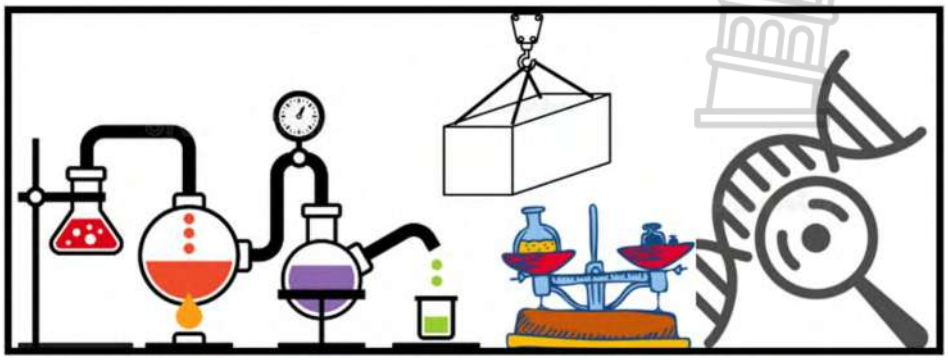
education

Department of Education
FREE STATE PROVINCE

NATURAL SCIENCES

GRADE 8

CONTENT MANUAL
BASIC CONCEPTS WITH ACTIVITIES



Strand: Life and Living (Term 1)

Topic: Photosynthesis and Respiration

Background knowledge (Gr. 4 - 7):

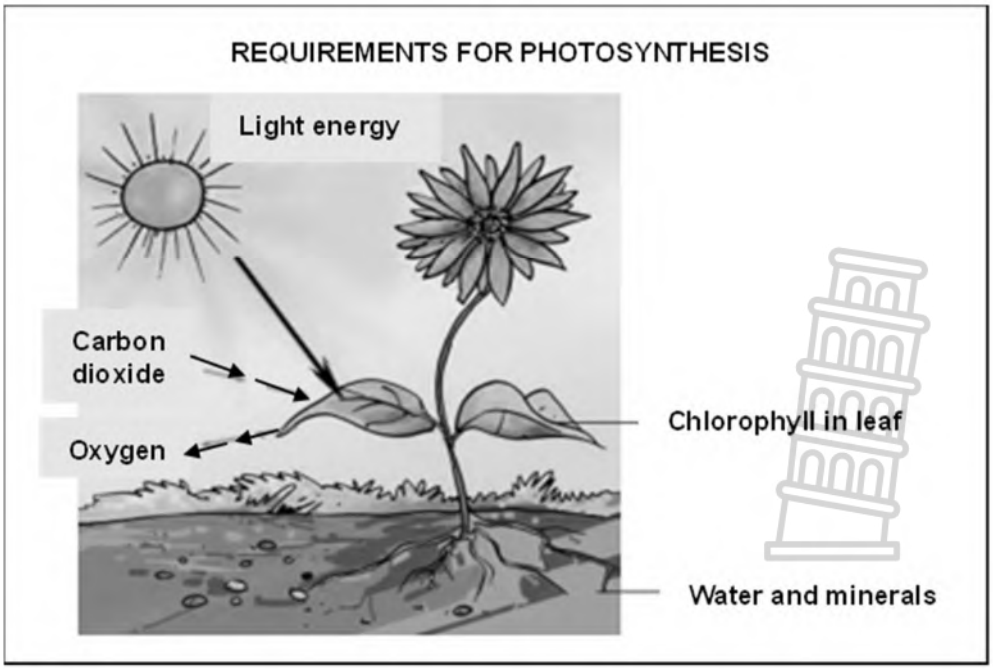
Grades 4 & 5: The **SEVEN** (7) life processes of living things - **movement, reproduction, sensitivity, nutrition, excretion, respiration, and growth**
Grade 6: Photosynthesis in the context of green plants and food chains; Feeding relationships
Grades 6 & 7: Energy for movement (kinetic energy) and energy that is stored (potential energy)

Grade 8 Content:

Photosynthesis (CAPS p. 35)

- Interactions and interdependence in an ecosystem are driven by the need for energy to sustain life.
- The Sun is the most important source providing this energy in the form of light and heat.
- Plants use carbon dioxide (from the air), water (from the soil) and energy from the Sun in a series of chemical reactions to produce glucose (food). This process is called **PHOTOSYNTHESIS**.
- Oxygen is released into the air as a by-product.
- WORD equation for photosynthesis:

$$\text{Carbon dioxide + water} \xrightarrow[\text{sunlight}]{\text{chlorophyll}} \text{glucose + oxygen}$$



(No further details required)

- Plants change glucose into starch, cellulose, and other chemical compounds to enable processes such as growth and reproduction.

What learners should know

1. The requirements needed for photosynthesis to take place.
2. The products which are released during photosynthesis.
3. How to test for the presence of starch in leaves of a plant.
4. The process of photosynthesis commonly written down as a word equation.
5. The scientific process; know how to write a scientific report.

NOTE:
The purpose of the activities in this document is to drill BASIC concepts. Therefore, some of the questions are NOT suitable for formal assessments as they are. Refer to question banks and previous question papers for questions on higher cognitive levels. (www.mindstream.co.za)

ACTIVITY 1: Photosynthesis

1.1 Choose the word from the **WORD BOX** that matches the statement or description given below. (Suggestion: Write the sentence and then the correct word.)

Potential energy	Chemical reaction	Water
Sun	Glucose	Chlorophyll
Radiant energy	Oxygen	Interdependence
Carbon dioxide	Photosynthesis	

1.1.1 The ultimate source of energy for all living things.

1.1.2 The green pigment in plant cells, that can absorb the radiant energy from the Sun.

1.1.3 The energy from the Sun in the form of heat and light.

1.1.4 Two things that rely or depend on each other.

1.1.5 A chemical change that takes place when compounds react with each other to form new substances.

1.1.6 Stored energy.

1.1.7 The liquid plant roots absorb from the soil.

1.1.8 The gas plants absorb (take in) from the atmosphere for photosynthesis.

1.1.9 The process by which plants make food from water, sunlight and carbon dioxide and where radiant energy is converted to potential energy which is stored in food and oxygen is released.

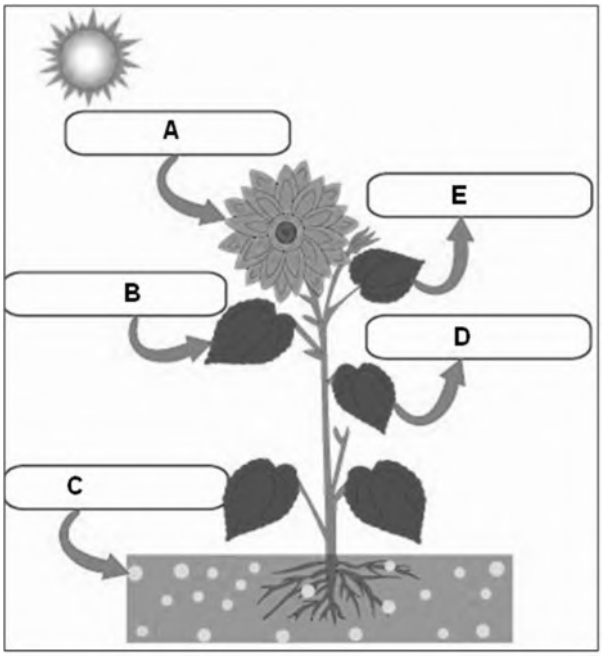
1.1.10 The food (simple sugar) plants produce from sunlight, water, and carbon dioxide.

1.1.11 The gas plants release as a waste product of photosynthesis.

(1 x 11 = 11)

1.2 Label the diagram of the PHOTOSYNTHESIS process with words from the word box.

Oxygen; Sunlight; Glucose; Water; Carbon dioxide



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Write the letters (A to E) underneath each other with the correct label next to each letter. (5)

1.3 Redraw the following table in your workbook and complete it.

Requirements for photosynthesis in green plants (what is needed)	Products of photosynthesis (what we get from photosynthesis)
1.	1.
2.	2.
3.	
4.	

(6)

1.4 Write down the complete word equation for photosynthesis. (6)

1.5 Plants change glucose into other chemical substances like starch and cellulose. Give one function of each. (2)

1.6 Write down the energy conversion that takes place during photosynthesis. (2)

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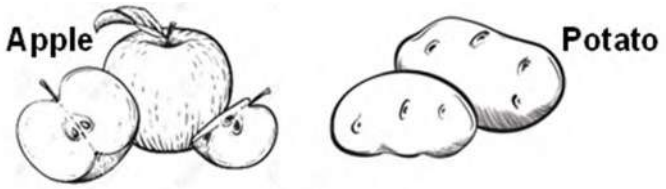
THE SCIENTIFIC INVESTIGATION PROCESS

AIM
(What we want to achieve in the investigation)

To determine whether apple and potato contain starch.



INVESTIGATIVE QUESTION
(A scientific question on which you find the answer through a scientific investigation)

Which of apples or potatoes contain starch?

HYPOTHESIS
(Expected outcome, based on scientific background knowledge. It does not have to be correct because the hypothesis is going to be tested through an investigation and can then either be accepted or rejected)

Possible hypotheses:
Potatoes contain starch, but apples not.
OR
There will be more starch in potatoes than in apples.
OR
There will be less starch in potatoes than in apples.
OR
Potatoes and apples will contain the same amount of starch.

APPARATUS AND METHOD
(Stepwise description of how the investigation will be conducted)

- Cut a thin slice of apple and a thin slice of potato, each 5 mm thick, on a tile, using a sharp knife.
- Cut pieces of equal size, 2 cm x 2 cm, from each slice.
- Put the slices in separate petri dishes.
- Add 5 drops of iodine solution to each of the slices.
- Wait 5 minutes for the results to develop and then record the observations.

VARIABLES:

INDEPENDENT VARIABLE
(The variable / factor / condition that the investigator changes.
Investigator ... Independent variable)

Type of food (that is tested)

DEPENDENT VARIABLE
(The variable that is measured or observed i.e., the result)

Presence of starch

CONTROLLED VARIABLES
(The variables / factors that must be controlled to make it a fair test or to ensure the validity of the results)

Thickness of the slices (both slices were 5 mm thick).
Size of the samples (size of each sample was 2 cm x 2 cm).
Number of drops of iodine solution (in each case 5 drops were used).
Time for the results to develop (5 minutes in each case).

RESULTS
(The observations and measurements made during the investigation)

The iodine solution on the potato turned blue-black but the iodine solution on the apple remained brown.

Summarise the results in a TABLE:

	Colour-change of iodine solution	**Conclusion**
POTATO	Iodine turned blue-black	Starch present
APPLE	Iodine remained yellowish-brown	Starch absent

CONCLUSION
(Answer to the investigative question and it indicates whether the hypothesis should be accepted or rejected.)

The potato contains starch, while the apple does not contain starch.

DISCUSSION
A discussion is not always needed after an investigation / experiment. Sometimes like here, there is nothing further to discuss. You can however make a comment, or if the experiment did not work, you can say what might have gone wrong.

NOTE: To ensure the RELIABILITY of an investigation, it should be repeated two or more times to make sure that the same results are obtained.

(Acknowledgement: Oxford Successful Gr. 8 Learner Book, pp. 14-15)

ACTIVITY 2: Scientific Investigation Process

Read through each scenario and answer the questions that follow:

2.1 **Investigative question:**
How does the temperature of water affect the rate at which sugar dissolves?

Method:
- Set up four beakers, each containing 100 mℓ of water.
- Heat the water in each beaker to a different temperature e.g., 30°C, 50°C, 70°C, 90°C.
- Add one spoonful of sugar to the water in each beaker.
- Stir the water in each beaker only once.
- Measure the time it takes for the sugar to disappear (completely dissolve).

2.1.1 Identify the independent variable. (1)

2.1.2 Identify the dependent variable. (1)

2.1.3 Identify THREE controlled variables. (3)

2.1.4 Choose the hypothesis that will eventually be ACCEPTED:

A: The lower the temperature, the quicker the sugar will dissolve.
B: The higher the temperature, the quicker the sugar will dissolve.

Choose between A and B. (1)

2.2 **Investigative question:**
How does stirring affect the rate at which sugar dissolves in water?

Think about how the method should be adapted to be able to conduct this investigation. Answer the questions.

2.2.1 What is the independent variable? (1)

2.2.2 What is the dependent variable? (1)

2.2.3 Which variables must now be controlled to make this a fair test? (3)

2.3 **Investigative question:**
Which type of fertilizer will cause plants to grow the fastest?

2.3.1 Identify the independent variable. (1)

2.3.2 Identify the dependent variable. (1)

2.3.3 Name TWO controlled variables. (2)
[15]

ACTIVITY 3: Test for starch in foods

3.1 Name the chemical that is used to test for starch. (1)

3.2 Do the test for starch on seven different foods, preferably light coloured foods on which the results for the starch test will be easily observed. A few examples are given in the table below but any food of your choice can be tested. Where necessary, grind or cut the food into smaller pieces.

	Type of food	Contains starch (✓)	Does not contain starch (X)
3.2.1	Onion		
3.2.2	Bread		
3.2.3	Rice		
3.2.4	Banana		
3.2.5			
3.2.6			
3.2.7			

(7)

3.3 What does a positive test for starch look like? (1)

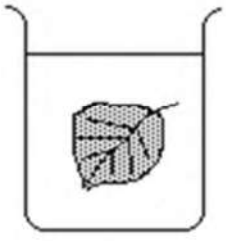
3.4 What does 'n negative test for starch look like? (1)

[10]

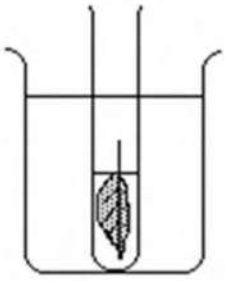
How to prove that green leaves contain starch

When the following procedure is followed, using a soft green leaf, then the test for starch in the final step will be positive, proving that green leaves contain starch.

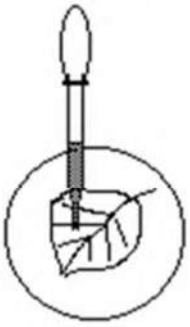
Testing a leaf for starch from photosynthesis



1. Boil the leaf in water to break the cell walls.



2. Put the leaf into ethanol / methylated spirits in a test tube and heat it in a water bath to extract (remove) the green chlorophyll.



3. Rinse the white leaf in hot water. In a petri dish add a few drops of iodine solution onto the leaf.

4. If photosynthesis has occurred the leaf will burn blue-black because it will have starch present.

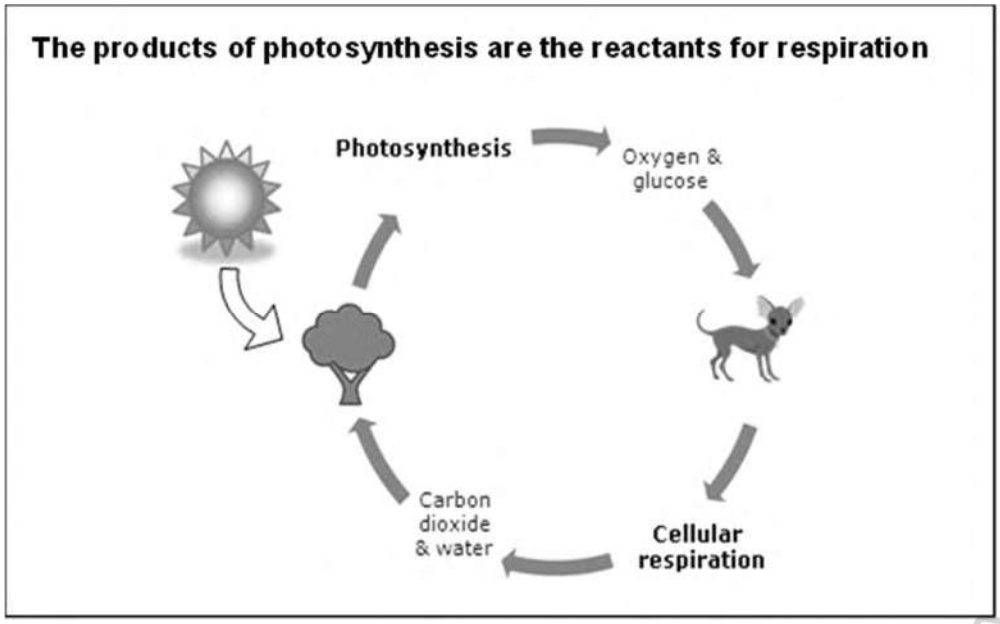
FORMAL PRACTICAL TASK:

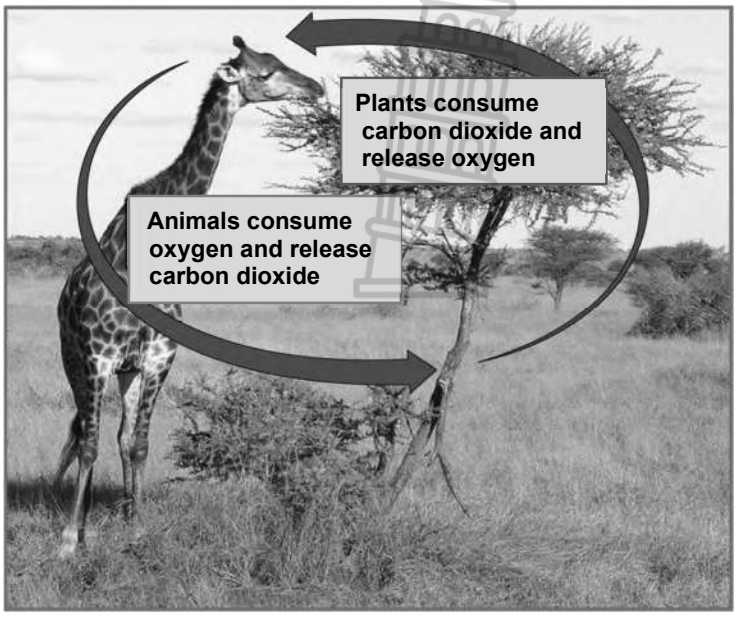
Do **PRACTICAL TASK 1** on photosynthesis (the test for starch on variegated leaves). Worksheet available on **www.mindstream.co.za** (Edu Resource Sharing).

