 5: Lesson Conclusion

1. What did you learn from this lesson?

2. What are some things you enjoyed about the lesson?

3. What is something you would like to learn more about in this topic?

Science Grade 10 Lesson No. 8

How Does Light Energy Travel Through Space?

Component 1: Short Review

Q1. What are examples of sources of light?

Q2. How do scientists describe 'light'? (Think of a few ways to describe it – write down your ideas)

Q3. What explains why people on Earth notice light from the Sun?

Component 2: **Lesson Purpose**

This lesson is about the form of energy that light is and the way light travels. The lesson may also help you to better understand other forms of energy and how they travel.

Component 3: Lesson Language Practice

Key words/terms:

electromagnetic; medium; charged particles

What do you know about these terms?

Component 4*:* Lesson Activity

Component 4A

The main lesson stimulus includes *text and a diagram* to describe how light, as a form of energy, travels in transverse waves.

Light travelling from the Sun to the Earth

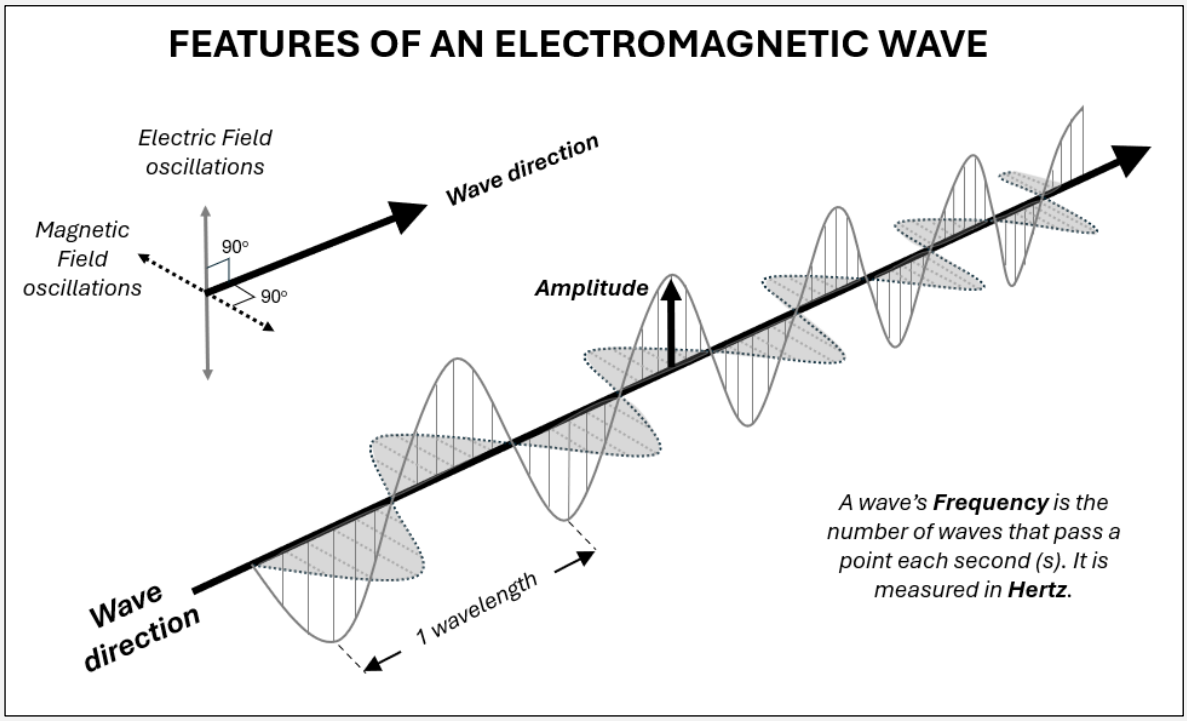
Light has to travels about 150 million kilometers from the Sun to the Earth through empty space. It takes about 8 minutes and 20 seconds – that means it travels **VERY FAST**!!!

Most of the waves that humans can sense on Earth are waves that need a material medium to travel through. These waves include *water waves*, *sound waves* and *earthquake waves*.

But light waves can travel without a physical medium – they can travel through empty space! Light is a type of **electromagnetic wave** that is made up of both **electric** and **magnetic energy** oscillating very quickly. All electromagnetic waves are produced by the vibration or acceleration of charged particles, such as electrons or ions. When charged particles vibrate or accelerate, they emit electromagnetic energy. The more vibration or acceleration, the more energy is emitted.

The types of electromagnetic waves is determined by the speed of oscillation that produced them – *radio waves* oscillate more slowly than *light*, while *X-rays* oscillate much more quickly than *light*.

An electromagnetic wave can be modelled as a wave of changing electric and magnetic fields with the electric and magnetic oscillations operating at 90° from each other and at 90° to the direction the wave is traveling.



A light wave's ***amplitude*** determines how intense, or bright, it is. The ***frequency*** and ***wavelength*** of light determines its color and energy.

If we compare Red, Green and Violet light:

Red light has a frequency of about **450 THz** and a wavelength of about **700 nm**,

Green light has a frequency of about **550 THz** and a wavelength of about **550 nm**,

Violet light has a frequency of about **700 THz** and a wavelength of about **400 nm**,

[1 terahertz (THz) = 1 trillion hertz; 1 nanometer (nm) = 1 billionth of a meter]

Component 4B

Q1. How fast in kilometers per second (km/s) does light travel to reach the Earth from the Sun? An approximate speed worked out from the stimulus will provide a good answer if you do not recall the answer. [Show your working if you can calculate it mathematically from the information in the stimulus]

Q2. What physical aspects are used to describe a transverse wave?

Q3. Describe the relationship between the movement of particles and the direction the energy is being transferred in a transverse wave?

Component 4C

Q1. What is the approximate frequency of green light compared to red or violet light?

Q2. What are some examples of the things that light can travel through that indicate travels as a transverse wave and rather than a longitudinal wave?

Q3. **(Optional)** Use the information in the stimulus to state the relationship between *frequency* and *wavelength* of colored light?

Component 5: Lesson Conclusion

Good learners reflect on their learning.

The focus of this lesson was on learning about light as a form of energy and the way it travels.

Q1. Has this lesson helped you to better understand light as a form of energy and the way it travels? If so, how?

Q2. Has this lesson helped you to remember what electromagnetic radiation is? If so, how?

Q3. What was hard to do or understand in the lesson?

Science Grade 10 Lesson No. 9

What Parts of White Light Have the Most Energy?

Component 1: Short Review

Q1. What do you know about rainbows and how they form?

Q2. What are the colors of the rainbow?

Q3. What other forms of energy are closely associated with light energy? Can you give an example?

Component 2: **Lesson Purpose**

This lesson is about how white light can be broken into its component colors, with violet light bending more than red light.

The lesson may also help you to be better able to recall the units for *frequency* and *wavelength*.

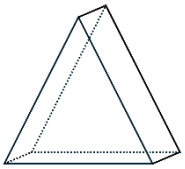
Component 3: Lesson Language Practice

Key words/terms:

wavelength; frequency

Practice saying the words.