Respiration (CAPS p. 35)

- Food contains energy (potential energy). This energy can be released from food by a series of chemical reactions called **RESPIRATION**.
- Respiration (in all living organisms) is the process by which energy is released from food in a series of chemical reactions.
- Respiration takes place in the cells of organisms. (In the mitochondria in cells.)
- Respiration takes place all the time.
- This is how the respiration process is represented as a word equation:

glucose + oxygen → energy + carbon dioxide + water





(No further details required)

What learners should know

1. The requirements for and the products of respiration.
2. Test for the presence of carbon dioxide in exhaled air using clear lime water.
3. The process of respiration commonly written down as a word equation.

ACTIVITY 4: Respiration

4.1 Choose the word from the **WORD BOX** that matches the statement or description given below. (Suggestion: Write the sentence and then the correct word.)

CO_2 and H_2O	Respiration	Chemical potential energy
Clear lime water	Glucose	Oxygen
Cells	Energy	

4.1.1 The type of energy stored in food.

4.1.2 The smallest units of living organisms.

4.1.3 The process in cells where glucose is broken down and energy is released.

4.1.4 The gas plants absorb during respiration and animals breathe in.

4.1.5 A solution of calcium hydroxide and water that turns milky when carbon dioxide is bubbled through it.

4.1.6 A chemical needed for respiration, other than oxygen.

4.1.7 The main (most important) product of respiration.

4.1.8 The by-products (waste products) of respiration. (8 x 1 = 8)

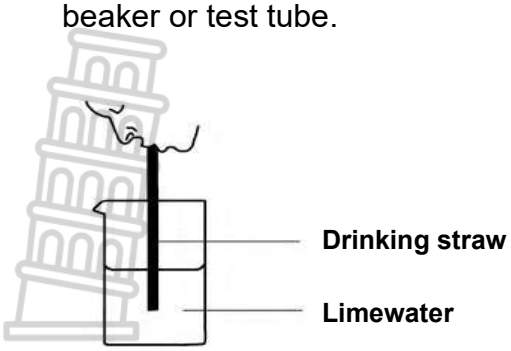
4.2 Redraw the following table in your workbook and complete:

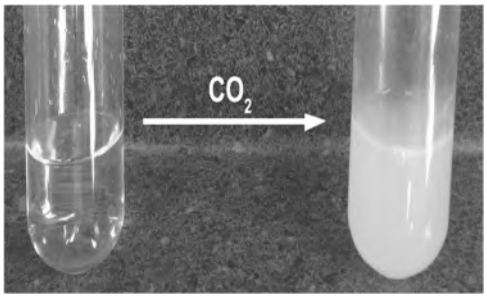
Requirements for respiration	**Products of respiration**
1.	1.
2.	2.
	3.

(5)

4.3 Write down the **WORD equation** for respiration. (5)

4.4 A person uses a drinking straw to bubble exhaled air through clear limewater in a beaker or test tube.





4.4.1 Which substance is used to test for carbon dioxide? (1)

4.4.2 What does a positive test for carbon dioxide look like? (1)

4.4.3 What will happen to the clear limewater after a short while? Describe your observation (what you see). (1)

4.4.4 What does this prove? (1)

4.4.5 Which PROCESS changes the oxygen living organisms absorb, into the carbon dioxide they release (give off)? (1)

4.4.6 Write down a definition for respiration. (2)
[25]

ACTIVITY 5: Comparing Photosynthesis with Respiration

5.1 Compare photosynthesis with respiration. TABULATE the differences. Redraw the table in your workbook. Draw the table over 12 lines or more so that there is enough space for writing.

	PHOTOSYNTHESIS	RESPIRATION
Type of cell where the process takes place		
When it takes place (what role does sunlight play in the process?)		
Requirements (Reactants and other things needed)		
Products		
Energy conversion that takes place		

(10)

5.2 During which process does each of the following take place?
Choose between PHOTOSYNTHESIS or RESPIRATION.

5.2.1 Releases oxygen.
5.2.2 Uses carbon dioxide.
5.2.3 Releases energy.
5.2.4 Stores energy.
5.2.5 Uses oxygen.

(5)
[15]

Topic: Interactions and interdependance within the environment

Introduction to ecology (CAPS p. 36)

Background knowledge (Gr. 5 - 7):

Grades 5 & 6: The concept of the ecosystem and feeding relationships; Food chains
Grade 7: Biosphere and biodiversity; Classification of living things (plants and animals) and their interdependence.

Grade 8 Content:

Ecology: Is the study of interactions of organisms with one another and with the physical and chemical environment.

Scientists usually classify the study of ecological interactions into **four** levels:

- **Populations**
- **Communities**
- **Ecosystems**
- **Biosphere**

What learners should know

1. Distinguish between different ecosystems.
2. Distinguish between biotic (living) and abiotic (non-living) factors of an ecosystem.
3. Explain concepts, like: Ecosystem, Habitat, Community, Population, Species, Adaptations, Extinct.

Terminology - Important concepts related to Ecology:

Ecosystem: It is all the plants, animals and smaller organisms that live, feed, reproduce and interact in the same area and/or environment.

Habitat: It is the natural environment where an organism lives.

Biosphere: All ecosystems combined make up the biosphere.

The biosphere is a global ecosystem composed of living (biotic) and non-living (abiotic) factors from which they derive energy and nutrients.

Since life exists on the ground (lithosphere), in the air (atmosphere), and in the water (hydrosphere), the biosphere overlaps all these spheres.

Biotic factors: Living organisms in the environment that work together with abiotic factors to create a unique ecosystem.

Abiotic factors: Is the non-living factors of an ecosystem that works together with biotic factors to create a unique environment.

Community: A group of various species in a common location.

Population: A group of individuals of the same species living in a given area at the same time.

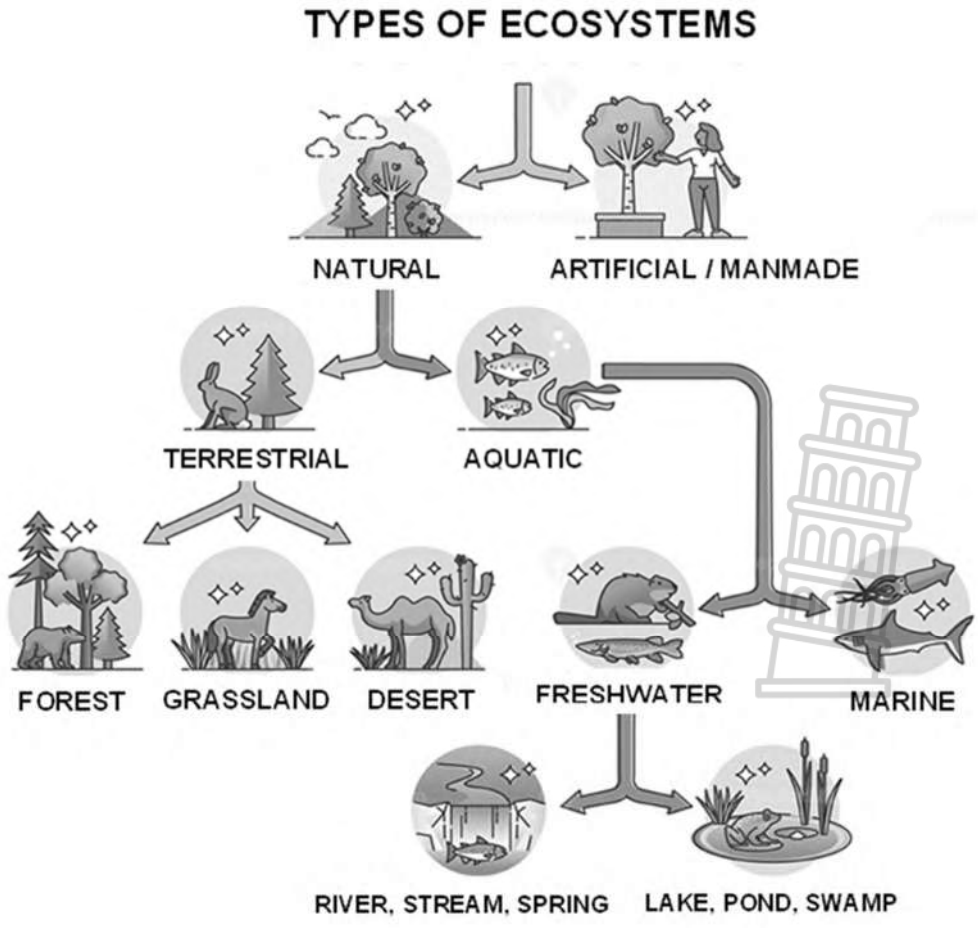
Species: A group of organisms (individuals) with the same biological characteristics.

Adaptation: It is the biological mechanism by which organisms adjust (change) to an environment or new environment

Extinct: Breed and recovery lost forever. Organisms that died out. (The moment of extinction is considered to be the death of the last individual of a species.)

Ecosystems (CAPS p. 36)

- All ecosystems combined makes up the biosphere.
- An ecosystem consists of an ecological community that includes living organisms (biotic) such as plants and animals, together with the non-living organisms (abiotic) environment such as: temperature, wind and water interacting as a system.
- The size of an ecosystem is not specifically defined, and it usually encompasses a specific limited area (although it can encompass the entire planet).
- Ecosystems are defined by the network of interactions amongst organisms and between organisms and their environment.
- Survival of individual organisms and populations depends on the ability to cope with changes (adapt) in its habitat (the place where an organism lives) or in the ecosystem.



https://vectormine.com/item/types-of-ecosystem-with-natural-and-artificial-division-outline-diagram/

ACTIVITY 6: Introduction to Ecology and Ecosystems

6.1 Give the correct SCIENTIFIC TERM for each of the following descriptions. (Suggestion: Write the sentence and then the correct word.)

6.1.1 All the plants, animals and smaller organisms that live, feed, reproduce and interact in the same area and/or environment.

6.1.2 Living organisms in the environment that work together with abiotic factors to create a unique ecosystem.

6.1.3 The natural environment where an organism lives.

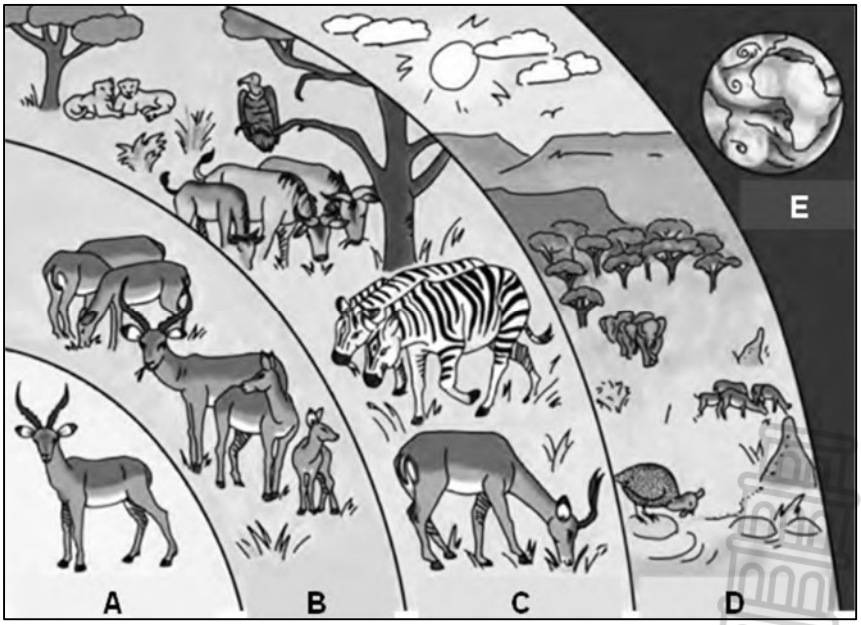
6.1.4 The non-living factors an ecosystem.

6.1.5 All ecosystems combined.

6.1.6 A group of organisms with the same biological characteristics.

6.1.7 All the organisms in an ecosystem depend upon each other. (7 x 1 = 7)

6.2 Study the diagram of the levels of organisation in an ecosystem.



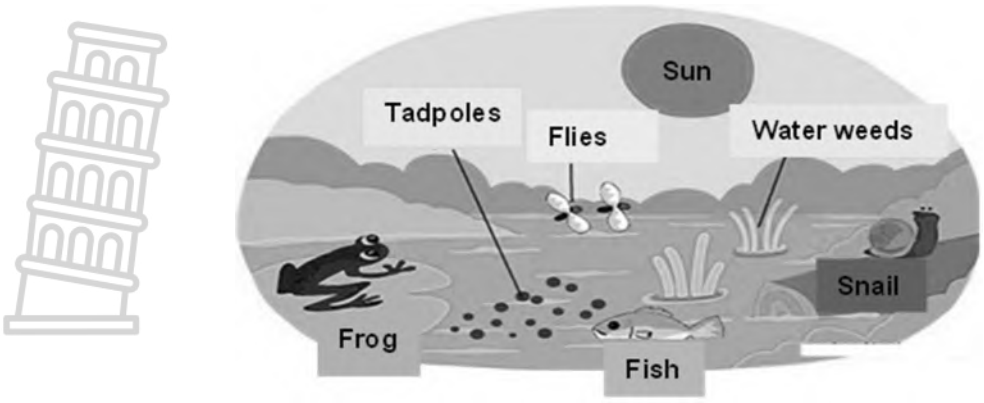
Which LETTER (A to E) in the diagram represents each of the following?

6.2.1 The biosphere (1)
6.2.2 An organism or individual (1)
6.2.3 A population (1)
6.2.4 An ecosystem (1)
6.2.5 A community (1)

6.3 Arrange the levels of organisation from the simplest to the most complex. Write down the WORDS in the correct order. (3)

[15]

The interdependence of biotic and abiotic factors in an ecosystem:

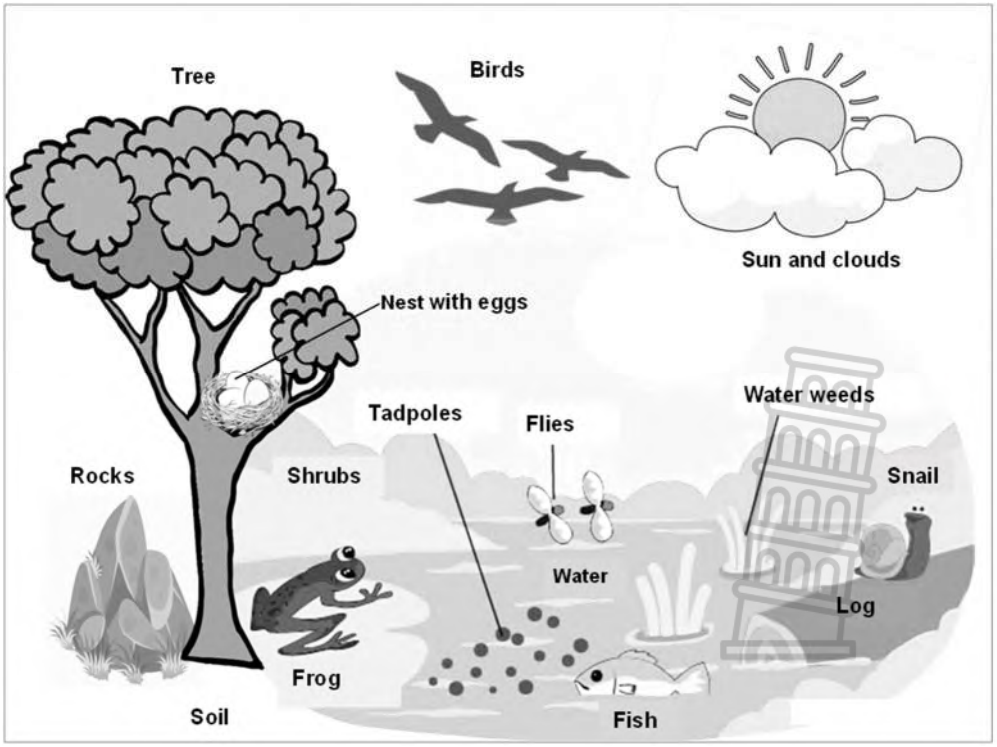


- The fish **swims with its fins** and needs the **water and oxygen** in the water to survive.
- The **green plants** need the sun to **produce food** and **release oxygen** into the water.
- The **frog feeds** on the **flies** and **snails** around the pond.
- The **snail** feeds on the **leaves of the plants** around the pond.
- The **snail and frog** will **shelter** in the bushes or leaves of plants.

The organisms are all interdependent (dependent on each other) to survive in this ecosystem.

ACTIVITY 7: Biotic and Abiotic Factors

Study the diagram of an ecosystem:



7.1 List all the BIOTIC (living) factors you can identify in the ecosystem above. (7)

7.2 List all the ABIOTIC (non-living) factors in the ecosystem. (5)

7.3 Explain the interdependence or the relationship between the following factors:

(a) The birds and the tree. (2)
(b) The frog and the water. (2)

7.4 How will a sudden increase in temperature during a heat wave affect the ecosystem? (2)

7.5 Lots of people have picnics around the pond over weekends. How will this human activity affect the ecosystem? (2)
[20]

Feeding relationships (CAPS p. 37)

Feeding group	Definition	Example
Producers	Organisms that can produce their own food.	Green plants Algae
Consumers	Organisms that cannot produce their own food; they obtain their food from plants and/or animals.	Herbivores Carnivores Omnivores
Herbivores	Feed on plant material only.	Cows Horses Elephants Giraffes
Carnivores	Feed on other animals, living or dead.	Predators Scavengers Insectivores
Omnivores	Animals that eat both animal and plant matter.	Pigs Humans Bears Chimpanzees
Predators	Animals that hunt and kill other animals (prey).	Leopards Cheetah Lions Sharks
Scavengers	Animals that feed on animals that are already dead.	Hyenas Vultures
Insectivores	Animals that feed mainly on insects and other smaller invertebrates such as worms (e.g., earthworms).	Frogs Lizards Spiders Anteaters
Decomposers	Break down (decompose) the remains of dead plants and animals. They recycle important nutrients in the environment.	Bacteria Fungi Earthworms

ACTIVITY 8: Feeding relationships - Terminology

(Grade 8 A Siyavula textbook p. 78)

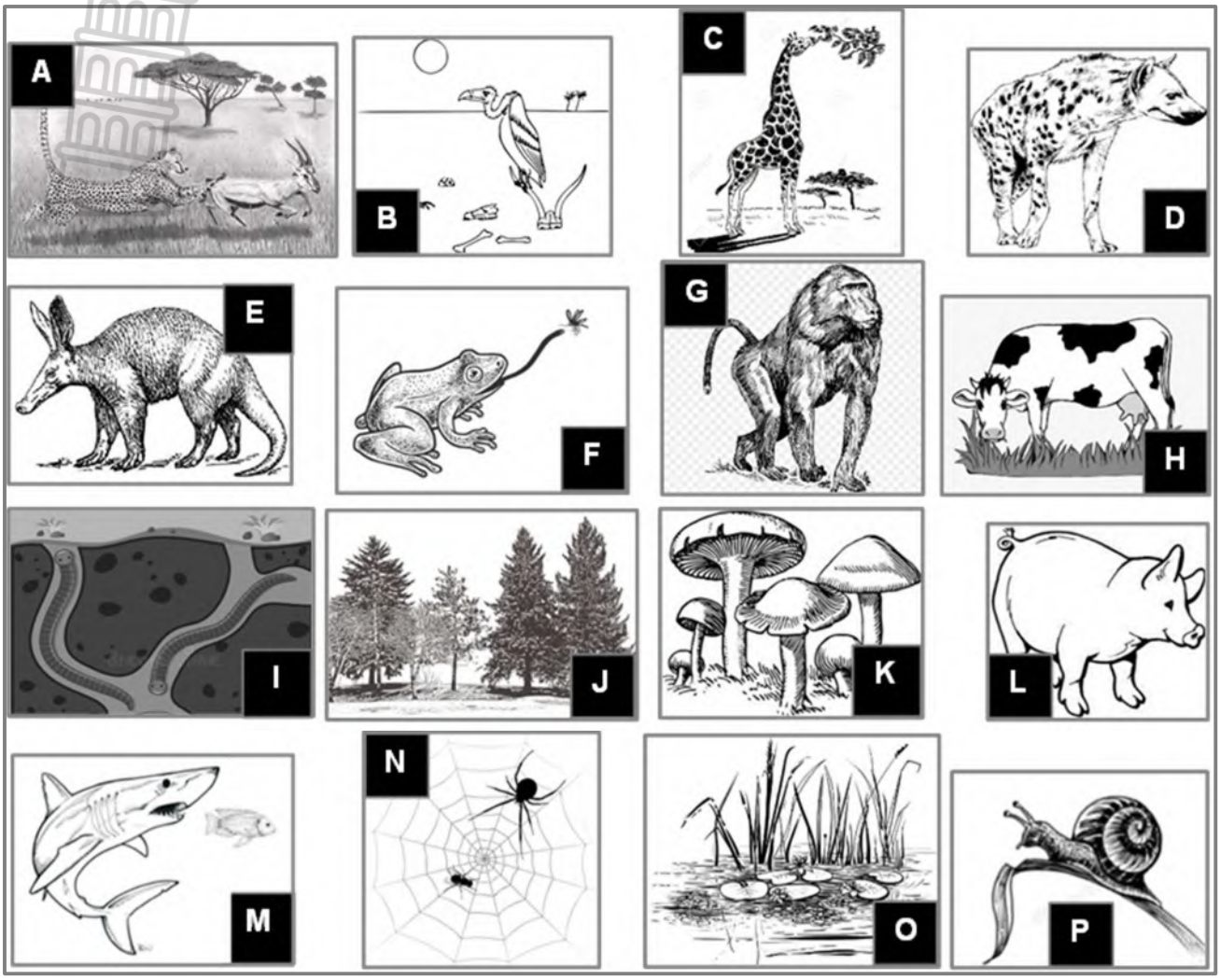
Match the statement in COLUMN A with the term in COLUMN B. Write the number and the letter of the answer e.g., 8.12 M.
(Suggestion: Write the sentence and then the correct word.)

COLUMN A		COLUMN B	
8.1	Organisms that eat other organisms to obtain food.	A	Producer
8.2	Feeds on plants and animals.	B	Carnivore
8.3	Organisms that make their own food.	C	Consumer
8.4	Organisms that eat only plant material.	D	Omnivore
8.5	A carnivore that eats dead animals.	E	Predator
8.6	An animal which feeds on other animals (dead or living).	F	Decomposer
8.7	An organism that breaks down the remains of dead plants and animals.	G	Insectivore
8.8	A carnivore that hunts other animals.	H	Scavenger
8.9	A carnivore that eats mainly insects and other small Invertebrates.	I	Prey
8.10	The term used for the hunted animal.	J	Herbivore

[10]

ACTIVITY 9: Feeding relationships

Study the organisms (A to P) shown below.



- Classify organisms A to P according to their respective feeding groups.
- Use the table on the next page.
- Either paste a copy of the table in your classwork book or redraw the table in your book.
- Use ticks (✓) to indicate to which food group each organism belongs.
- More than one tick (✓) can be made next to an organism.

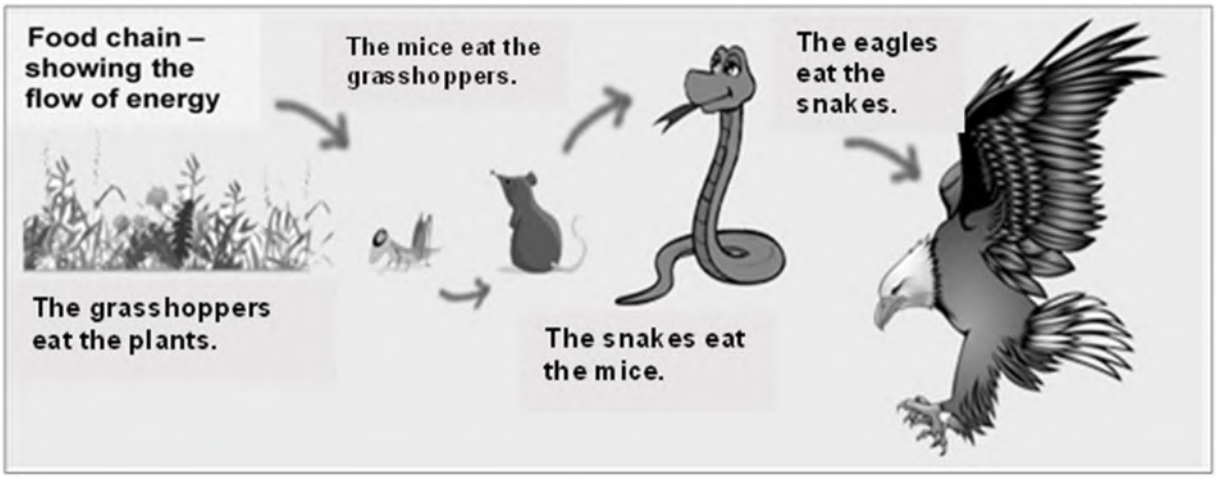
ACTIVITY 9: Table for the classification of organisms according to their feeding groups:

	Organism	Producer	Consumer	Herbivore	Carnivore	Omnivore	Predator	Scavenger	Insectivore	Decomposer
A	Cheetah									
B	Vulture									
C	Giraffe									
D	Hyena									
E	Aardvark									
F	Frog									
G	Baboon									
H	Cow									
I	Earthworms									
J	Trees									
K	Mushrooms									
L	Pig									
M	Shark									
N	Spider									
O	Water lilies									
P	Snail									

[1 mark per organism for all ticks correctly indicated; 16 x 1 = 16]

Energy flow: Food chains & food webs (CAPS p. 38)

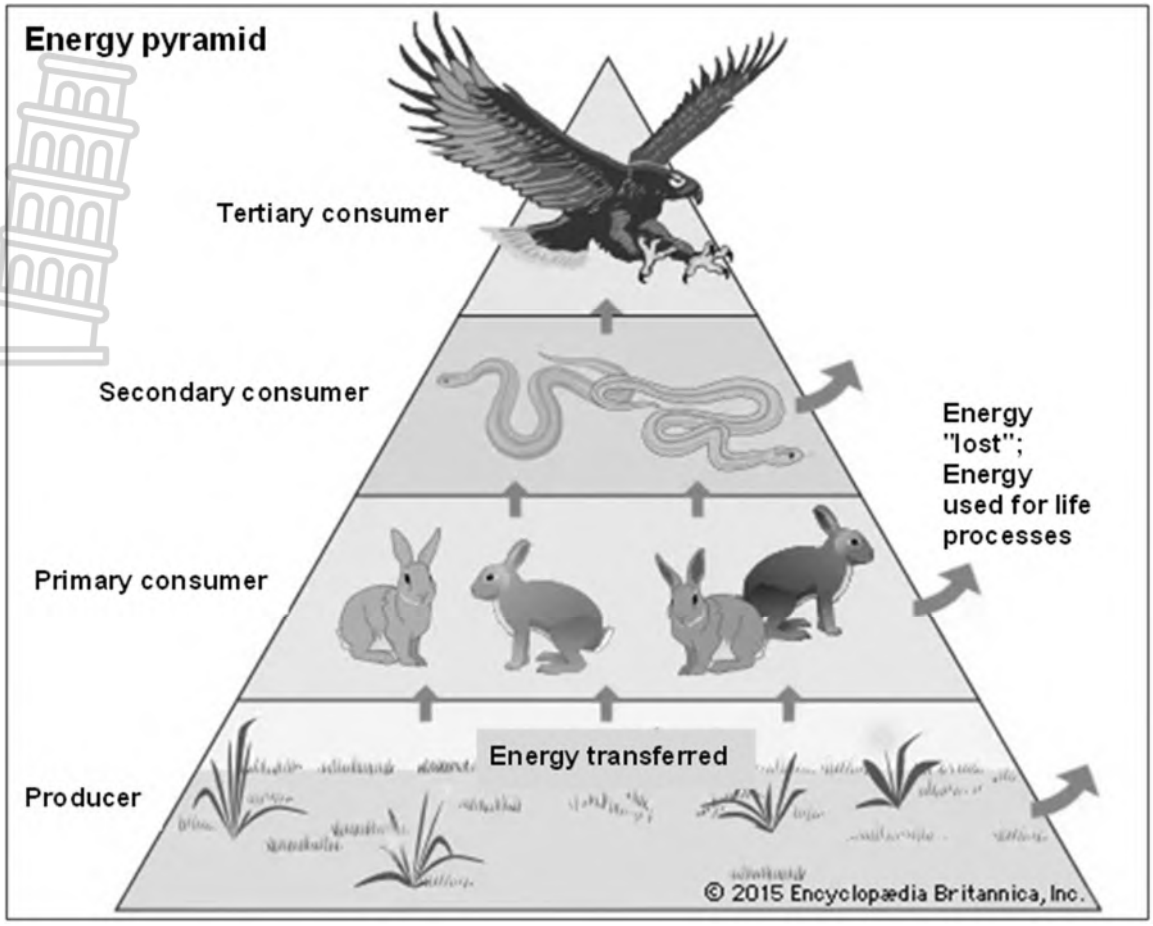
- Plants and algae play an important role in the ecosystem as they capture energy from the Sun by the process of photosynthesis.
- This energy is passed along a food chain from the producers to the consumers.
- Decomposers, the last link in this transfer of energy, release energy as heat to the environment.
- Each stage of the food chain is called a **trophic level**.
- Energy transfer and energy loss occur at every trophic level (on average, about 10% of the energy at one trophic level is passed on to the next).
- Interlinked food chains together form **food webs**.
- **Food chain:** Plants → Grasshopper → Mouse → Snake → Eagle



- The arrows indicate the flow of energy from one organism to the next.

What learners should know

1. How to write a food chain or food web (linking names with arrows) in different ecosystems.
2. How to draw and analyse energy pyramids.
3. Evaluate the impact of different factors e.g., loss of habitat, loss of species and change of weather conditions on ecosystems.
4. Evaluate the impact on a food web when one of the species is removed.
5. Distinguish between:
   - Producers
   - Primary consumers
   - Secondary consumers
   - Tertiary consumers



Balance in an ecosystem (CAPS p. 38)

What learners should know

- An ecosystem can only accommodate as many organisms as its resources (food, water and shelter) can carry, otherwise the **balance** will be disturbed.
- This balance can be disrupted by:
  - **Natural factors** that include extreme changes in weather patterns and climate such as floods, droughts, and extreme and sudden changes in temperature.
  - **Human factors** include removing organisms (plants and animals) from the ecosystem (through e.g., poaching) or human induced pollution.
- These factors can contribute to an imbalance in an ecosystem, seriously impacting on its components and altering its nature.

ACTIVITY 10: Food chains, food webs and the balance in an ecosystem

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A – D) next to the question number, e.g., 1.1 D.

10.1 A food chain will always start with a / an …

A top predator.
B herbivore.
C producer.
D insectivore. (1)

10.2 A primary consumer will eat …

A meat only.
B plants only.
C meat and plants.
D dead animals only. (1)

10.3 Which one is the secondary consumer in the food chain?

Grass → Grasshopper → Frog → Snake

A Grass
B Grasshopper
C Snake
D Frog (1)

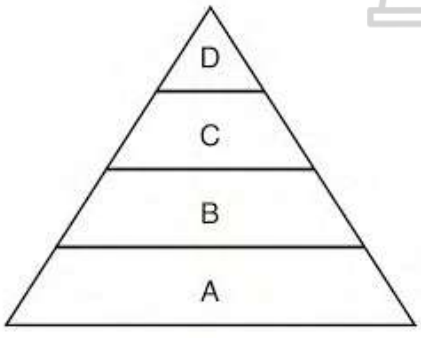
10.4 A series of organisms that eat one another so that energy and nutrients flow from one organism to the next.

A Community
B Food chain
C Trophic level
D Producers (1)

10.5 The last link in the transfer of energy in a food chain.

A Producer
B Carnivore
C Decomposer
D Scavenger (1)

Use the energy pyramid to answer questions 10.6, 10.7 and 10.8:



10.6 What are A to D in the energy pyramid called?

A Links
B Steps
C Trophic levels
D Energy levels (1)

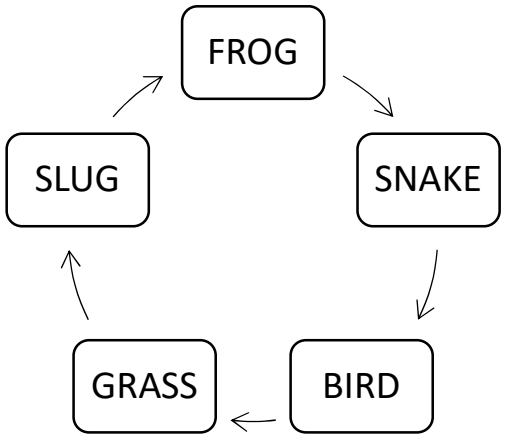
10.7 Omnivores will most probably be found in ...