Component 4*:* Lesson Activity

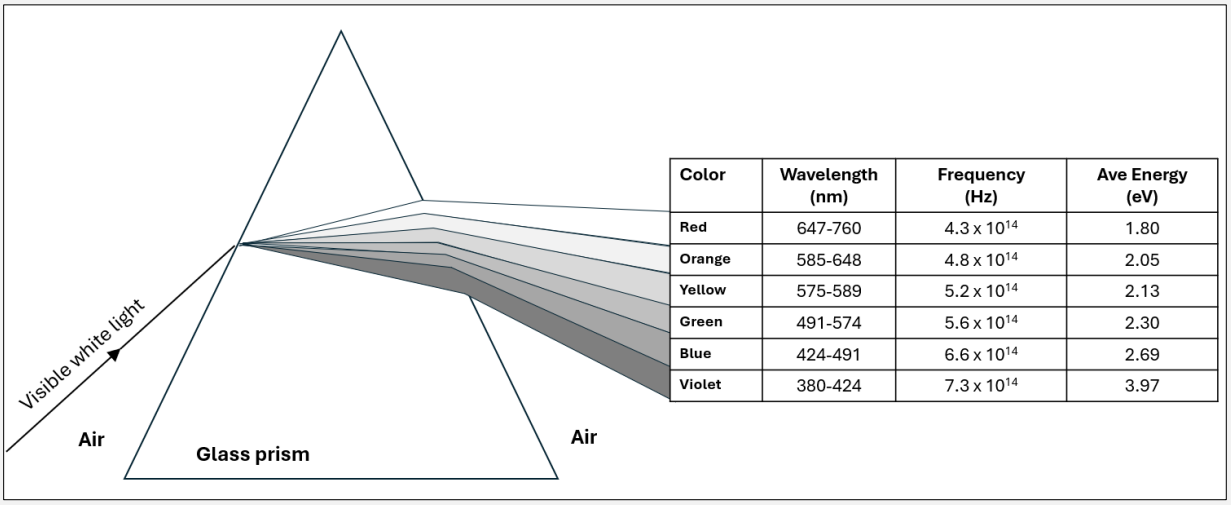


Component 4A

The main lesson stimulus includes information about how white light can be broken into its component colors when passes through a clear prism.

Splitting visible light into its colors

As white light enters a glass prism from the air, it bends and spreads into different bands of color. The various colors have different *wavelengths* (i.e. distances between waves, measured in *nanometers*) and different *frequencies* (i.e. numbers of waves that pass a point in one second, measured in *Hertz*).



Color	Wavelength (nm)	Frequency (Hz)	Ave Energy (eV)
Red	647-760	4.3×10^{14}	1.80
Orange	585-648	4.8×10^{14}	2.05
Yellow	575-589	5.2×10^{14}	2.13
Green	491-574	5.6×10^{14}	2.30
Blue	424-491	6.6×10^{14}	2.69
Violet	380-424	7.3×10^{14}	3.97

There is a relationship between the **wavelength**, the **frequency** and the **amount of energy** that light has and this relationship can be seen in the table above.

The amount of energy that light has is directly related to its frequency – as frequency increases, the energy increases. At the same time, the wavelength decreases.

Scientists describe this relationship using technical mathematical language as:

"Wavelength is ***inversely proportional*** to Frequency but is ***directly proportional*** to Energy."

Component 4B

Q1. What shape is the glass prism?

Q2. What happens to light when it enters the glass prism shown in the stimulus?

Q3. What is the relationship between the wavelength and the frequency of light?

Component 4C

Q1. What is the wavelength range for Orange light?

Q2. Which colors fall within the range of frequencies between 5.2×10^{14} Hz and 8.0×10^{14} Hz?

Q3. **(Optional)** Describe scientifically the relationship between Energy, Frequency and Wavelength?

Component 5: Lesson Conclusion

1. Could you find any answers in the Stimulus text provided for questions in Component **4B** or **4C**? Which ones?

2. What connections or differences do you notice between questions in **4B** and **4C.**

3. Did you find it easier to answer the questions in Component **4B** or **4C**? Why?

Science Grade 10 Lesson No. 10

The Electromagnetic Spectrum

Component 1: Short Review

Q1. What are *electromagnetic waves*?

Q2. What are some examples of *electromagnetic waves*?

Q3. Why do scientist study electromagnetic waves?

Component 2: **Lesson Purpose**

This lesson is about getting to know about the full electromagnetic spectrum (EMS) which comprises a continuous range of electromagnetic waves categorized by properties and their ranges of wavelengths and frequencies.

The lesson may also help you to understand and use *scientific notation*.

Component 3: Lesson Language Practice

Key words/terms:

spectrum; spectra; radiation; x-rays; gamma rays

Practice saying the words.

Component 4*:* Lesson Activity

Component 4A

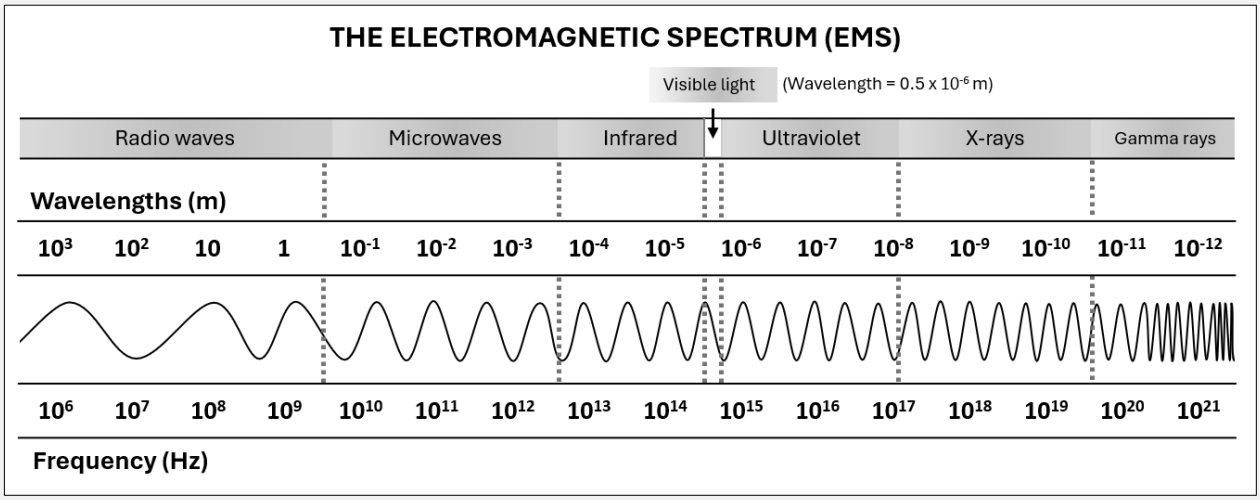
The main lesson stimulus includes *a diagram* that depicts *numerical data* around a *symbolic representation* of the wave-shapes for the different regions of the electromagnetic spectrum.

THE ELECTROMAGNETIC SPECTRUM (EMS)

Different types of electromagnetic waves exist with an enormous range of different wavelengths and frequencies. This continuous range of wavelengths and frequencies is known as the **electromagnetic spectrum**. The entire range of the spectrum is often broken into specific regions including *radio waves, microwaves, infrared, visible light, ultra-violet, x-rays,* and *gamma radiation.*

The subdividing of the entire spectrum into smaller spectra is done mostly on the basis of how each region of electromagnetic waves interacts with matter.

The diagram below depicts the electromagnetic spectrum and its various regions.



The longer wavelength, lower frequency regions are located on the far left of the spectrum and the shorter wavelength, higher frequency regions are on the far right.

Component 4B

Q1. If a wave has a wavelength of 10^{-2} m, which type of radiation would it be?

Q2. Which electromagnetic waves have frequencies higher than the frequency of visible light?

Q3. What is the best way to describe gamma rays in terms of their frequency and wavelength?

Component 4C

Q1. Which wave types of the electromagnetic spectrum have the longest wavelength?

Q2. Complete the following table with the approximate values for the wavelength and frequencies for *Microwaves* and *Infrared radiation*? [Two values have been added for you.]

	Microwaves		***Infrared radiation***	
Wave type	From:	To:	From:	To:
Wavelength range (In meters)	10^0			
Frequency range (in hertz)		10^{12}		

Q3. **(Optional)** Why do you think that the location of Visible light has been shown above the other types of waves?

Component 5: Lesson Conclusion

1. What did you learn from this lesson?

2. What are some things you enjoyed about the lesson?

3. What is something you would like to learn more about in this topic?

Science Grade 10 Lesson No. 11

The Sizes of Electromagnetic Waves

Component 1: Short Review

Q1. What is an application?

Q2. What are some applications of light energy?

Q3. How might the size of an electromagnetic wave affect what it can do?

Component 2: **Lesson Purpose**

This lesson is about understanding how the sizes of electromagnetic waves relates to their uses and applications in various ways.

The lesson may also help you to be better at using s*cientific notation* for very big and very small numbers. The stimulus provides supportive information by giving both s*cientific notation* and *decimal notation.*

Component 3: Lesson Language Practice

Key words/terms:

applications; penetrate/penetration; size range

In Science, many ***verbs*** are converted to ***nouns*** because they are recognized by the scientific community as *general processes* that apply across different areas of science.

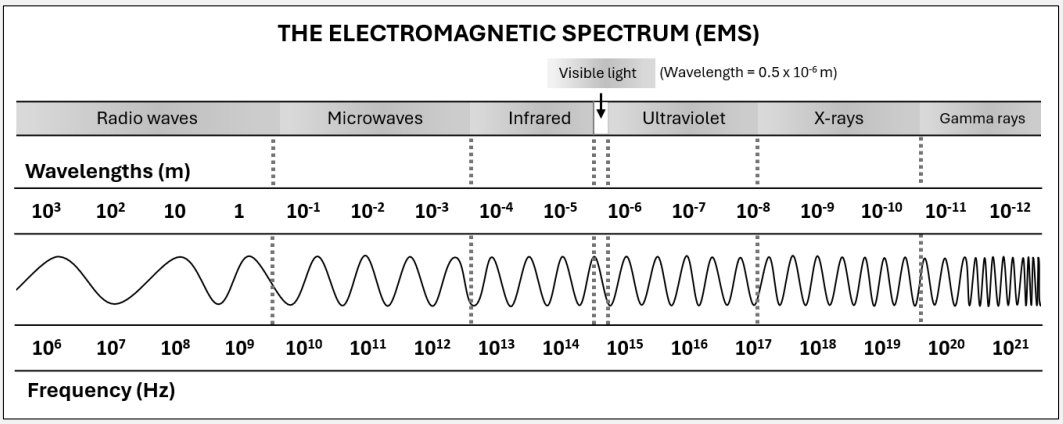
It's important that you recognize what a 'range' is when referring to numbers.

Component 4*:* Lesson Activity

Component 4A

The main lesson stimulus includes the table from Lesson 10 to help you recall the features of the EMS.

The sizes of EMS waves determines their uses



The table from Lesson 10 to help your understanding of the EMS

The length of electromagnetic waves influence their uses and applications by determining their ability to penetrate materials, how they interact with matter, and how they perform specific functions, such as for communication, imaging, heating, sterilization, and scientific research. For example, look at the wavelength range for *Radio waves* in the following table. Because radio waves are very long, their lengths often matches the size of the obstacles and they can go around them, including very big objects such as buildings and mountains, This makes them very good for carrying information over very long distances.

Type of EMS	**Wavelength range** (in meters)	**Wavelength range** (in meters)	**Typical sizes/size ranges**	**Penetration** Through:
Radio waves	$10^3 – 10^0$	1,000 - 1.0	Range: a volcano; building; size of human; umbrella length	walls, foliage; forest; Around buildings, small mountains.
Microwaves	10^0 - 10^{-3}	1.0 v 0.001	Range: umbrella; wristwatch face; Fingernail; a small insect	clouds, fog, light foliage. Some materials, like plastic, glass, and certain fabrics. (Not metals)
Infrared	10^{-4} - 10^{-5}	0.0001 - 0.00001	width of a human hair	thin fabrics and plastics. (Not insulation)
Visible light	10^{-5} - 10^{-6}	0.00001 - 0.000001	a body cell	transparent materials, e.g. glass and water. (Not opaque things)
Ultraviolet	10^{-6} - 10^{-8}	0.000001 - 0.00000001	a molecule; a virus	air, skin, certain materials.
X-rays	10^{-8} - 10^{-11}	0.00000001- 0.00000000001	an atom	soft live tissue, fabrics, and thin metals.
Gamma rays	10^{-11} - 10^{-12}	0.00000000001 - 0.000000000001	an atomic nucleus	human tissue; fabrics, paper, thin metals. (Not thick lead or concrete.)

The ability of electromagnetic waves to penetrate or go around materials depends on their wavelength and energy.

Component 4B

Q1. If a wave had a wavelength that was about the same length as a Philippines peso, what type of wave would it be?

Q2. What are some things that radio waves will penetrate or go around?

Q3. Why can radio waves go around very big objects such as buildings and mountains?

Component 4C

Q1. What does the table show as the average length of a radio wave?

Q2. Which wave types are smaller than a body cell?

Q3. **(Optional)** Why might X-rays and gamma rays be able to go through soft human and living tissue?

Component 5: Lesson Conclusion

1. What did you learn from this lesson?

2. What are some things you enjoyed about the lesson?

3. What is something you would like to learn more about in this topic?

Science Grade 10 Lesson No. 12

Applications and Harmful Aspects of EMS

Component 1: Short Review

Q1. What does harmful mean?

Q2. What are some beneficial applications of electromagnetic radiation?

Q3. How does wavelength and frequency relate on the electromagnetic spectrum?

Component 2: **Lesson Purpose**

The lesson may help to better understand that the electromagnetic spectrum comprises harmful and beneficial radiation, depending on how it is understood and used.