A Level A
B Level B
C Level C
D Level D (1)

10.8 A tertiary consumer will be found in ...

A Level A
B Level B
C Level C
D Level D (1)

10.9 What will happen to the food chain if all the frogs die due to a severe drought?



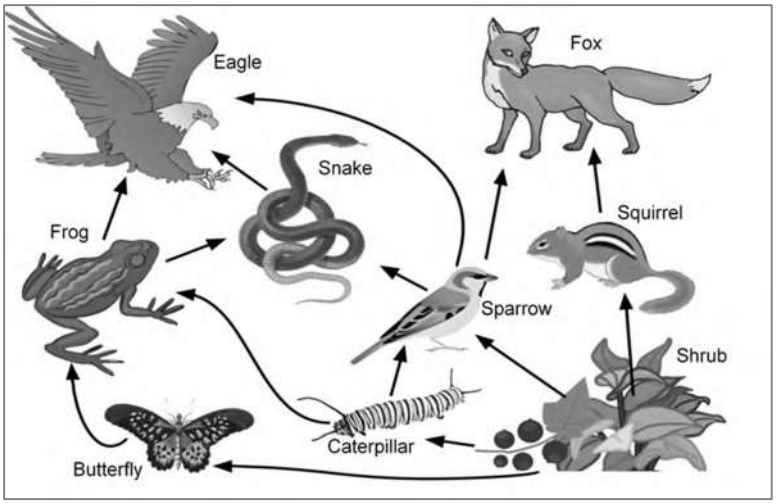
A The number of snakes will increase.
B The number of slugs will decrease.
C The number of slugs will increase.
D All animal totals will stay the same. (1)

10.10 Which one of the following is NOT a natural factor disrupting the balance in an ecosystem?

A Flood due to heavy rain.
B Drought due to lack of rain.
C Veld fire due to lightning.
D Overfishing of the ocean. (1)
[10]

ACTIVITY 11: Food chains, food webs and the balance in an ecosystem

Study the diagram:



11.1 Provide the diagram with a suitable heading. (1)

11.2 Name an organism from the diagram above which is an example of each of the following:

(a) Producer
(b) Primary consumer
(c) Secondary consumer
(d) Tertiary consumer
(e) Carnivore
(f) Insectivore
(g) Herbivore
(h) Omnivore (8)

11.3 From the diagram above write down TWO different food chains. Both chains must contain FOUR organisms. (8)

11.4 What do the arrows in a food chain indicate? (2)

11.5 Explain the difference between a predator and a scavenger. (2)

11.6 An unknown bacteria attack the caterpillars and cause them to die. Describe the effect this will have on the food web. (2)

11.7 The following food chain appears in the food web above:
Shrub → Caterpillar → Frog → Snake → Eagle

(a) Draw an energy pyramid to represent the food chain. Label the trophic levels representing the producers and the primary, secondary and tertiary consumers. (4)

(b) If the shrubs produce 800 000 kilojoules of energy, how much energy will be transferred to the caterpillars? Show your calculation. (2)

(c) How much energy will eventually be available for the eagles? (1)

[30]

Adaptations (CAPS p. 38)

Background knowledge (Gr 7):

Grade 7: Biosphere and biodiversity.
Diversity in plants and animals.
Variation exists within a specie.

- **Adaptation** is the change in the structural, functional and behavioural characteristics of an organism.
  - **Structural:** the physical characteristics of a species such as having long legs and strong muscles.
  - **Functional:** a species may have special ways of carrying out its life processes such as being able to produce eggs with a hard shell, so that the embryos can grow and hatch even if the climate changes.
  - **Behavioural:** the species can have special behaviours that are instinctive or can be learned such as making safe nests to protect their babies.
    - These changes take place over a LONG period of time within a species and must be passed on from generation to generation.
- Adaptations allow the organism **to survive** as it adapts to the changing conditions within the environment.
- Organisms that are unable to adapt to changes within the environment die out; they become **extinct.**

Conservation of the ecosystem

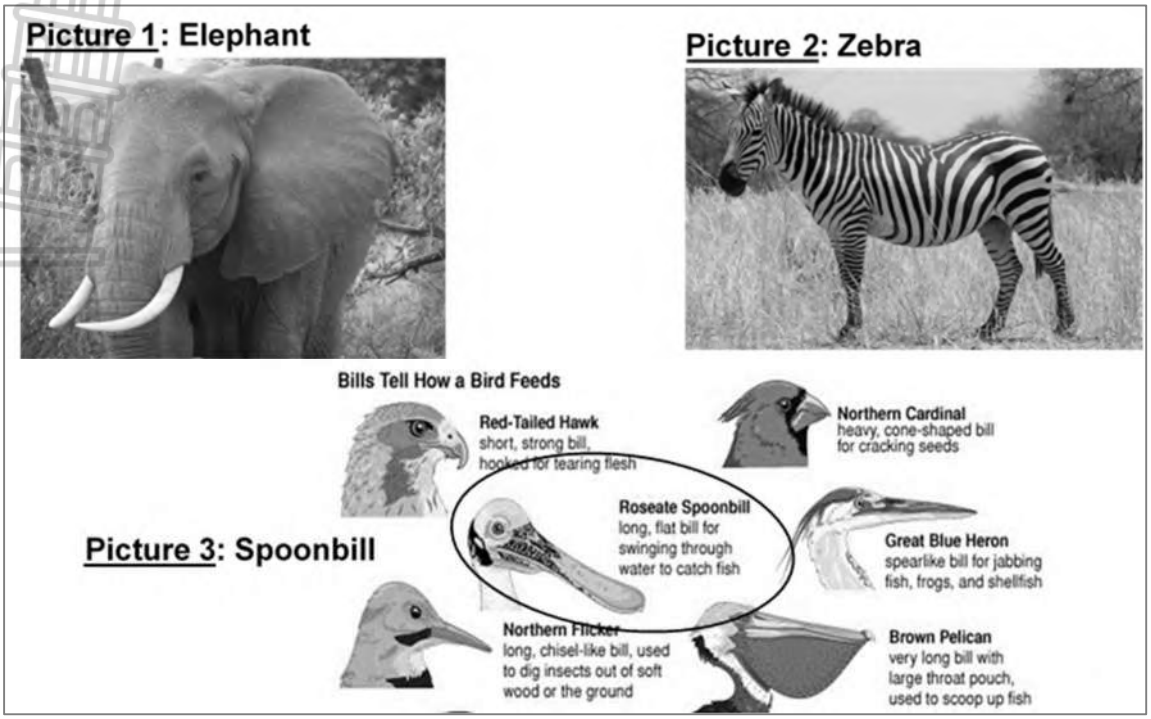
- Environmentalists and others work towards managing ecosystems, such as control of alien vegetation and preservation of wetlands.
- Individuals can contribute to conservation in various ways, such as appropriate waste disposal (including recycling, re-using)

What learners should know

- Adaptations of selected plants to survive in their habitat.
- Adaptations of animals e.g., camels and polar bears to live in extreme environments.
- Adaptations of animals e.g., sharks and cheetah to be good predators.
- Other animals show a wide range of different types of adaptations that allow them to survive in their natural habitat.
  - **Camouflage**: The use of different colours, patterns and shapes to look like the things around them (the environment or parts of the environment).
  - **Mimicry**: The use of different colours, patterns and shapes to look like another plant or animal.

ACTIVITY 12: Adaptation

12.1 Study pictures 1, 2 and 3 below.

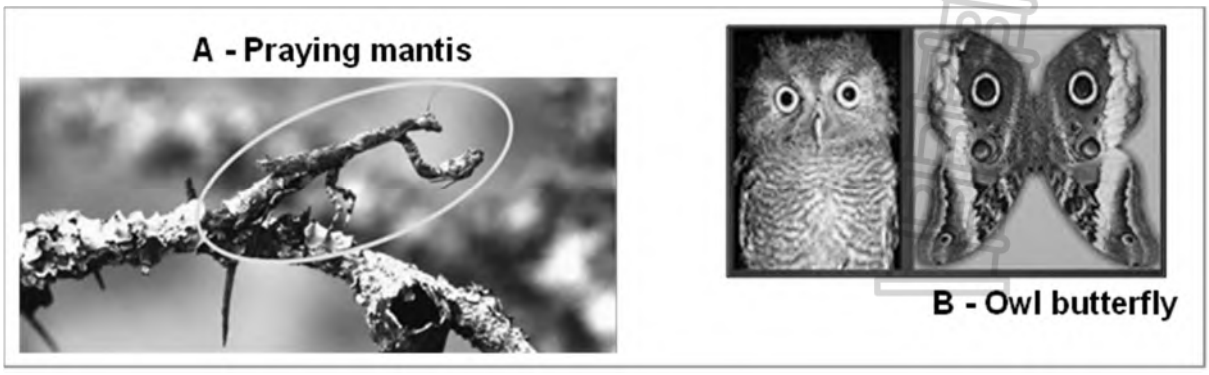


Identify an adaptation of each animal and explain the purpose of each adaptation. Redraw the table in your workbook and complete.

Animal	Adaptation	Purpose of adaptation
Elephant		
Zebra		
Spoonbill		

(6)

12.2 Study the adaptations in photos A and B below. Photo A shows a praying mantis (circled) on a twig. Photo B shows an owl butterfly next to a real owl.



(a) Identify the adaptation in photo A. Choose between MIMICRY or CAMOUFLAGE. Give a reason for your answer. (2)

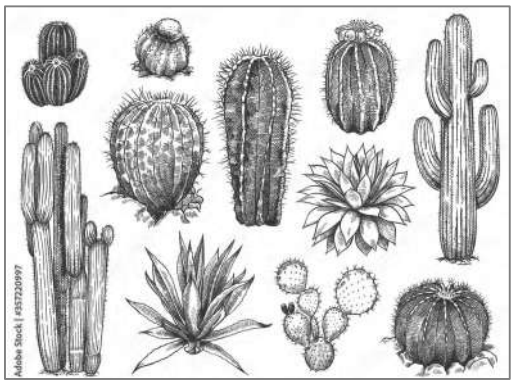
(b) Identify the adaptation in photo B. Choose between MIMICRY or CAMOUFLAGE. Give a reason for your answer. (2)

[10]

Adaptations in extreme conditions

Extreme conditions: Very hot or dry or very cold conditions. Animals and plants can have adaptations to survive in extreme conditions

1. Adaptation of plants to live in very dry (arid) conditions (e.g., aloe and cactus)



Adaptation	Function
Thick fleshy leaves	To store water.
Hairy leaves	Hair keeps plant cool and reduces water loss.
Small needle shaped leaves	Smaller leave area limits the loss of water.
Well-developed roots	Allows the plant to absorb a lot of water.

2. Adaptation of animals to live in very dry (arid) conditions (e.g., camel)

Adaptation	Function
Thick, long eyelashes	To protect eyes from sand and dust.
Can close their nostrils	To keep sand and dust out.
Hump on back of animal	Stores fat; helps animal to survive long periods without food and water.
Long, strong legs	To keep the body far away from the hot sand.
Wide, padded feet	To be able to walk on the sand without sinking.
The body is sand coloured	To blend in with the desert or sand.
Has thick fur and wool on body	Keeps animal warm in winter and cool in summer.

3. The adaptation of animals to live in very cold conditions (e.g., polar bear)

Adaptation	Function
Thick, hollow fur on the body	Insulates the warm body from the cold Arctic water and air.
Light coloured fur on body	Provides camouflage against the white ice.
Small, rounded ears	Help to conserve body heat and prevents water from entering the ears and freeze.
Long stiff hair between the pads of the feet	Protects the feet from cold and helps the bear to move on ice and to swim in the very cold water.

4. Adaptations of carnivores that are also predators

Predators are carnivores that hunt and eat meat. Their adaptations will support them to hunt, chew and digest the meat of the prey they caught e.g., a cheetah.

Characteristics and adaptations of a cheetah:

- These animals can run very fast and use their strong, sharp claws for high-speed turns.
- The animal has very muscular and long legs with an extremely long tail to support balancing when chasing another animal for food.
- The black lines on the face (look like tears along the cheeks) prevent the glare from the Sun in the eyes.
- The canine teeth are very long and sharp to tear meat.
- The pale yellowish-brown fur is covered with black spots for camouflage to hunt their prey effectively.

5. Adaptations of aquatic carnivores

The adaptations of this animal will support it to hunt, chew and digest the meat of the prey caught in water e.g., a shark.

Characteristics and adaptations of a shark:

- Sharks can swim and are very agile in water.
- The body is streamlined and is shaped like a torpedo to move very fast in water.
- The animal has a strong tailfin to keep the body upright and level.
- The grey colour of the body makes it difficult to be spotted in the water.
- The teeth are very sharp and are continuously replaced.
- The skin is covered with sharp scales. It lowers friction in the water to move silently.
- The snout is covered with sensory organs to pick up electrical impulses from potential prey.

ACTIVITY 13: Adaptation

Suggestion: Do more research on the cheetah and the shark before you answer the following questions.

13.1 Copy the table below in your workbook and list at least FOUR adaptations of the cheetah that allow it to function effectively as a predator. Also describe the function of each adaptation.

	Adaptation	**Function**
1		
2		
3		
4		

(8)

13.2 Copy the table below in your workbook and list at least FOUR adaptations of the shark that allow it to function effectively as a predator. Also describe the function of each adaptation.

	Adaptation	**Function**
1		
2		
3		
4		

(8)

[16]

ACTIVITY 14: Conservation of the ecosystem

The teacher can provide the learners with any relevant article / case study on conservation.

Learners should read and write about any of the following:

- The importance of maintaining biodiversity.
- Sustainable use of natural resources like forests, oceans, etc.
- Irresponsible human practices such as inappropriate waste disposal.

- Also discuss the IMPACT of any issue on ecosystems.
- Suggest POSSIBLE SOLUTIONS.

(Refer to the gr. 8 Siyavula textbook pg. 71 to 74.)

Topic: Micro-organisms (CAPS p. 39)

Terminology:

Microscopic: When something is so small, it can only be seen under a microscope.

Virus: It is a sub-microscopic agent that infects the inside of living cells in an organism.

Bacterium: It is a type of biological cell which comes in several shapes and is found in all habitats. (Plural: bacteria)

Viruses and bacteria can cause diseases and even death.

Types of micro-organisms

- Micro-organisms are living things.
- They are too small to see with the naked eye; they can only be seen under a microscope.
- There is a variety of micro-organisms, including viruses, bacteria, protista and fungi.

Harmful micro-organisms

- Harmful micro-organisms cause diseases.
- Micro-organisms causing diseases are found almost anywhere e.g., ATM's, staircases, toilets, handrails, in the air, in water, etc.
- Diseases caused by harmful micro-organisms:

  - **TB** (Tuberculosis caused by bacteria)
  - **AIDS** (caused by the HI-virus)
  - **MALARIA** (caused by a protist, carried by mosquitos)
  - **COVID** (**Co**rona **vi**rus **d**isease)
  - Waterborne diseases such as **DIARRHOEA** and **CHOLERA** cause many child deaths.

- Effective methods of preventing the spread of diseases caused by micro-organisms include washing of hands and sterilising.
- Scientists like Louis Pasteur played an important role in identifying and developing cures for some diseases. He invented some vaccines and pasteurisation (kills microbes in e.g., milk).

Useful micro-organisms

- Useful micro-organisms play an essential role in ecosystems, such as decomposing dead plant and animal matter, thereby recycling nutrients in the soil.
- Some micro-organisms are used by people for making certain foods such as yoghurt and medicines like penicillin.

ACTIVITY 15: Micro-organisms

15.1 Describe COVID-19 under the following headings:

(a) How the disease is caused (2)
(b) Effects of the illness on the human body or the symptoms (3)
(c) Treatment (2)
(d) How to prevent the disease (3)
(e) Tabulate the differences between common flu and COVID-19. Draw a table like the one below in your workbook.

COMMON FLU	COVID

(3)

NOTE: *Similar activities can also be done on any other disease such as* ***TB, Malaria, HIV and AIDS, cholera, or diarrhoea.***

15.2 Yeast is very commonly used in the production of food and beverages.

(a) Name four things that yeast need to grow. (4)

(b) Name TWO products released by yeast during fermentation. (2)

(c) Name TWO foods and/or beverages that are made with yeast. (2)

15.3 Give two examples each of how the following micro-organisms can be useful.

(a) Fungi (2)
(b) Bacteria (2)

[25]

OPTIONAL: ACTIVITY 16 - Informal practical activity (scientific process)

Observe micro-organisms by investigating the growth of yeast.

- Yeast is used to make bread rise and to ferment beer.
- There are many species of yeast, but the most common one used in cooking and baking is known as *Saccharomyces cerevisiae*, which is known as **brewer's yeast**. (See picture above.)
- As yeast grows, it uses sugar for energy and converts it into carbon dioxide and alcohol / acids; this is called **fermentation**.

16.1 Investigate the GROWTH OF YEAST under different conditions

Either different temperatures **OR** different amounts of sugar can be used when growing yeast. Do some research on a method that can be used.

AIM:
To determine how temperature affects the growth of yeast.
OR
To determine how the amount of sugar affects the growth of yeast.

Keep the following in mind when growing the yeast:

- 55°C – 60°C: Yeast cells die.
- 41°C – 46°C:
  Ideal temperature of water for dry yeast being reconstituted (to return, reconstruct) with water and sugar.
- 4°C: The temperature of a fridge – yeast will be too cold to work properly.

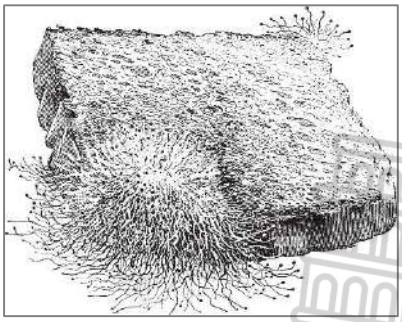
In the experiment you will trap the carbon dioxide released during the fermentation process. The more active the yeast, the more carbon dioxide will be produced by the yeast.