Component 3: Lesson Language Practice

Key words/terms:

ions; ionizing radiation; **radiotherapy;** ***DNA***

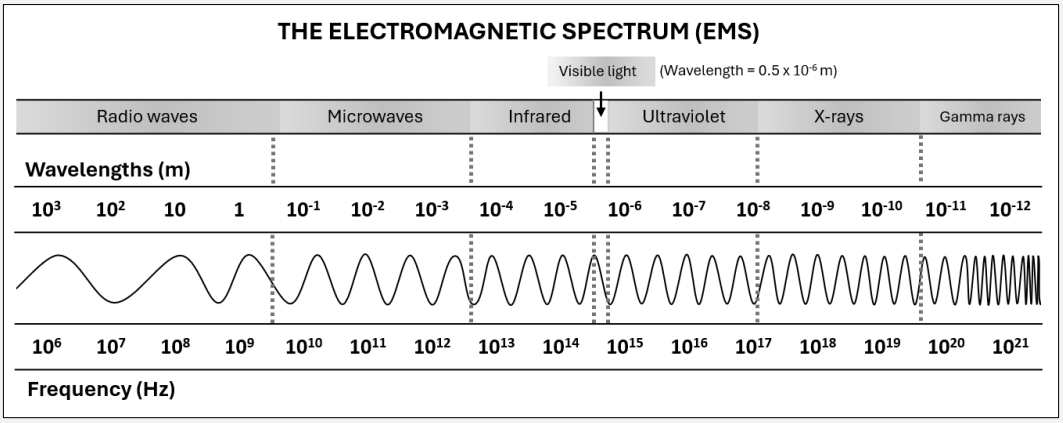
Can you say or work out what the words mean?

Component 4*:* Lesson Activity

Component 4A

The main lesson stimulus is about common applications of electromagnetic radiation, as well as harmful effects. It includes the table from Lesson 10 to help recall the features of the EMS.

THE EMS – It can be both good and harmful



The table from Lesson 9 to help your understanding of the EMS

Type of EMS	**Wavelength range** (in meters)	**Ionizing?**	**Common everyday applications**
Radio waves	$10^3 – 10^0$	**No**	AM radio; FM Radios; Radio broadcasting; Television communication; Short wave radios;
Microwaves	10^0 - 10^{-3}	**No**	Satellite television; Radar systems; Wi-Fi; Microwave ovens;
Infrared	10^{-4} - 10^{-5}	**No**	Remote controller; Intruder alarms Night vision goggles; heat from radiator; remote temperature sensing,
Visible light	10^{-5} - 10^{-6}	**No**	For human and animal vision; Optic fibers; Light bulbs; cameras; for photography and cinematography,
Ultraviolet	10^{-6} - 10^{-8}	**Yes**	Sunbeds; sterilization of medical equipment; Dental curing; fluorescence detection
X-rays	10^{-8} - 10^{-11}	**Yes**	Baggage scanning; X-ray images; CT scans; PET scans; scientific research
Gamma rays	10^{-11} - 10^{-12}	**Yes**	Engineering applications; Radiation therapy; Cancer treatment;

Is electromagnetic radiation that is ionizing harmful to living things?

Ionizing radiation, such as gamma rays, have high energy and can penetrate deeply into living tissues. When ionizing rays interact with atoms in the body, they can ionize atoms, meaning they can knock electrons out of atoms, creating charged particles known as ions. These ions can directly damage cellular components including the DNA of cells. DNA damage can cause cancer. Ionizing radiation can also interact with water molecules in cells, damaging cell components.

Because gamma rays are ionizing, they are used in radiotherapy by doctors to treat cancers in patients. When a fine stream of gamma rays are directly targeted on cancer cells, they can knock out the DNA of cells which prevents them from dividing and multiplying in a patient's body.

Component 4B

Q1. What is ionizing radiation?

Q2. What can infrared radiation be used for?

Q3. Explain how people can protect themselves from UV rays to stop being sunburned.

Component 4C

Q1. What is the wavelength range for Ultraviolet light?

Q2. What electromagnetic radiation types are ionizing?

Q3. **(Optional)** Explain why gamma rays can be both good and bad for people?

Component 5: Lesson Conclusion

The focus of this lesson was on learning about harmful and beneficial effects of the electromagnetic spectrum.

Q1. Has this lesson helped you to better understand that the electromagnetic spectrum comprises harmful and beneficial radiation*? If so, how?*

Q2. Has this lesson helped you to remember what electromagnetic radiation is? If so, how?

Q3. What was hard to do or understand in the lesson?

Science Grade 10 Lesson No. 13

Bonds

Component 1: Short Review

Q1. If compounds have two or more different types of atoms, how do they stay together?

Q2. What do we call the electrons that bond with other atoms?

Q3. How would you describe a chemical bond?

Component 2: **Lesson Purpose**

This lesson is about how atoms combine to form chemical bonds.

The lesson may also help you to better understand and describe the meaning of a diagram.

Component 3: Lesson Language Practice

Key words/terms:

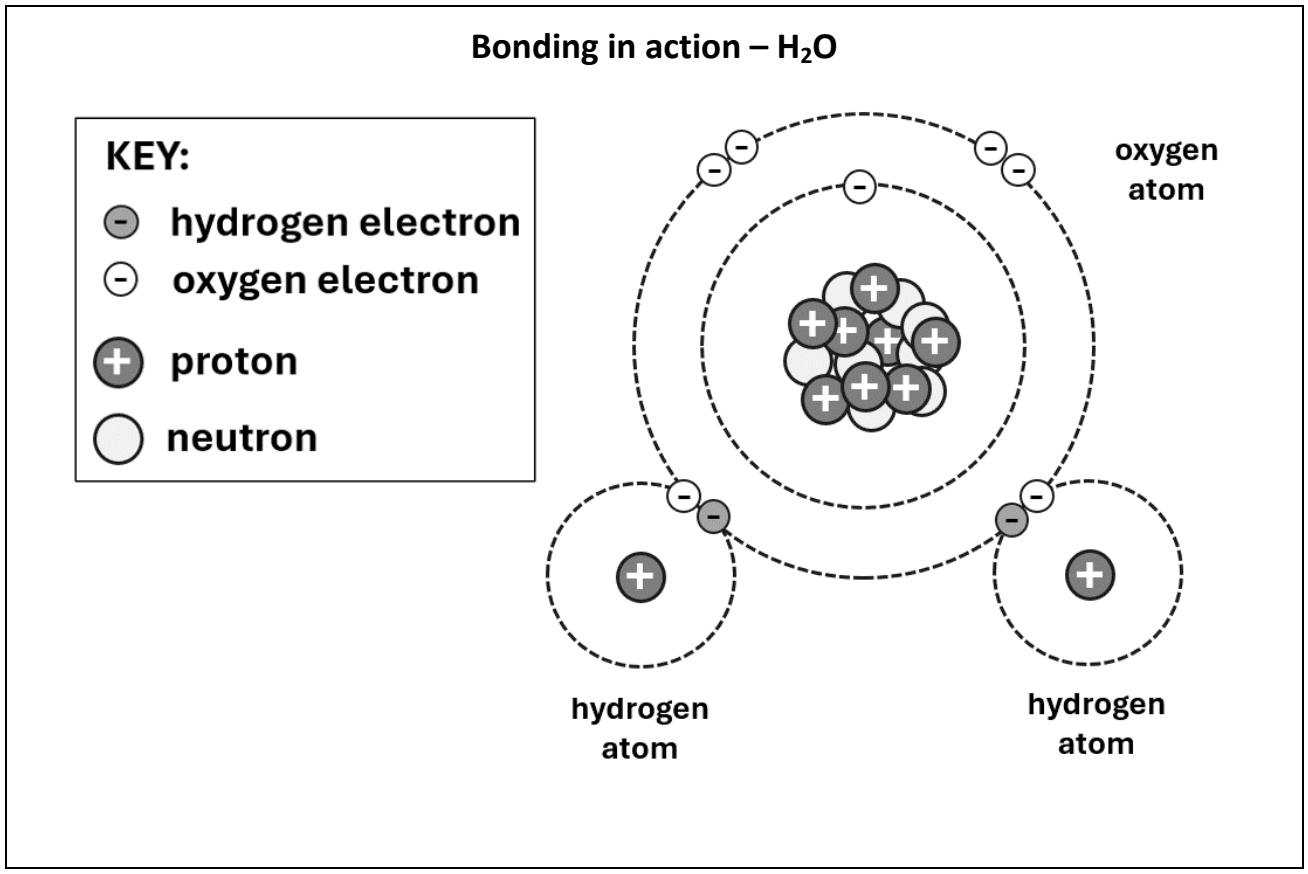
bonds; diagram

Select one of the words above and write a sentence using the word in a scientific sense and then write a sentence using the word in an everyday sense.

Component 4*:* Lesson Activity

Component 4A

The main lesson stimulus includes *symbolic representations* of a chemical bond.



Component 4B

Q1. What does the diagram tell you about oxygen?

Q2. What does the diagram tell you about hydrogen?

Q3. What does the diagram tell you about the new substance formed?

Component 4C

Q1. What is the new substance made by the formation of the bond between oxygen and hydrogen?

Q2. If the new substance is made up of hydrogen and oxygen, can we get oxygen back?

Q3. **(Optional)** How does the diagram better explain the concept of a chemical bond?

Component 5: Lesson Conclusion

The focus of the lesson was on understanding more deeply about chemical bonds.

1. How has the lesson helped you to better understand chemical bonding?

2. Which questions were easy to answer – the ones in Component 4B or Component 4C? Why?

Science Grade 10 Lesson No. 14

Types of Bonds

Component 1: Short Review

Q1. Are all chemical bonds the same?

Q2. Name at least two types of bonds.

Q3. What type of chemical bond is there in water? Explain.

Component 2: **Lesson Purpose**

This lesson is about the different types of chemical bonds.

The lesson may also help you to better understand that not all chemical compounds are the same.

Component 3: Lesson Language Practice

Key words/terms:

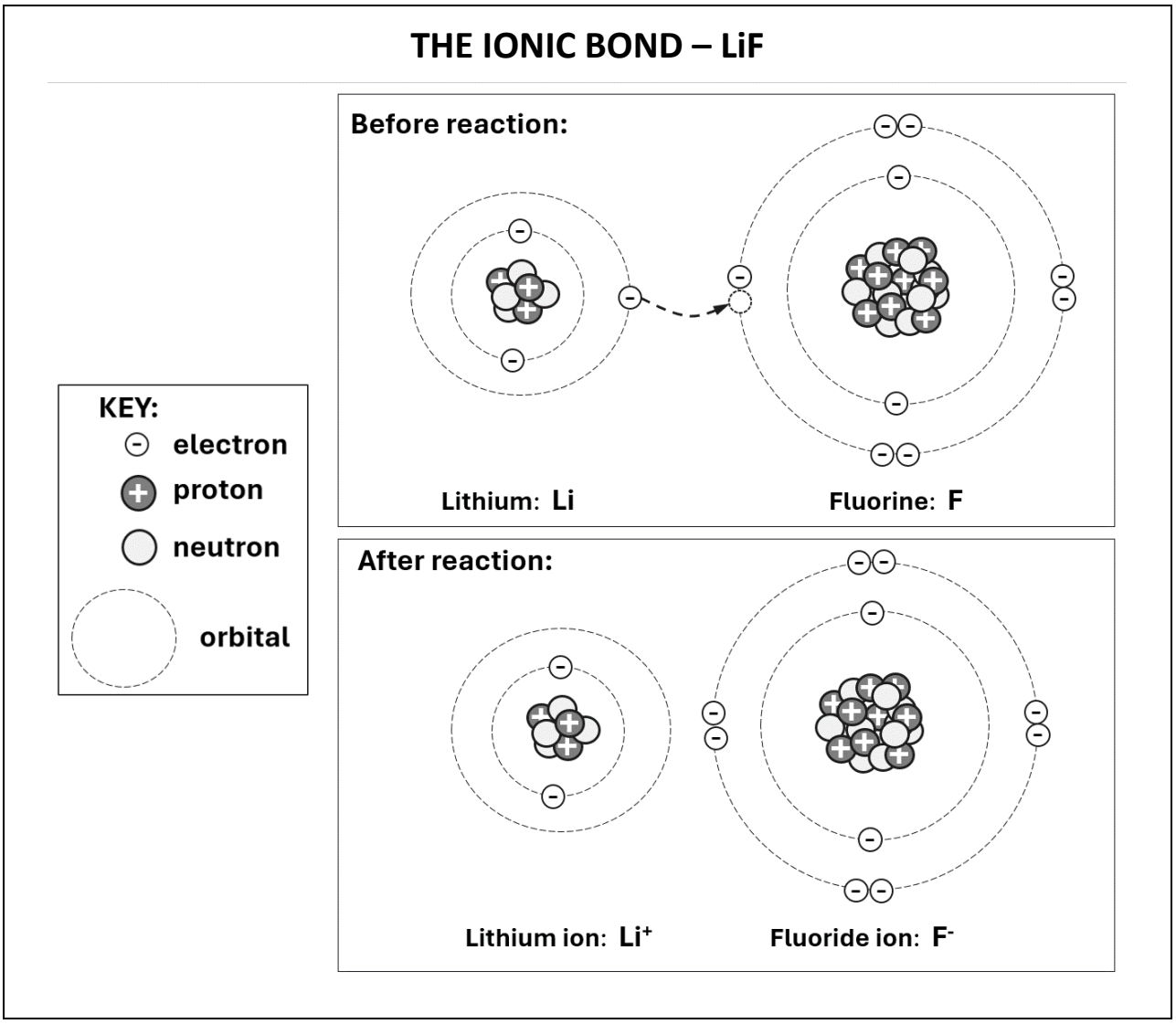
configuration; charge

Select one of the words above and write a sentence that would explain its meaning in a scientific sense and then write a sentence that would explain its meaning in an everyday sense.

Component 4*:* Lesson Activity

Component 4A

The main lesson shows *symbolic representations* of the formation of a type of chemical bond.



Component 4B

Q1. If lithium is in group 1 and period 2 of the periodic table what would be its electron configuration?

Q2. How many electrons does the diagram above before the reaction show for fluorine atom in the outer shell? What would be its configuration?