By introducing the variables of different temperatures OR different amounts of sugar, you will be doing **real science!**

Conduct the investigation, record your observations and results and write a scientific report.

16.2 Investigate the GROWTH OF BREAD MOULD under different conditions

Bread mould is the fungus, Rhizopus that grows on bread.



Conduct an investigation and write a report, using the following headings:

- **Aim:**
  To determine how the amount of moisture affects the growth of bread mould
  OR
  To determine how temperature affects the growth of bread mould
- Investigative question
- Hypothesis
- Method
- Results
- Conclusions

END OF TERM 1

Strand: Matter and Material (Term 2)

Topic: Atoms

Background knowledge (Gr. 7):

Properties of materials: strength, flexibility, melting and boiling points, electrical conductivity, and heat conductivity.

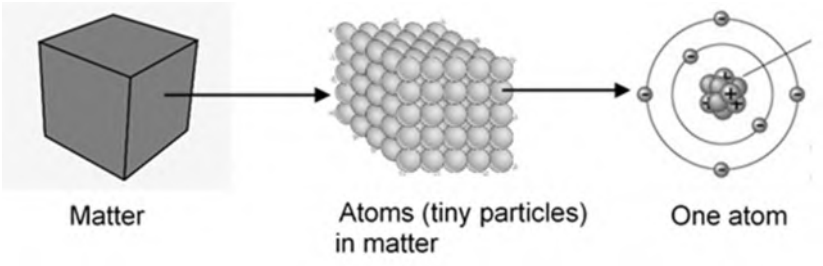
The properties of materials determine their suitability for a particular use.

The properties of materials are determined by its build up.

Grade 8 Content:

Atoms, the building blocks of matter

- All matter is made up of tiny particles called atoms.



- An element is made up of atoms of the same kind. For example, all the atoms of an element, such as copper, are identical.
- An element is a (pure) substance that cannot be broken down into simpler substances by chemical means.
- An element cannot be changed into another element by means of a chemical reaction.
- Atoms of one element differ from the atoms of all other elements.
- All known elements are listed on the Periodic Table of the Elements.

Background knowledge (Gr. 7):

Elements in the Periodic Table are arranged according to their properties.
Each element has its own name, symbol, atomic number (number of protons in the nucleus) and position on the Periodic Table.

	Metals	**Semi-metals**	**Non-metals**
Position on the Periodic Table	Left-hand side (except H, which is a gas and a non-metal)	In the region between metals and non-metals	Far right-hand side
Properties	Shiny, ductile, malleable. Solid (except mercury). High melting and boiling points. Good thermal and electrical conductors.	Solids. Have some properties of metals and some properties of non-metals.	Some are solids like C, S, P, etc. Bromine is a liquid. Some are gases like hydrogen, oxygen, chlorine, nitrogen, etc. Little or no metallic lustre. Brittle solids; not malleable/ductile. Poor thermal and electrical conductors.

ANNEXURE A: THE PERIODIC TABLE OF THE ELEMENTS

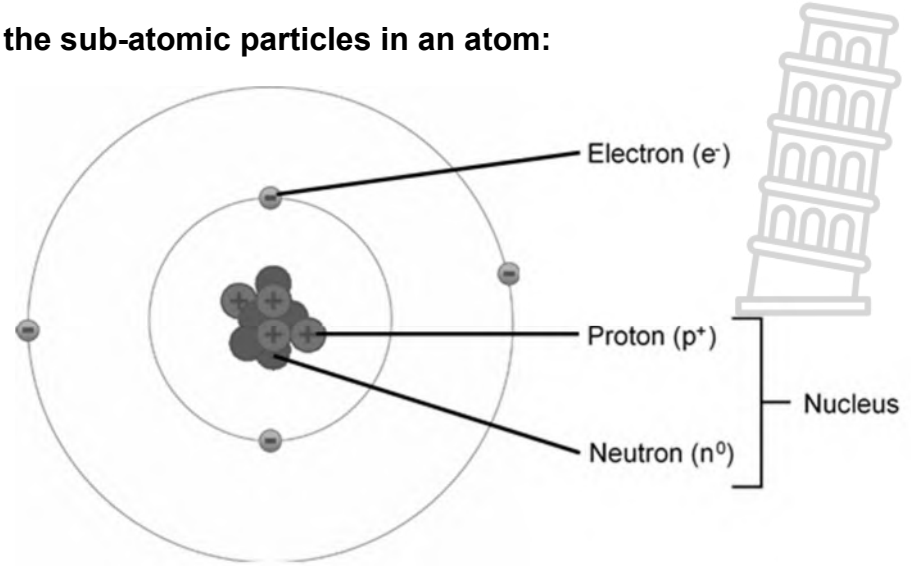
	1A 1												3A 13	4A 14	5A 15	6A 16	7A 17	8A 18
1	1 H	2A 2																2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg	3B 3	4B 4	5B 5	6B 6	7B 7	8B 8	8B 9	8B 10	1B 11	2B 12	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110	111	112	113	114	115	116		

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No

Sub-atomic particles

- Atoms are made up of smaller particles called sub-atomic particles.
- The sub-atomic particles are called protons, neutrons, and electrons.
- The central region of the atom is called the nucleus.
- The nucleus is made up of positively charged particles called protons and neutral particles called neutrons.
- Negatively charged particles called electrons move around the nucleus.
- Atoms are neutral because the number of negatively charged particles (electrons) is equal to the number of positively charged particles (protons).

Diagram of the sub-atomic particles in an atom:



Note the distribution of e^-: 2 in the first orbit, 8 in the second, 8 in the third and 2 in the fourth.

NOTE: ***The purpose of the activities in this document is to drill BASIC concepts. Refer to question banks and previous question papers for questions on higher cognitive levels (www.mindstream.co.za)***

Activity 1 - Atoms and sub-atomic particles

1.1 Give one word/term for each of the following descriptions:

1.1.1 The tiny particles all matter is made up of.
1.1.2 A substance (material) that is made up of atoms of the same kind.
1.1.3 The organised arrangement of all the known elements.
1.1.4 A substance that cannot be broken down into simpler substances.
1.1.5 Particles, such as protons, neutrons and electrons found in an atom. (5)

1.2 Atoms consist of three different sub-atomic particles.

(a) List the names of the three sub-atomic particles. (3)
(b) Next to the name of each particle, write down its charge. (3)

1.3 Draw and label a fluorine atom consisting of 9 protons, 10 neutrons and 9 electrons. (4)
[15]

Pure substances

- Elements AND compounds are pure substances.
- Both consist of only ONE type of particle.
- Copper, an element, consists of only copper atoms.
- Water (pure water), a compound, consists of only water molecules.

Elements

- An element is a material that consists of atoms of only one kind, such as hydrogen (H), oxygen (O), carbon (C), sodium (Na) and chlorine (Cl).
- All known elements are listed on the Periodic Table of Elements.
- Elements are limited in number and are the building blocks of millions of compounds.
- Some elements on the Periodic Table of Elements form diatomic molecules. These are called molecules of elements.
- **Diatomic molecules:**
  H_2 N_2 F_2 O_2 I_2 $C\ell_2$ Br_2
  To remember: **H**ave **N**o **F**ear **O**f **I**ce **C**o**l**d **B**ee**r**
- Sometimes atoms form chemical bonds with each other to form molecules of compounds, such as H_2O and CO_2.

Compounds

- A compound is a material that consists of atoms of two or more different elements chemically bonded together.
- Examples of compounds are water (H_2O), carbon dioxide (CO_2), table salt (NaCl) and copper chloride ($CuC\ell_2$).
- The atoms in a given compound are always bonded in a fixed ratio such as, in water, the ratio is always two hydrogen atoms (H) to one oxygen atom (O).
- A chemical bond is the force that holds atoms together.
- Compounds [such as water (H_2O), carbon dioxide (CO_2), salt (NaCl)] are formed by chemical reactions.
- Compounds can be broken down in a decomposition reaction into other compounds or their original elements by heating or electrolysis. For example, electrolysis decomposes water (H_2O) to form hydrogen (H_2) and oxygen (O_2).

Mixtures of elements and compounds

Background knowledge (Gr. 7):

Mixture:
Is made up of two or more substances or materials that have different physical properties. Where the properties differ, the substances can be separated.

Methods of separation:

- Sorting (separating sheep wool from thorns)
- Sieving (separating stones from sand)
- Filtration (separating sand from water)
- Using a magnet (separating iron from sand)
- Evaporation (retrieving salt from sea water)
- Distillation (retrieving pure water from sea water)
  Distillation always involves boiling and condensation [change from gas to a liquid].
- Chromatography (separating different colour pigments from one colour pigment, such as black

Grade 8 Content:

- A mixture consists of different types of particles and is not a pure substance.
- Elements and compounds are often found mixed with each other, such as in air, sea water, rocks, and in living things.
- Mixtures can be separated by physical means.
- Compounds can be separated by chemical means.

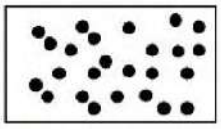
Activity 2 - Pure substances (Elements and Compounds); Mixtures

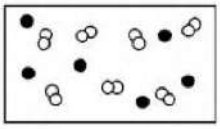
2.1 Complete the table by drawing the models of the diatomic molecules and compounds. Write down the number and, next to it, draw the correct model.

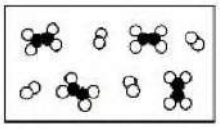
Element	Molecule	Model of the molecule
Hydrogen 	H_2	2.1.1
Oxygen 	O_2	2.1.2
	N_2	2.1.3
Nitrogen 	H_2O	2.1.4
Carbon 	CO_2	2.1.5

(5)

2.2 Study diagrams A to I below.


A


B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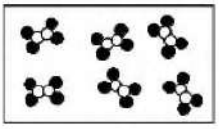
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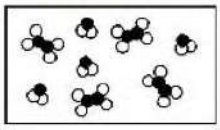
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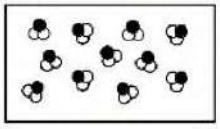
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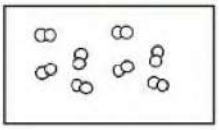
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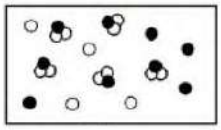
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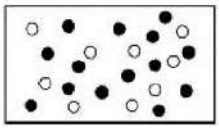

I

List the letters A to I underneath each other. Next to each letter, indicate whether it is an ELEMENT, a COMPOUND, or a MIXTURE. (9)

2.3 Consider the following substances:

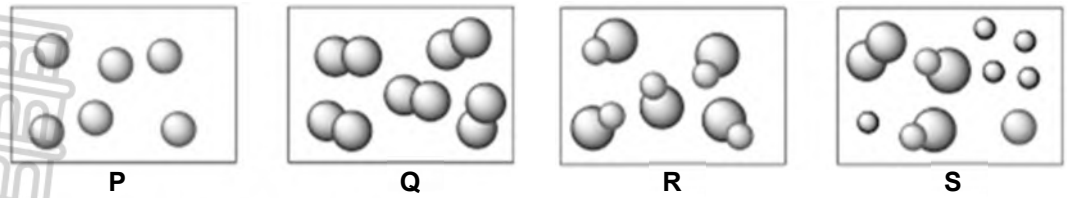
CO_2 (Carbon dioxide) **H_2SO_4 (Sulphuric acid)**
NaCℓ (Sodium chloride) **H_2O (Water)**

2.3.1 Write down the chemical formula of the substance in which the ratio is:

(a) 1:1 (1)
(b) 2:1 (1)
(c) 1:2 (1)
(d) 2:1:4 (1)

2.3.2 What is the ratio in $CaCO_3$? (1)

2.4 Consider the diagrams of four different substances below:



2.4.1 Identify each of the following:
(Only write down P, Q, R and/or S. Letters can be used more than once.)

(a) Pure substances. (3)

(b) A diatomic element. (1)

(c) A mono-atomic element. (1)

(d) A mixture. (1)

(e) A compound consisting of two different elements. (1)

2.4.2 Which one of P, Q or R represents each of the following the best?

(a) Carbon monoxide (CO) (1)

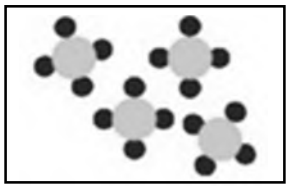
(b) Helium atoms (1)

(c) Oxygen gas molecules (1)

2.4.3 For **diagram S**, which one of the following statements is TRUE?
Only write the number and the LETTER (A, B, C or D) of the correct answer.

A It is a mixture.
B It is a pure substance.
C It is an element.
D It is a compound. (1)

2.5 Consider the diagram:



2.5.1 How many molecules can you identify in the diagram? (1)
2.5.2 How many atoms are there in one molecule? (1)
2.5.3 How many different elements are represented in the diagram? (1)
2.5.4 How many atoms are there in TOTAL represented in the diagram? (1)
2.5.5 Choose the correct answer:
The chemical formula of the substance is **H_2SO_4** or **CH_4** or **H_2O_2**. (1)

[35]

Particle model of matter

- Atoms and molecules are referred to as particles in the particle model of matter.
- The particle model of matter is a scientific theory used to explain that all matter (solids, liquids, and gases) is made up of particles.
- These particles are too small to see with the naked eye (in a drop of water there would be many billions of water particles).
- The spaces between the particles are empty (these spaces do not contain air, they contain nothing).
- The particles are arranged differently in a solid, liquid and a gas.

Comparing a solid, a liquid and a gas in terms of:

1. arrangement,
2. movement,
3. forces, and
4. spacing (size of spaces between particles).

In a **solid**, the particles …

1. are closely packed in a regular arrangement.
2. do not move around but vibrate against each other (in one position).
3. have strong forces holding them together.
4. have very small spaces between them.


Solid

In a **liquid**, the particles …

1. are loosely arranged but still quite close together.
2. can move quite fast and slide past each other.
3. have weaker forces between them (than in a solid).
4. have bigger spaces between them (than in a solid).


Liquid

In a **gas**, the particles …

1. have no particular arrangement.
2. move very fast.
3. have extremely weak forces between them.
4. have very big spaces between them compared to solids and liquids.


Gas

- **Diffusion**
  - It is a process in which particles in liquids and gases move (separate and spread) from a highly concentrated area to an area with a lower concentration of those particles.
  - Is faster in gases compared to liquids.

Activity 3 - Particle model of matter; Diffusion

3.1 Draw a table, like the one below, to compare solids, liquids, and gases in terms of arrangement, movement, forces and spacing.
(**Tip**: Draw the table BIG enough to ensure that there is enough space.)

	SOLID	LIQUID	GAS
Diagram of the state of matter			
Arrangement of the particles			
Movement of the particles			
Forces between the particles			
Spacing between the particles			
Density			

(18)

3.2 The rate of diffusion in a gas and in a liquid is investigated.

Diagram 1:
When the glass plate between the two flasks is removed, the bromine vapour spreads within 10 minutes from the bottom flask to fill the whole space.

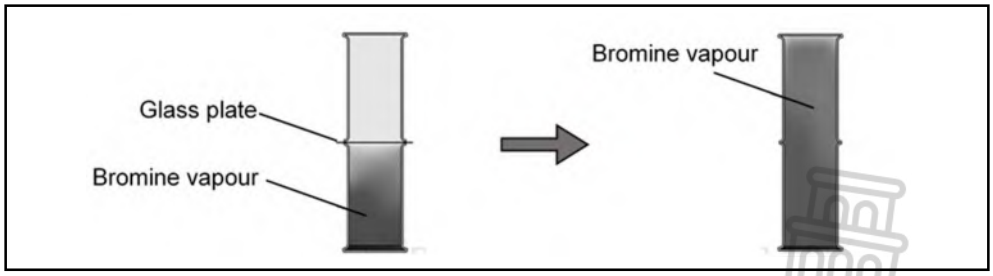
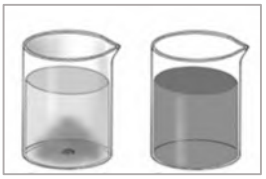


Diagram 2:
In water, a drop of ink takes an hour to spread and colour all the water in the beaker.



3.2.1 Define the term diffusion. (2)

3.2.2 Explain why diffusion in a gas takes place much faster than in a liquid. (3)
[23]

Change of state

- Heating and cooling can cause a material (substance) to change state.
- The solid material first changes to a liquid (melting) when heated, and then it changes to a gas (evaporating) on further heating.
- The gas first changes to a liquid (condensing) when cooled, and then it changes to a solid (freezing or solidifying) when cooled further.
- As a solid material is heated, the movement of the particles increases which enables them to move past each other and form a liquid.
- The particles move much further apart from each other when the material changes from the liquid to the gas state.

➢ **Formal Practical Task**

Change of state worksheet of 2020 (www.mindstream.co.za)

Activity 4 - Change of state

4.1 Name the process described in each case:

4.1.1 When a solid changes to a liquid. (1)
4.1.2 When a liquid changes to a gas. (1)
4.1.3 When a gas changes to a liquid. (1)
4.1.4 When a liquid changes to a solid. (1)

4.2 Which processes in question 4.1 require heating to occur? (2)

4.3 Which processes in question 4.1 require cooling to occur? (2)

4.4 A piece of candle wax is placed in a metal tin and heated over a flame.

4.4.1 What will be observed when the candle wax is heated? (1)
4.4.2 What will be observed after a few minutes if the hot candle wax is removed from the flame? (1)
[10]

Density, mass and volume

- The density of a material describes the amount of mass in a given volume of that material.
- Density (g/cm^3) = $\frac{mass\ (g)}{volume\ (cm^3)}$

Density and states of matter

- In general, gases are less dense than liquids and liquids are less dense than solids.
- Water is an exception as ice is less dense than water and therefore ice floats on water.