Q3. What has happened to the outer shell for both lithium and fluorine after the reaction?

Component 4C

Q1. What is the new substance formed when lithium and fluorine bond together?

Q2. What is the charge shown in the diagram for lithium and fluorine?

Q3. **(Optional)** As we know that atoms are supposed to have a neutral charge what are lithium and fluorine shown in the diagram, called, and why?

Component 5: Lesson Conclusion

The focus of this lesson was on different types of chemical bonds.

Q1. Has this lesson helped you to better understand chemical bonding? If so, how?

Q2 What was hard to do or understand in the lesson?

Science Grade 10 Lesson No. 15

Making and Breaking Bonds

Component 1: Short Review

Q1. What sort of change happens when ice melts into water?

Q2. What sort of change happens when an ionic or a covalent bond is formed?

Q3. What is a chemical reaction and how is it different to a physical change?

Component 2: **Lesson Purpose**

This lesson is about the concept of a chemical reaction or chemical change.

The lesson may also help you to better understand the difference between chemical and physical changes.

Component 3: Lesson Language Practice

Key words/terms:

reaction

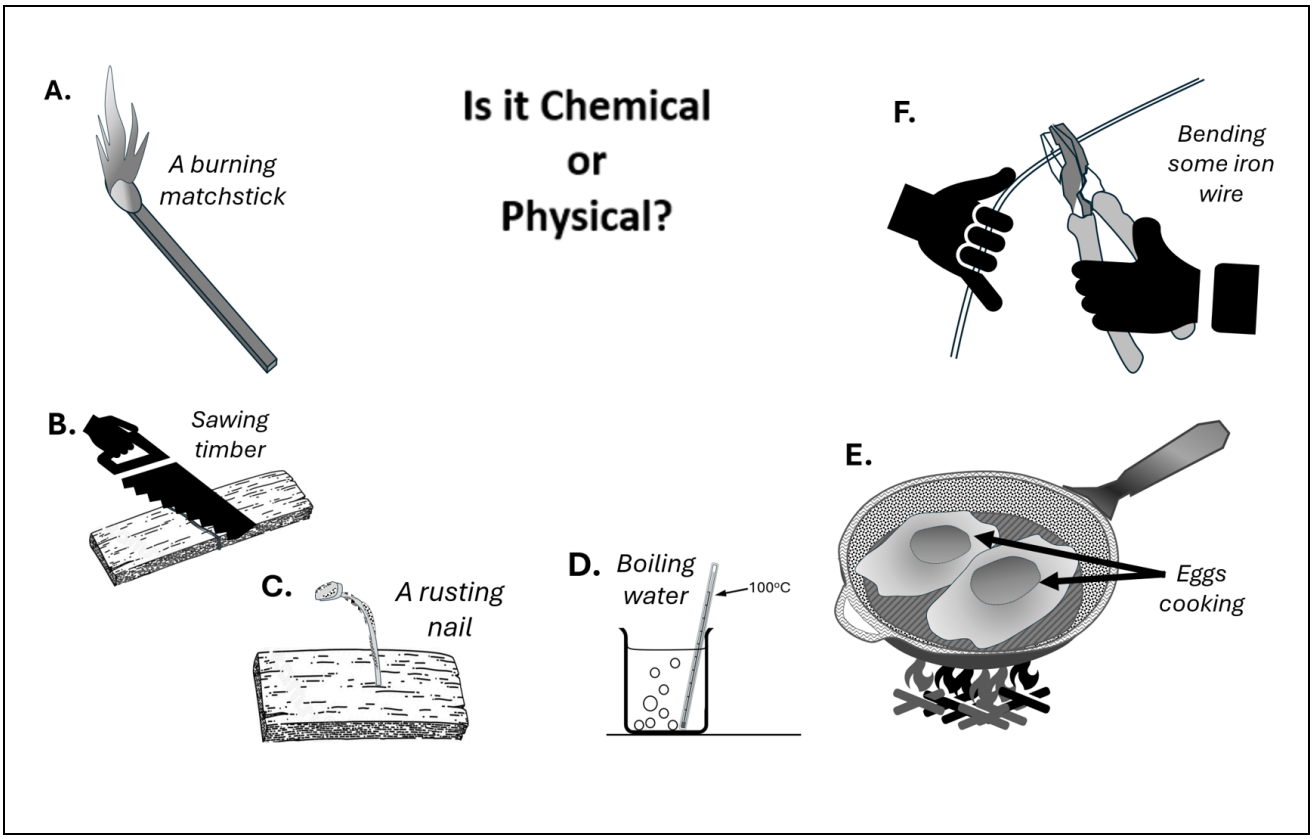
Practice saying the word.

Write a sentence that would explain its meaning in the scientific or technical sense and then write another sentence using the same word that would explain its meaning in an everyday sense.

Component 4*:* Lesson Activity

Component 4A

The main lesson stimulus includes *diagrammatic representations* of changes both physical and chemical.



Component 4B

Q1. What is happening in the diagram labelled D?

Q2. Which diagrams show only physical changes?

Q3. Which diagrams show only chemical changes and explain why?

Component 4C

Q1. Is electrolysis a chemical reaction?

Q2. What happens when an ionic bond is formed?

Q3. **(Optional)** How do scientists describe a chemical reaction?

Component 5: Lesson Conclusion

The focus of this lesson was on chemical reactions.

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Q1. Has this lesson helped you to better understand what a chemical reaction is? If so, how?

Q2. Has this lesson helped you to remember the difference between a chemical and a physical change? If so, how?

Science Grade 10 Lesson No. 16

Signs of a Reaction

Component 1: Short Review

Q1. Is the process of baking a cake a chemical reaction?

Q2. What evidence of a chemical reaction can you see when baking a cake?

Q3. What other types of evidence can be used indicating chemical reactions?

Component 2: **Lesson Purpose**

This lesson is about different types of evidence for chemical reactions.

The lesson may also help you to better understand the difference between chemical and physical changes by the evidence.

Component 3: Lesson Language Practice

Key words/terms:

Evidence

Practice saying the word.

What do you think it means?

Component 4*:* Lesson Activity

Component 4A

The main lesson stimulus includes, in Part A, two *tables:* Table 1 shows examples of *processes* and Table 2 shows examples of *types of evidence* that allow us to recognize a chemical reaction occurring.

How do we know?

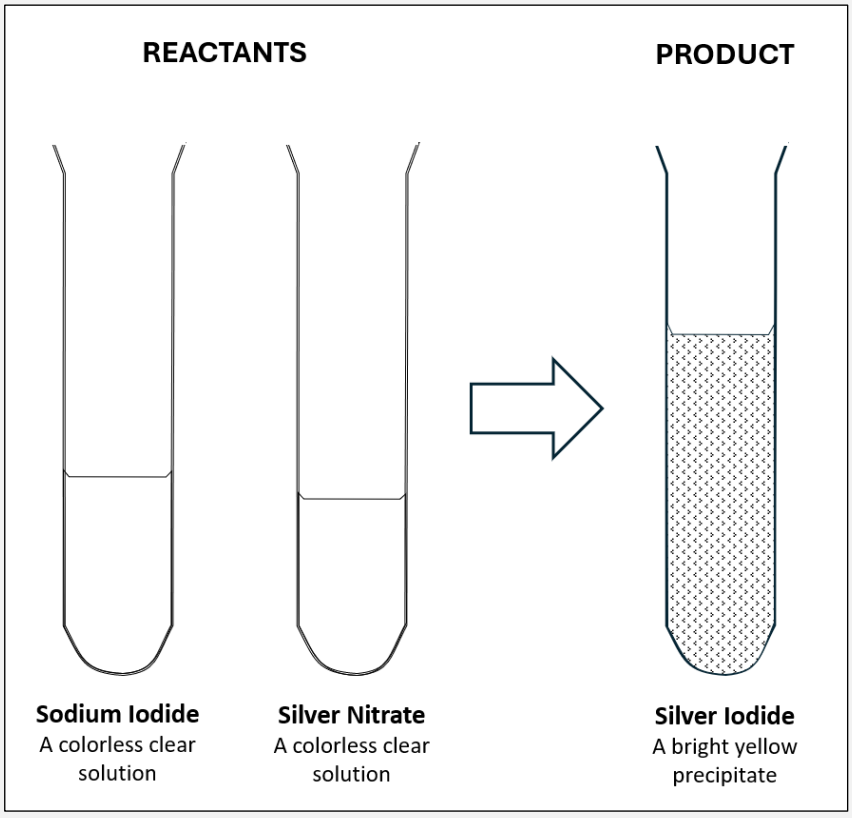
PART A. Use the tables below to answer the questions in 4B.

Table 1	No.	The process
	1	Milk curdling
	2	Burning wood in a barbecue
	3	Lighting fireworks
	4	Adding vinegar to baking soda
	5	Burning coal

Table 2	No	Evidence for a chemical reaction
	A	gas is given off
	B	a precipitate is formed
	C	light is given off
	D	new substance formed
	E	Heat is given out

PART B. Use the diagrams below to answer the questions in 4C.

In the laboratory a very interesting chemical reaction happens when you add a colorless clear solution of sodium iodide with a colorless clear solution of silver nitrate. What happens is shown below.



Component 4B

Use the information in the tables shown in the stimulus in **Part A** to answer the next three questions.

Q1. Which one of the examples of evidence in **table 2** would show that 'lighting fireworks' is a chemical reaction.

Q2. Which process shown in **table 1** above would have evidence that a 'new substance is formed', and which process would have evidence that 'a gas is given off'?

Q3. Do you think that one of the above processes in **table 1** would have more than one piece of evidence that it is a chemical reaction? Explain.

Component 4C

Use the information in the diagram shown in the stimulus in **Part B** to answer the next three questions.

Q1. If Sodium is in group 1 and Iodine is in group 7 of the periodic table what would be the formula of sodium iodide.?

Q2. If sodium iodide is a clear colorless solution and so is silver nitrate what might be the yellow precipitate, that is, the new substance formed?

Q3. **(Optional)** If the formula for sodium nitrate is $NaNO_3$ what is the valency of the NO^-_3 ion?

Component 5: Lesson Conclusion

The focus of this lesson was on types of evidence of chemical reactions.

Q1. Has this lesson helped you to better understand the importance of evidence? If so, how?

Q2. Has this lesson helped you to remember the different types of evidence? If so, how?

Science Grade 10 Lesson No. 17

Rates of Reaction

Component 1: Short Review

Q1. Give an example of a chemical reaction that is almost instantaneous.

Q2. What are two chemical reactions that you might see happen over time?

Q3. For one of the examples you have given, what is the evidence that a chemical reaction has taken place?

Component 2: **Lesson Purpose**

This lesson is about how the rate of chemical reactions can be altered.

The lesson may also help you to better understand the processes of chemical reactions.

Component 3: Lesson Language Practice

Key words/terms:

surface area; variable; dependent variable; independent variable; valid; reliable

Practice saying the words.

Component 4*:* Lesson Activity

Component 4A

The main lesson stimulus includes *a graph* that represents the results of an investigation that helps explain what is happening in an experiment.

HOW CAN WE MAKE IT HAPPEN FASTER?

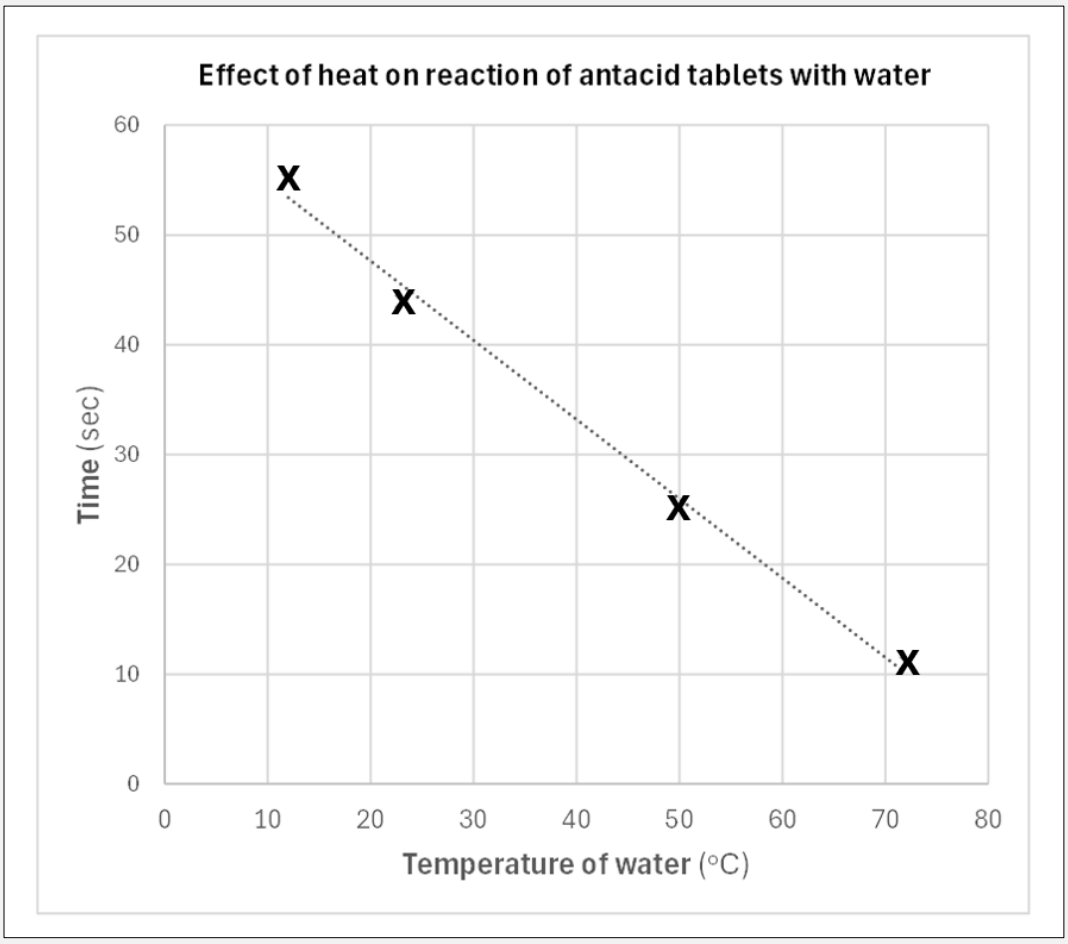
A group of Grade 10 learners had discovered in chemistry that you can make reactions go faster by adding heat or by making the particles smaller, so they decided to investigate this themselves.