Density of different materials

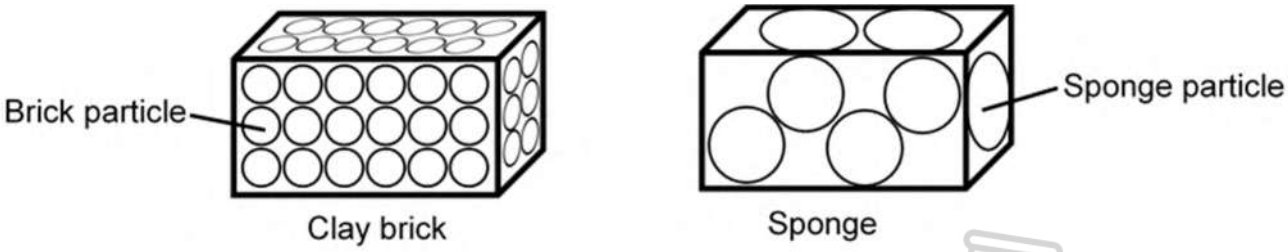
- Some materials have low density and some have a high density, for e.g., a loaf of bread has a lower density than a clay brick of the same size.
- The density of a material will depend on the kind of particles it is made up of and the size of the spaces between them.
- A material which has lower density will float on a liquid which has higher density, for example oil (lower density) will float on water (higher density).

➢ **Practical activity (Optional; can also be done as the formal practical task)**

Density worksheet of 2020 (www.mindstream.co.za)

Activity 5 - Density

5.1 The clay brick and the sponge in the diagram have the same volume.



5.1.1 Which one (brick or sponge) will feel heavier when they are picked up simultaneously (at the same time)? (1)

5.1.2 Explain your answer in question 5.1.1 based on what you see in the diagram. (2)

5.1.3 Calculate the volume of the brick and the sponge if the measurements are as follows:

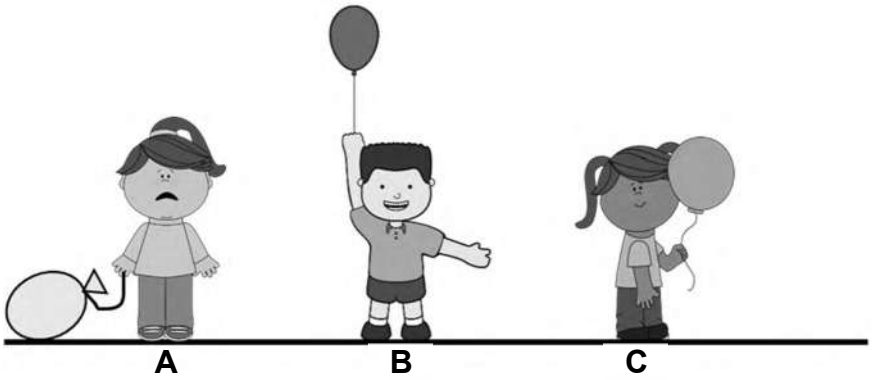
length = 20 cm; breadth = 10 cm; height = 15 cm (3)

5.1.4 Calculate the density of the brick in g/cm^3 if it has a mass of 2 kg. (3)

5.1.5 Calculate the density of the sponge if it has a mass of 200 g. (2)

5.1.6 Define density. (2)

5.2 Helium gas is less dense than air, while carbon dioxide gas is denser than air. Three balloons are respectively filled with helium, carbon dioxide and air. Each of three children (A, B and C) is then given one of the balloons to hold.



5.2.1 Which child (A, B or C) is holding the balloon filled with helium? Motivate your choice. (2)

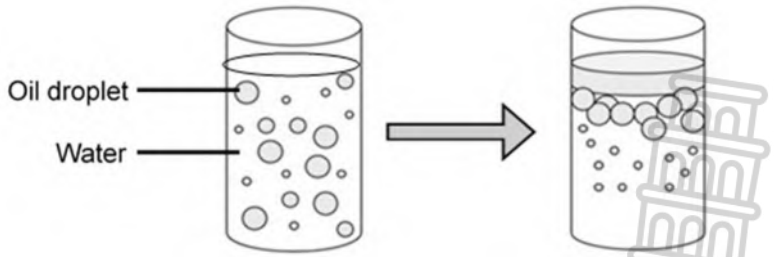
5.2.2 Which child (A, B or C) is holding the balloon filled with carbon dioxide? Motivate your choice. (2)

5.2.3 Consider the three densities: 1,23 kg/m^3, 0,164 kg/m^3 and 1,98 kg/m^3.

Write down the density for:

(a) helium
(b) air
(c) carbon dioxide (3)

5.3 Oil with a density of 0,85 g/cm^3 is mixed well with water, which has a density of 1 g/cm^3. The mixture is left to stand for a few minutes and the observation shown below is made.



5.3.1 What happens after a while with the oil and water? Describe the observation. (2)

5.3.2 Explain why this happens. (2)

5.3.3 Why will a small pebble sink if it is put in water? (1)

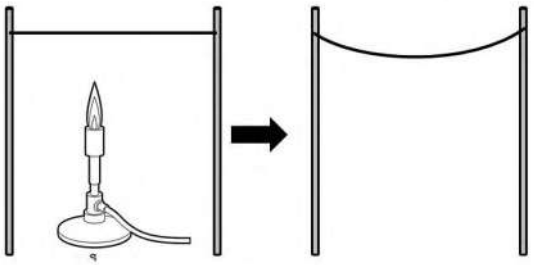
[25]

Expansion and contraction of materials

- Solids, liquids, and gases tend to expand when heated and contract when cooled.
- Particles of liquids and gases are in a state of constant motion.
- As a material is heated, the movement of the particles increases, and they move further apart, therefore the material expands.
- As a material is cooled, the movement of the particles decreases and they move closer together, therefore the material contracts.
- When a material expands or contracts, the size and number of particles does not change. Instead, it is only the spaces between the particles that get bigger or smaller.
    - During expansion, the spaces between the particles get bigger.
    - During contraction, the spaces between the particles get smaller.

Activity 6 - Expansion and contraction

6.1 A very thin piece of metal wire is suspended between two vertical rods. The wire is heated with a flame. After a while, the wire begins to sag as shown below.

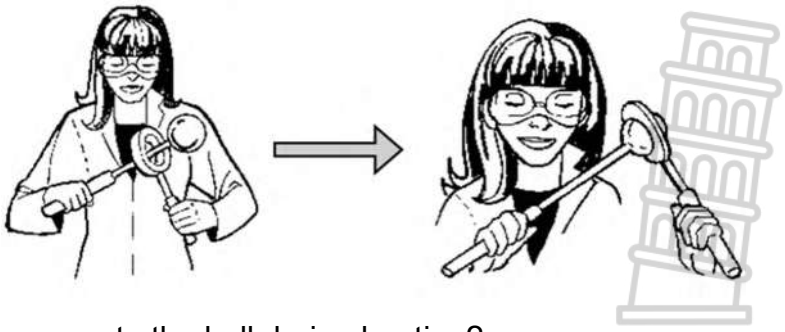


6.1.1 Give the scientific term for a wire that gets longer due to heat. (1)

6.1.2 What will happen to the wire when it cools down again? (1)

6.1.3 Explain the process mentioned in 6.1.2. (3)

6.2 A copper ball easily slides through a copper ring when it is cold but after the has been heated it does not fit through the ring anymore.



6.2.1 What happens to the ball during heating? (1)

6.2.2 To explain how this happens, refer to the particle model of matter, and make drawings of the ball before and after heating. Clearly show the size of the ball and the arrangement of the particles inside the ball, before and after heating. (4)

[10]

Pressure

- A gas exerts a pressure because of the collisions of the particles with each other and against the sides of the container.
- Pumping more gas into a container increases the number of gas particles in the container. This increases the number of collisions and therefore increases the pressure.

Activity 7 - Pressure

7.1 Only write the number and the letter of the correct answer:

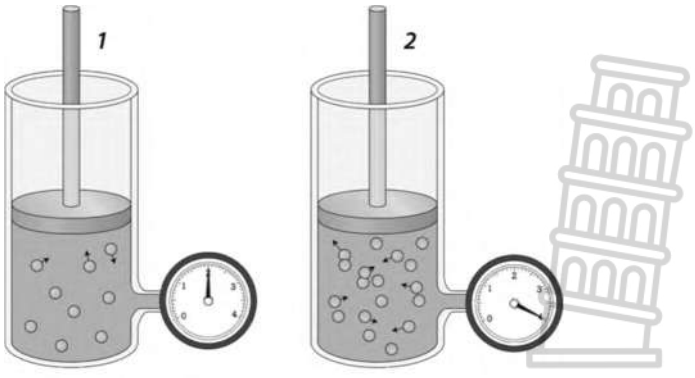
7.1.1 A gas exerts a pressure because …

A the particles have fixed positions.
B the particles vibrate in fixed positions.
C of the collisions of the particles with each other.
D of the collisions of the particles with each other and with the sides of the container. (1)

7.1.2 Pumping more air into a car tyre …

A increases the number of particles and decreases the number of collisions.
B increases the number of particles and increases the number of collisions.
C decreases the number of particles and decreases the number of collisions.
D decreases the number of particles and increases the number of collisions. (1)

7.2 Two gas cylinders, 1 and 2, contain the same gas at the same temperature. The pressure meter in 1 registers a lower pressure than the pressure meter in 2.



7.2.1 Explain how a gas exerts pressure. (2)

7.2.2 Use the diagram and explain why the pressure in cylinder 2 is higher than the pressure in cylinder 1. (2)
[6]

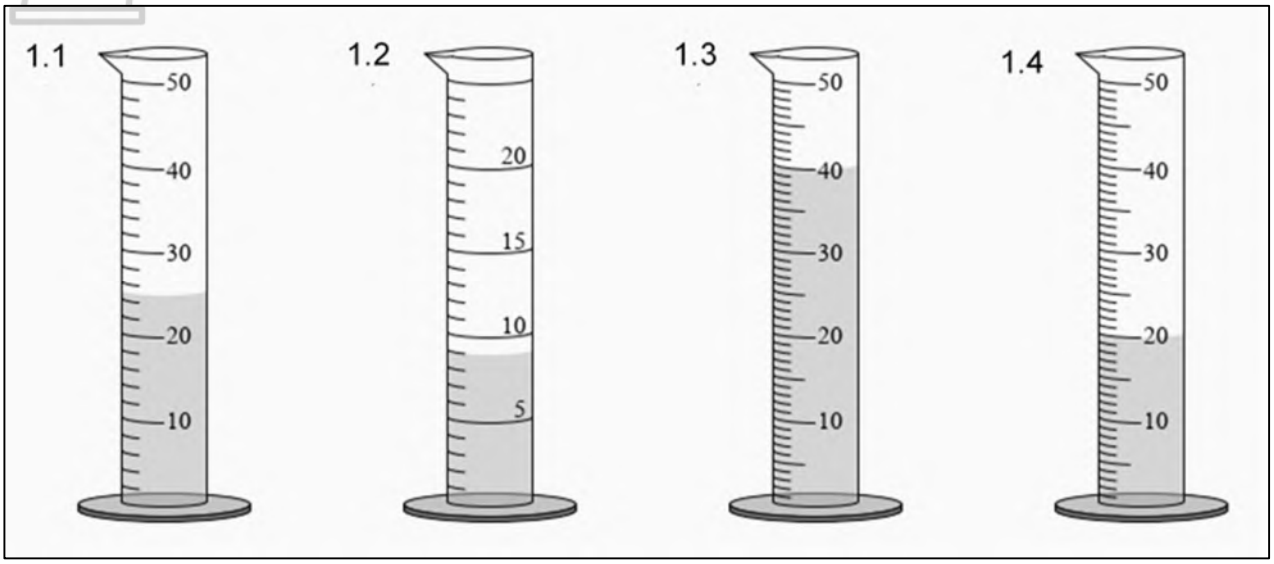
NB: All process skills as well as the scientific method must continually be addressed.

Practising of Process Skills **Informal assessment**

KNOWLEDGE STRAND: Matter and Material **TOPIC: DENSITY**

1. Measure volume:

Measure the volume of the liquid in each measuring cylinder in cm^3.

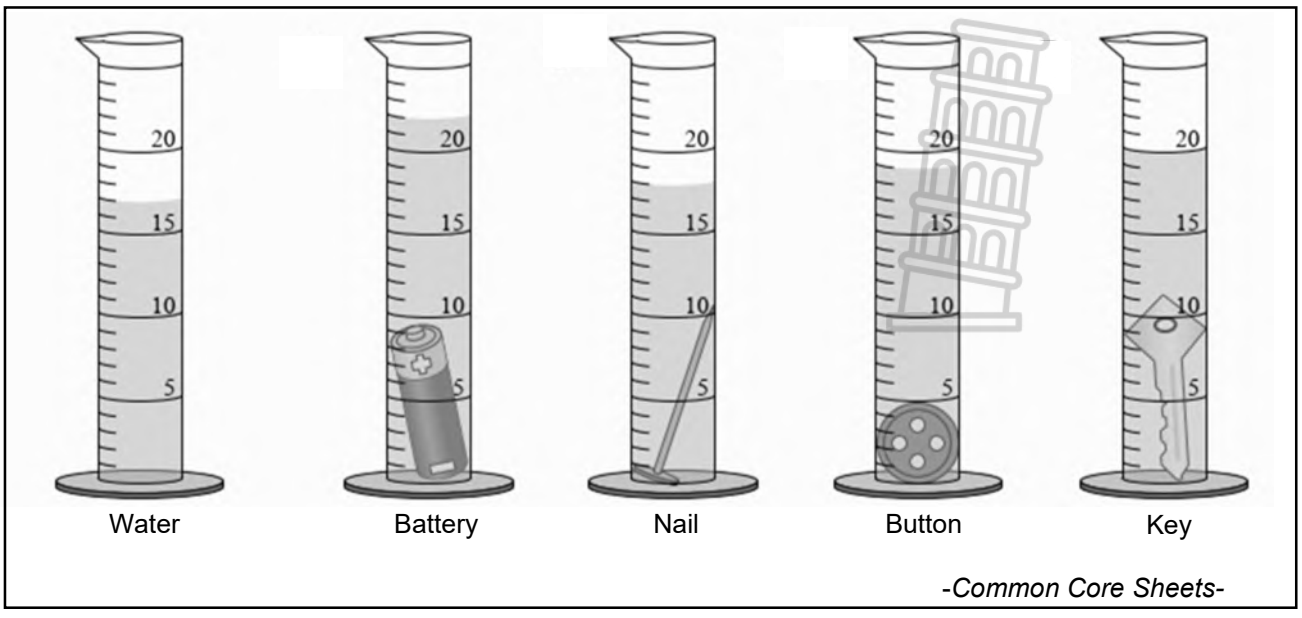


1.1 _____ 1.2 _____

1.3 _____ 1.4 _____ (4)

2. Calculate density (Density = $\frac{mass}{volume}$) of objects that sink in water.

Four different objects were placed, one at a time, in a measuring cylinder filled with water.



-Common Core Sheets-

2.1 Take the volume measurements (in cm^3) in the diagram above. Do the necessary calculations and determine the density of each object. Show all calculations and units.

Object	Volume of water and object	Volume of water only	Volume of object	Mass of object	Density of object
Battery				25,2 g	
Nail				7,9 g	
Button				13,1 g	
Key				26,2 g	

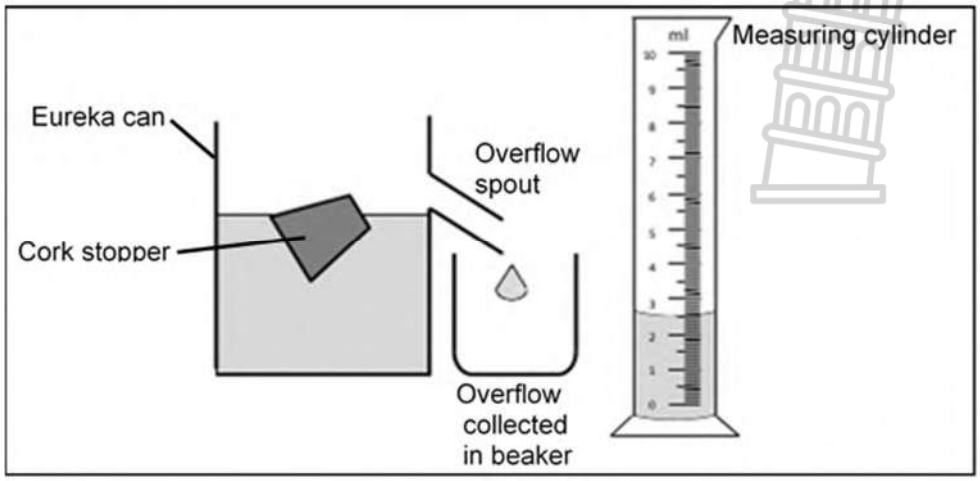
(13)

2.2 The density of water is 1 g/cm^3. Explain why the objects all sink to the bottom. (2)

_____

3. Calculate density of an object that floats on water.

An eureka can is filled with water to just below the overflow spout. A cork stopper is carefully placed in the water. The overflowing water is collected in a beaker and the volume of it is measured in a measuring cylinder.



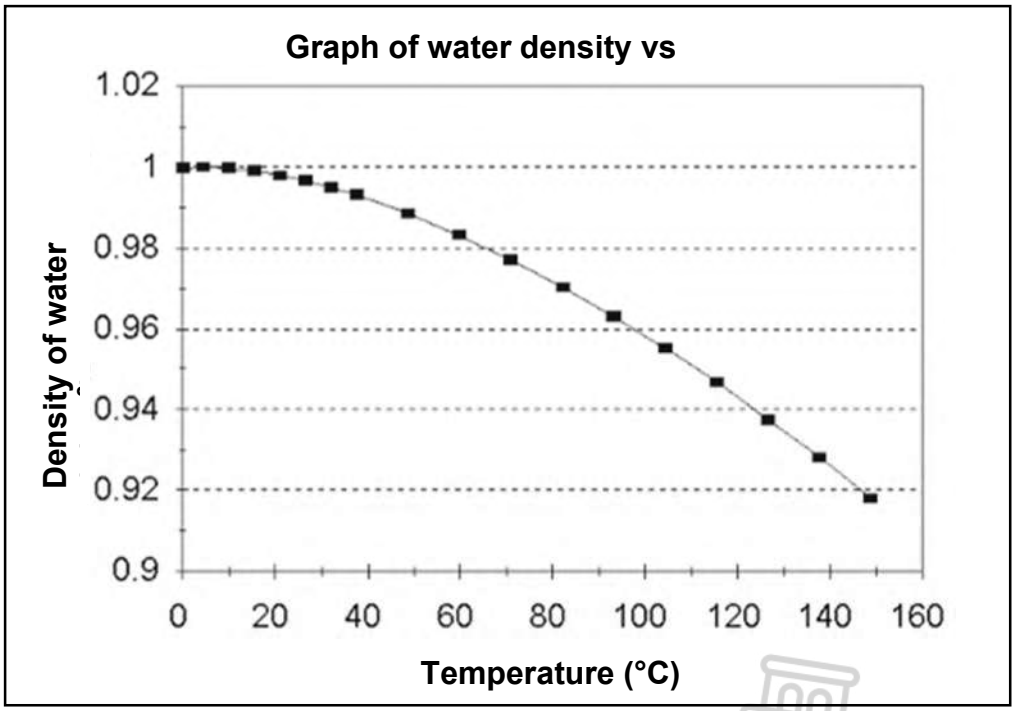
3.1 The mass of the cork stopper is 0,75 g. Determine the volume of the water that was displaced by the cork stopper and calculate the density of cork. (4)

3.2 Water has a density of 1 g/cm^3. Explain why the cork stopper floats on water. (2)

_____

4. Interpreting graphs; investigative question; hypothesis; identifying variables

Study the graph below:



4.1 Formulate an investigative question based on the information in the graph. (2)

_____

4.2 Decide whether the following hypothesis can be ACCEPTED or NOT.

If the temperature of water increases, then the density of the water increases.

_____ _____ (1)

4.3 Read from the graph:

4.3.1 The density of water at 10°C. _____ (1)

4.3.2 The density of water at 82°C. _____ (1)

4.4 REWRITE the hypothesis to be acceptable by changing only ONE word. (1)

_____

4.5 Identify the:

4.5.1 Dependent variable: _____ (1)

4.5.2 Independent variable: _____ (1)

4.6 Describe what happens to each of the following when a substance is heated. Only write INCREASES, DECREASES or REMAINS THE SAME.

4.6.1 The kinetic energy of the particles: _____ (1)

4.6.2 The distance between the particles: _____ (1)

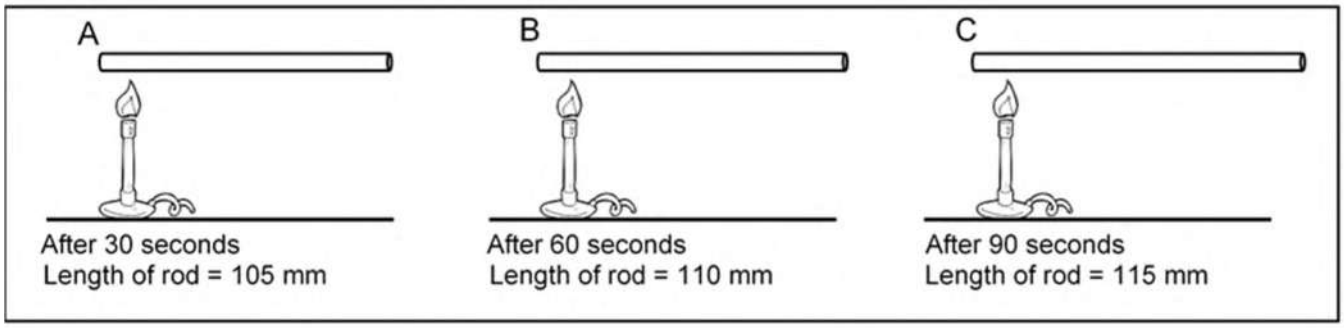
4.6.3 The number of particles: _____ (1)

4.6.4 The volume of the substance: _____ (1)

4.6.5 The density of the substance: _____ (1)

5. **Drawing tables and graphs; identify variables; formulate conclusion

A thin copper rod, 100 mm long, is strongly heated at one end with a bunsen burner. The length of the rod is measured every 30 seconds.



5.1 Identify the independent and dependent variables. (2)

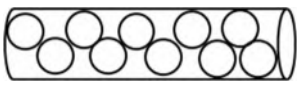
5.2 Draw a table with the following headings and record the results. (7)

Time (s)	Length of rod (mm)	Increase in length of rod (mm)

5.3 Draw a line graph to show the **INCREASE IN THE LENGTH OF THE ROD** versus **TIME**. (Use graph paper if possible.) (8)

5.4 Formulate the conclusion for this investigation. (2)

5.5 COMPARE the arrangement of the copper atoms in rod A with that of rod C. Use a drawing like the one below.



Draw both rods to indicate the differences and label them A and C. (2)

END OF TERM 2

Strand: Energy and Change (Term 3)

Topic: Static electricity

Background knowledge (Gr. 7):

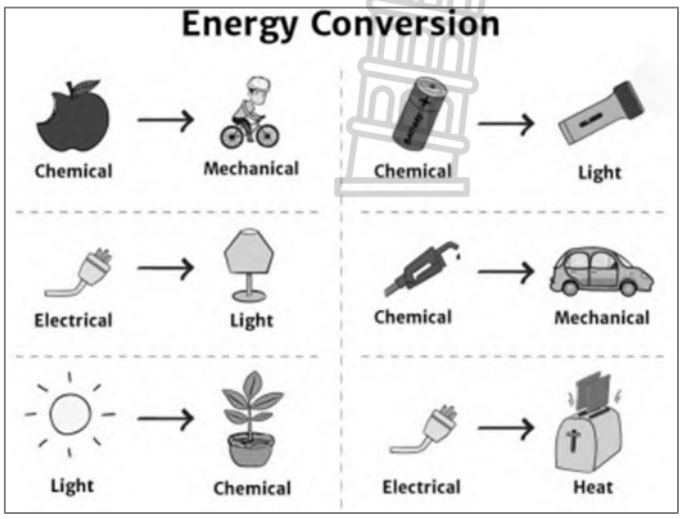
Energy and sources of energy
- Energy is needed to make everything work, move, or live.
- **NON-RENEWABLE SOURCES** of energy cannot be replenished once used, such as fossil fuels (coal, oil, natural gas) and nuclear fuels (such as uranium).
- **RENEWABLE SOURCES** of energy are continually replenished, such as hydro power, wind, sunlight, biofuel (wood).

Potential energy
- Is energy that is stored in a system, such as in a stretched rubber band, a weight balanced on the edge of a table, a cell (battery), fuel, and is also stored in food.
- Energy is measured in a unit called joule (J).

Kinetic energy
- Is the energy that a body has when it is moving, such as when a rubber band snaps back, a weight falls off a table, wind blows, water falls, a vehicle moves, current flows through a circuit.

Potential and kinetic energy in systems
- Potential and kinetic energy are involved in:
  - mechanical systems - a bicycle.
  - thermal (heating) systems – solar panel heating water.
  - electrical systems – wiring of a home or the national electricity grid.
  - biological systems – human nervous system.

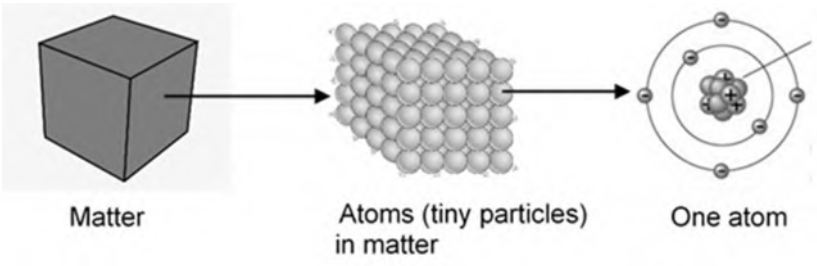
Law of conservation of energy
- Energy can neither be created nor destroyed but can be converted from one form to another.
- Energy can be TRANSFERRED from one object to another.
  - Energy transfer is the movement of energy from one location to another. For example, when electric current (electricity) moves from a wall plug, through a charger, to a battery.
- Energy can be CONVERTED/TRANSFORMED from one form to another.
  - Energy transformation (energy conversion) is when energy changes from one form to another, like in a hydroelectric dam that transforms the kinetic energy of water into electrical energy.



Background Knowle`dge (Gr. 8 Matter and Material):

Atoms, the building blocks of matter

- All matter is made up of tiny particles called atoms.



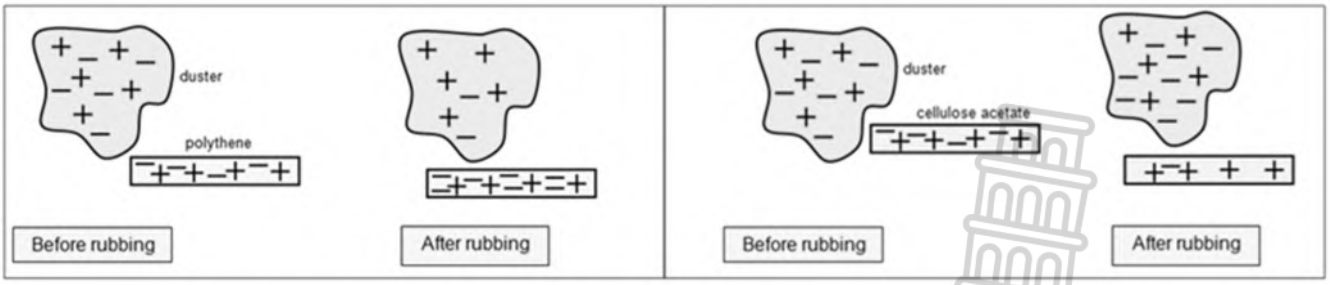
- An element is made up of atoms of the same kind. For example, all the atoms of an element, such as copper, are identical.
- An element is a (pure) substance that cannot be broken down into simpler substances by chemical means.
- An element cannot be changed into another element by means of a chemical reaction.
- Atoms of one element differ from the atoms of all other elements.
- All known elements are listed on the Periodic Table of the Elements.

Grade 8 Content:

STATIC ELECTRICITY

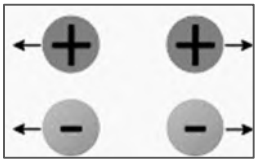
Friction and static electricity

- Friction (rubbing) between certain materials (such as plastic, perspex, glass, nylon, wool, silk) transfers electrons between the atoms of the two materials being rubbed together.
- The electrons move from one material, causing a positive charge on its surface, to the other material, causing a negative charge on the surface of the other material.
- It is only the electrons that are transferred; protons and neutrons do not move.

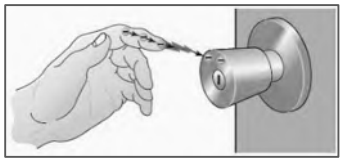


- Objects/materials with opposite/unlike charges ATTRACT each other.

- Objects/materials with same/like charges REPEL each other.



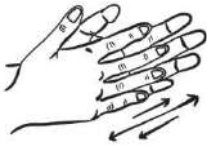
- A discharge of the electrons causes the sparks or shock of static electricity, especially when the air is dry.



***NOTE:* The purpose of the activities in this document is to drill BASIC concepts. Refer to question banks and previous question papers for questions on higher cognitive levels (www.mindstream.co.za)**

INFORMAL ACTIVITY 1 – FRICTION AND STATIC ELECTRICITY

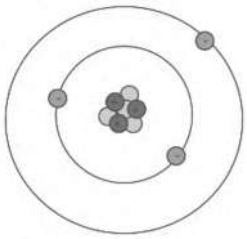
1. You rub your hands together for several seconds as shown in the diagram below.



1.1 What will you feel after a few seconds? (1)

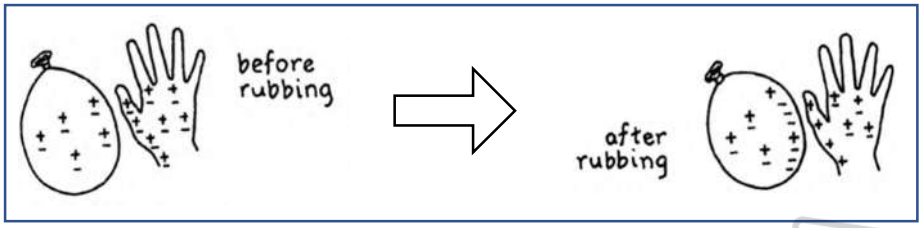
1.2 Explain the sensation you felt (experienced) in question 1.1. (1)

2. Study the model of an atom.



Which particles (protons, neutrons, electrons) can be removed from or added to an atom? Give a reason for your answer. (2)

3. The pictures below show a hand and a balloon BEFORE and AFTER rubbing them together.



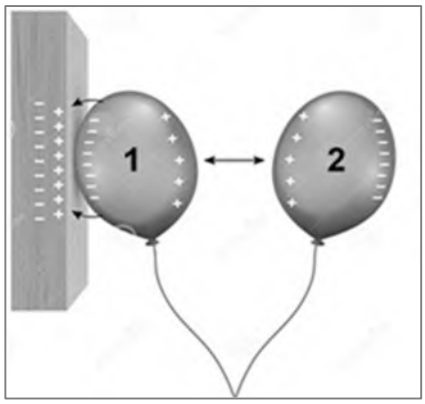
3.1 Use the pictures to complete the table below. Redraw the table in your workbook.

	Number of p^+ on the balloon	Number of e^- on the balloon	Charge of the balloon (+ or - or neutral)	Number of p^+ on the hand	Number of e^- on the hand	Charge of the hand (+ or - or neutral)
BEFORE RUBBING	5	5	neutral			
AFTER RUBBING						

(9)

3.2 Underline the correct word in brackets:
(Electrons / Protons) were transferred FROM the (balloon / hand) TO the (balloon / hand) (over a distance / through friction). (4)

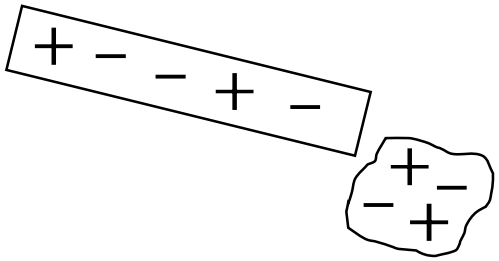
4. In the picture, balloon 1 clings to the wall while balloon 2 remains a distance from balloon 1.



4.1 Explain why balloon 1 clings to the wall. (2)

4.2 Explain why the two balloons remain a certain distance from each other. (1)

5. A plastic ruler is rubbed with a cloth and becomes negatively charged, as shown below. The negatively charged ruler is brought closer to a neutral piece of tissue paper.



5.1 What will happen to the piece of tissue paper when the ruler is brought close enough? (1)

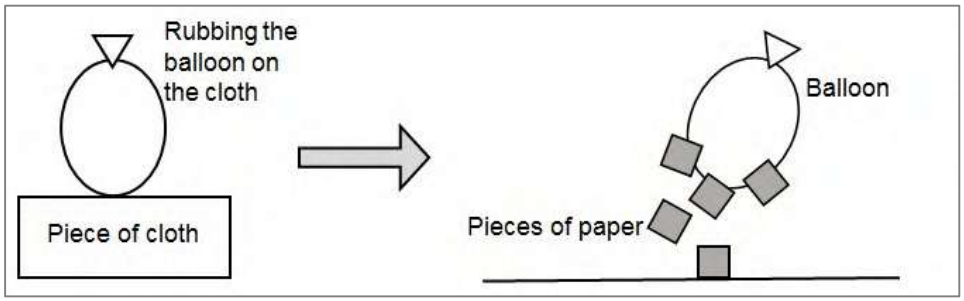
5.2 Redraw the ruler and the piece of cloth. Show how the charges will be REDISTRIBUTED (rearranged) to explain your answer in question 5.1. (3)

6. Explosions have been known to occur at petrol stations when static electricity is discharged when a person handles the nozzle to put petrol in the car.