One of the learners, Joseph, asked his mother if they could use her kitchen for a while as they were doing some homework. Another learner, Maria, said she would write everything down so they could show their teacher.

The learners decided to see if effervescent antacid tablets would react faster in warm water than in cold water. The learners wanted to be sure that their investigation would be valid and reliable.

They used just one tablet in each case and used the water at three different temperatures. They timed, using a stopwatch, how long it took for the tablet to react completely.

The learners produced the graph below.



Component 4B

Q1. What should the learners use to measure the independent variable, that is, the temperature?

Q2. Which variables, or what sort of things, should the learners make sure are the same so that the experiment is valid/ a fair test.

Q3. What other way could the learners have tried to make the reaction go faster?

Component 4C

Q1. What might be an appropriate aim for the learners' experiment?

Q2. How could the learners make sure their experiment is reliable?

Q3. **(Optional)** Use the graph to write an appropriate conclusion for their experiment.

Component 5: Lesson Conclusion

The focus of this lesson was on what changes the rate of a chemical reaction.

Q1. Has this lesson helped you to better understand how rates of reaction can be changed*? If so, how?*

Q2. What was hard to do or understand in the lesson?

Science Grade 10 Lesson No. 18

Chemical Reactions in Nature

Component 1: Short Review

Q1. What is the most important difference between plants and animals?

Q2 Where does the process of photosynthesis occur?

Q3. Is the process of photosynthesis a chemical reaction?

Component 2: **Lesson Purpose**

This lesson is about identifying chemical reactions that occur in nature.

The lesson may also help you to better understand the place of chemical reactions in their lives.

Component 3: Lesson Language Practice

Key words/terms:

Photosynthesis; respiration; decomposition

Practice saying the words.

The meaning for possibly unfamiliar words is described in the stimulus.

Component 4*:* Lesson Activity

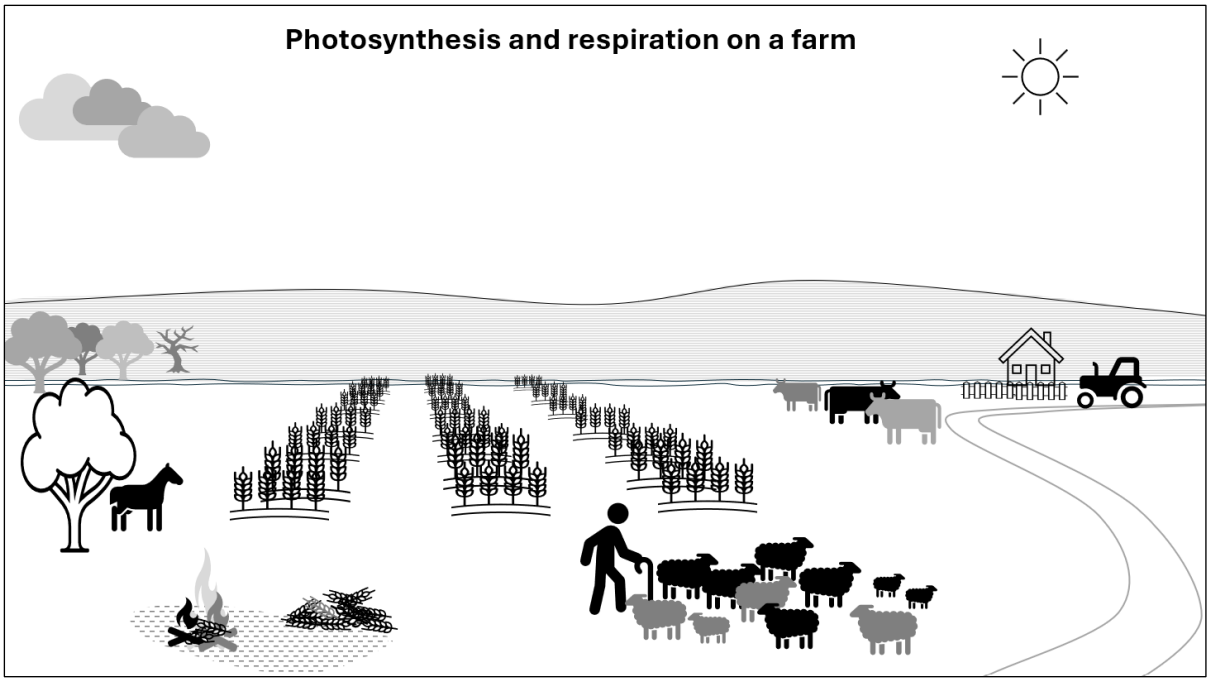
Component 4A

The main lesson stimulus includes *symbolic representations of a natural landscape where chemical reactions take place* that help explain what is happening.

Do Chemical Reactions occur in the Environment?

Many of the chemical reactions that happen in nature are vital for the survival of living things.

Some of the most important for our survival are *photosynthesis*, *respiration*, d*ecomposition* and *combustion*. In a chemical reaction the two or three elements or compounds that react together are called the *reactants* and the new substances formed are called the products.



Notes

Photosynthesis occurs in the chloroplasts of plants and converts light energy into chemical energy and produces food (glucose) from carbon dioxide in the air and water in the ground.

$$\text{Carbon dioxide + water} \xrightarrow[\textit{chlorophyl}]{\textit{light}} \text{glucose + oxygen}$$

Respiration is the process of using glucose to obtain energy and could be seen as a combustion reaction. It happens in the cells of plants and animals.

$$\text{Glucose + oxygen} \longrightarrow \text{carbon dioxide + water + } \textit{energy}$$

Decomposition is the breakdown of dead matter by bacteria and fungi and their respiration puts carbon dioxide and water back into the atmosphere.

Component 4B

Q1. What are the names of the reactants in photosynthesis?

Q2. What is the role of light in photosynthesis?

Q3. One of the products of photosynthesis is oxygen, why is that so important?

Component 4C

Q1. Where does the reaction of respiration occur?

Q2. What is a combustion reaction? Give an example.

Q3. **(Optional)** One of the products of photosynthesis is glucose, why is that so important?

Component 5: Lesson Conclusion

The focus of this lesson was on chemical reactions in nature.

Q1. Has this lesson helped you to better understand the importance of chemical reactions for the living world? If so, how?

Q2 What was hard to do or understand in the lesson?

Three weeks of extra learning – WELL DONE!

For inquiries or feedback, please write or call:

Department of Education - Bureau of Learning Delivery (DepEd-BLD)
Contact Numbers: 8637-4366; 8637-4347; 8633-9347

Department of Education - Bureau of Learning Resources (DepEd-BLR)
Contact Numbers: 8634-1072; 8631-6922

Email Address: blr.od@deped.gov.ph

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