As the attendant walks up and down, rubbing takes place between the different parts of his clothing, which can cause a build-up of static electricity.

6.1 Explain what is meant by a **discharge** and how this can cause a fire or an explosion. (2)

6.2 Theto wonders which type of material is most suitable for making work uniforms for petrol attendants. He conducts an investigation by rubbing four identical balloons, each with a different piece of cloth. The pieces of cloth are respectively made of cotton, polyester, nylon and silk. He then counts how many pieces of paper each of the charged balloons can pick up.

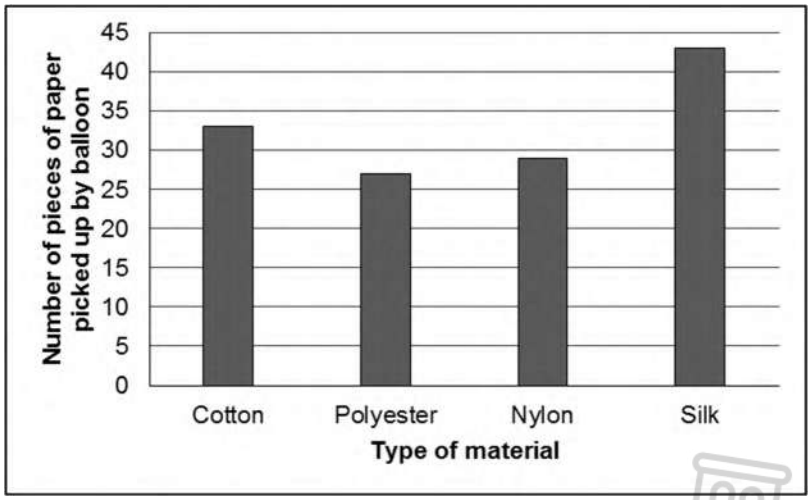


6.2.1 Identify the independent variable for this investigation. (1)

6.2.2 Identify the dependent variable for this investigation. (1)

6.2.3 To ensure that the results of the investigation are reliable, he uses the same type and size of balloon throughout the experiment. Name ONE more controlled variable. (1)

6.3 The following graph represents the results of this investigation.



6.3.1 How many pieces of paper were picked up by the balloon rubbed with nylon? (1)

6.3.2 How many pieces of paper were picked up by the balloon rubbed with cotton? (1)

6.3.3 Which cloth created the highest amount of static electricity? Explain your choice. (2)

6.3.4 Based on the results, which material is the most suitable for making the uniforms for petrol attendants? Explain your choice. (2)
[35]

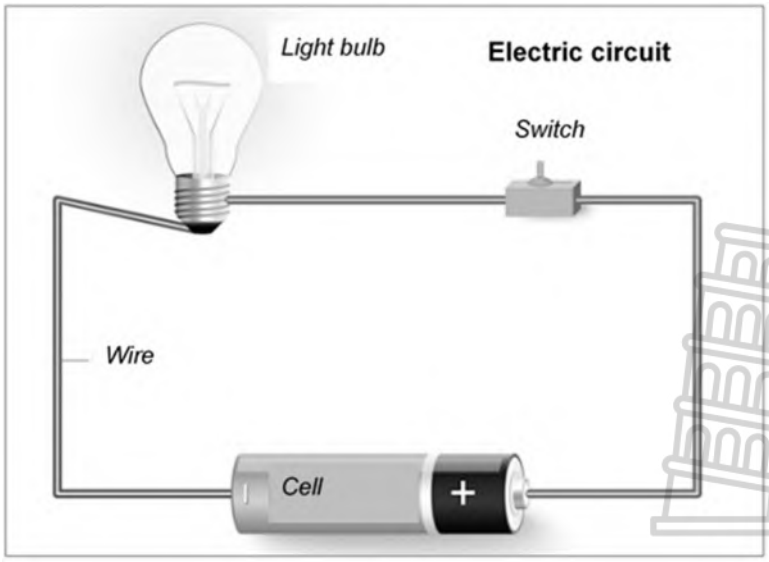
ENERGY TRANSFER IN ELECTRICAL SYSTEMS

Circuits and current electricity

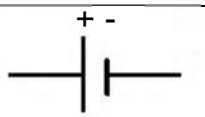
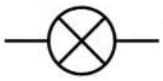
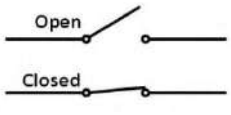
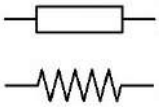
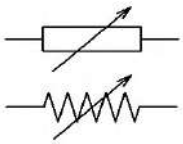
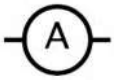
- A circuit is a system for transferring electrical energy.
- A closed circuit is needed to make a device work, such as making a bulb light up.
- A circuit is a complete conducting pathway for electricity and has several components connected together.
- Current flows from one terminal at the source of energy (cell/battery), along conducting material (wires), through the device (bulb, resistor, buzzer), back to the other terminal of the source of energy (cell/battery).

Components of a circuit

- Conducting wires are usually made of metal and carry electricity over a distance.
- Switches provide a convenient way of controlling electrical circuits.
- Cells/batteries are chemical systems that are sources of energy.
- Cells/batteries store chemical substances (potential energy).
- When the circuit is completed, the chemicals react, energy is transferred to the charges and an electric current is produced.
- An electric current is the flow of charge (kinetic energy) along a conductor.
- **RESISTORS** are made of materials that resist/oppose the flow of electrical current in a circuit.
- Resistors control the amount of electric current flowing in a circuit. High resistance, small current; Low resistance, large current.
- Some resistors (including bulb filaments, heating wires, elements in kettles / heaters / geysers / stoves) can heat up to provide useful output energy.
- A **LIGHT BULB** such as a torch bulb, contains a resistance wire called a filament.
  The filament heats up to be white hot when connected in a circuit.
  The resistance wire is connected to two contact points.
  The one end to the screw part (casing) and the other end to the solder knob at the bottom.
  The two contacts are separated by an insulator.

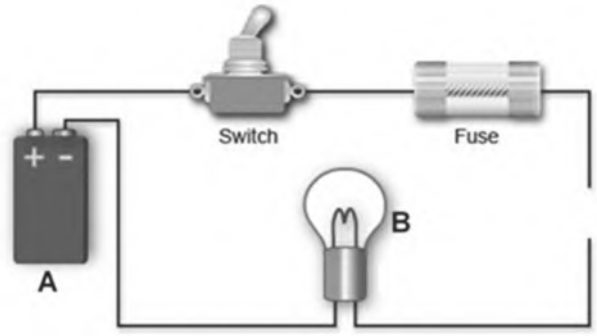


Components of a circuit

COMPONENT	SYMBOL	FUNCTION
Cell		Source of energy. Converts chemical potential energy to electrical energy.
Battery (Two or more cells in series.)		Source of energy. Converts chemical potential energy to electrical energy.
Bulb		Source of light. Converts electrical energy to light (and heat) energy.
Open switch Closed switch		Switches control electrical circuits. **Open switch** breaks the circuit and prevents the flow of current. **Closed switch** completes the circuit and allows the current to flow in the circuit.
Resistor		Resists or opposes the flow of electrical current. Resistors control the amount of electric current flowing in a circuit. Resistors (bulb filaments, heating wires, elements in kettles/heaters/geysers/stoves) converts electrical energy to heat energy.
Variable resistor		A resistor of which the resistance can be adjusted higher or lower to allow less or more current to flow.
Conduction wire		Carries electric current over a distance.
Ammeter		Measures current strength in ampere (A).
Voltmeter		Measures potential difference in volt (V).
Beepers/Buzzers		Converts electrical energy to sound energy.

INFORMAL ACTIVITY 2 – CIRCUITS AND CURRENT ELECTRICITY; COMPONENTS OF A CIRCUIT

1. Study the electric circuit:



1.1 Give the NAME and SYMBOL of component:

1.1.1 A (2)
1.1.2 B (2)

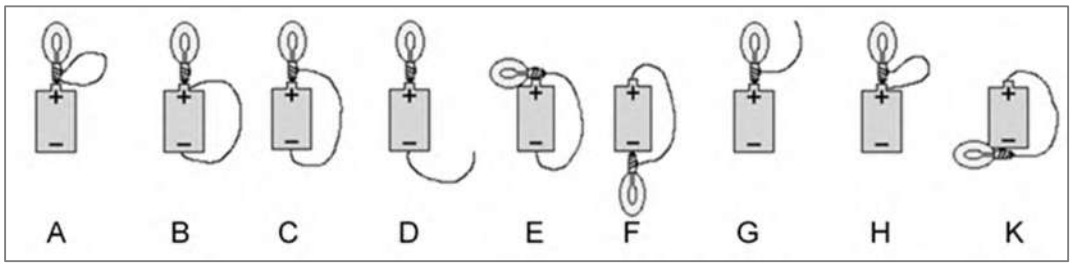
1.2 Give the SYMBOL for:

1.2.1 an open switch. (1)
1.2.2 a closed switch. (1)

1.3 If the switch is closed, will component B glow? Motivate your answer. (2)

1.4 Make TWO suggestions on HOW the problem in question 1.3 can be solved. (2)

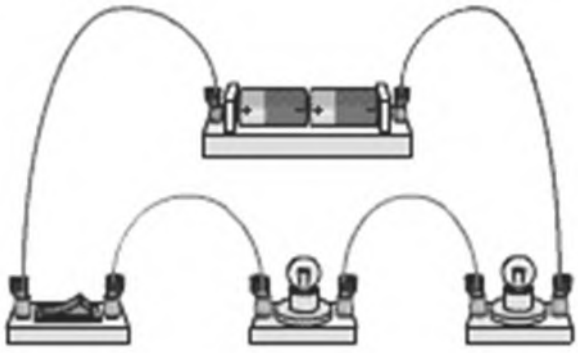
2. The drawings below show SUCCESSFUL and UNSUCCESSFUL attempts of making a bulb glow.



Write down the letters of the SUCCESSFUL attempts in which the bulb will glow. (4)

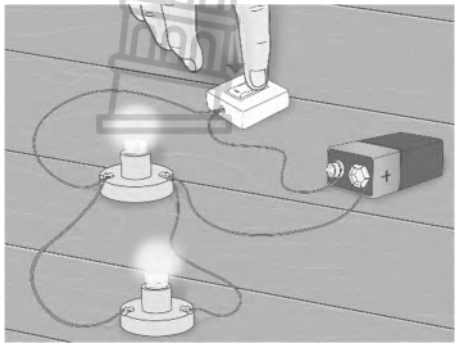
3. Draw in each of the following cases the circuit diagram, using the correct symbols.

3.1



http://resources.schoolscience.co.uk/britishenergy

3.2



https://www.wikihow.com/Make-a-Parallel-Circuit

(2 x 4 = 8)

4.1 Draw a circuit diagram consisting of the following components:

- a battery made up of three cells, connected in series;
- two bulbs connected to one another in parallel;
- one resistor connected in series with the battery;
- an open switch connected in series with the battery and with the resistor. (4)

4.2 What is the function of each of the following in an electrical circuit?

4.2.1 Resistor (1)
4.2.2 Switch (1)

4.3 Give the energy conversion that takes place in a battery when the switch is closed and the current flows through the circuit. (2)
[30]

EFFECTS OF AN ELECTRIC CURRENT

Heating effect:

- A current can heat a resistance wire (such as a bulb filament).
- An electrical current transfers energy to the particles in a bulb filament, producing light that the filament emits.
- Circuits can overheat if a short circuit occurs:
  - FUSES are special wires which break the circuit when they overheat and melt. These are safety devices (inside e.g. a stove) that reduce the danger when using electricity.
  - A SHORT CIRCUIT can occur when an electric current takes the path of lowest resistance, for example when a conductor is connected directly to both terminals of a cell/battery.

Magnetic effect

- A current causes a magnetic field (such as in electromagnets).
- An electric current can be used for making temporary magnets known as electromagnets.
- Moving charges (current) in a conductor (such as a wire), cause a magnetic field around it.

Chemical effect

- An electric current can cause a chemical reaction in a solution.
- This process is called ELECTROLYSIS.
  - Water can be broken down by electrolysis to produce oxygen and hydrogen gas.
  - Copper (II) chloride solution can be broken down to copper metal and chlorine gas. Copper is deposited on one electrode (cathode; negative electrode) and chlorine gas is formed as bubbles at the other electrode (anode; positive electrode).

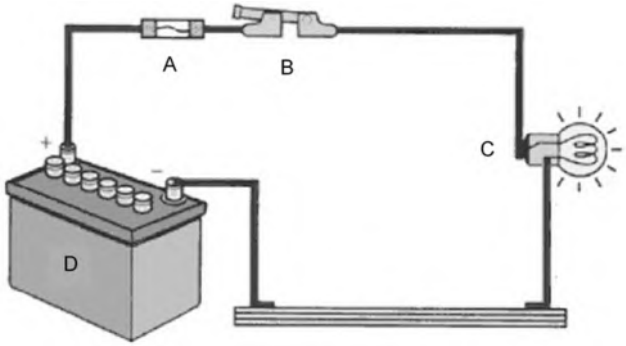
INFORMAL ACTIVITY 3 – EFFECTS OF AN ELECTRIC CURRENT

Heating effect

1. Study each of the appliances below:

1.1 What happens when these appliances are switched on? (1)
1.2 Give the main energy conversion that takes place in the appliances. (2)
1.3 What is the coil of wire that heats up inside these appliances called? (1)

2. A fuse (a thin piece of wire) is connected, together with other components, in a circuit:

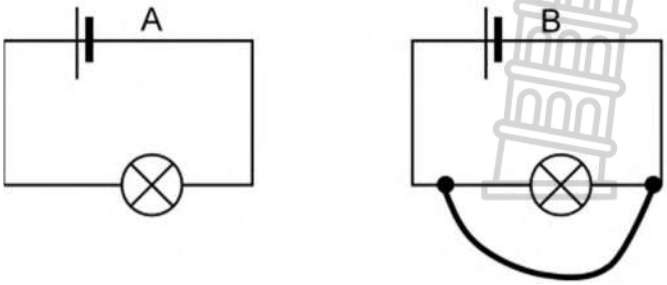


2.1 Identify the following components (only write A, B, C or D):
2.1.1 Battery (1)
2.1.2 Switch (1)
2.1.3 Bulb (1)
2.1.4 Fuse (1)

2.2 What will happen to the fuse if the current flowing through the circuit is too much for the bulb to handle? (1)

2.3 Explain the purpose (function) of a fuse in an electric circuit. (2)

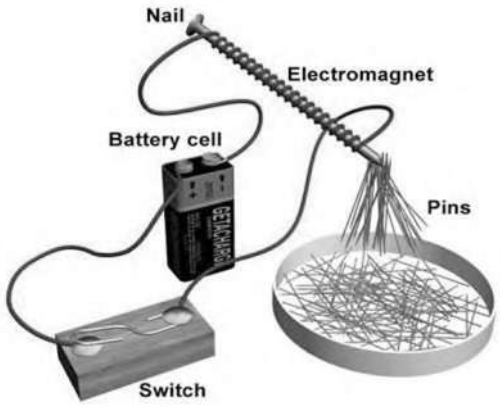
3. Study circuits A and B:



3.1 In which circuit (A or B) does the bulb NOT glow? (1)
3.2 Redraw the diagram mentioned in 3.1 and use coloured arrows to show the path of the flow of current. (1)
3.3 What is the phenomenon in 3.2 called? (1)

Magnetic effect

4. Study the diagram:



4.1 Is the electromagnet a temporary or permanent magnet? (1)
4.2 Is the switch in the diagram open or closed? (1)
4.3 Give a reason for your answer in 4.2. (1)

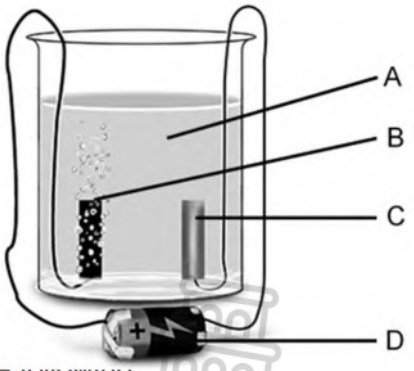
4.4 Use the words in the word bank to complete the paragraph:

headphones	wire turns	magnetic field	current	magnetised

When a **4.4.1** flows in a conductor, a **4.4.2** is produced around it. When an iron nail is put into a current-carrying coil, the nail becomes **4.4.3** and attracts magnetic objects. Electromagnets can be made more powerful by using a stronger current and by increasing the number of **4.4.4** in the coil. Electromagnets are used in loudspeakers, **4.4.5** and in cranes to pick up scrap cars. (5)

Chemical effect

5. Copper chloride is decomposed into two elements in a chemical reaction.



5.1 What is the name of this PROCESS? (1)

5.2 Write a word equation for the chemical reaction taking place. (1)

5.3 Use the labelled diagram to identify each of the following. (Only write A, B, C or D)

5.3.1 The source of electrical energy. (1)
5.3.2 The copper chloride solution. (1)
5.3.3 The negative electrode. (1)
5.3.4 The anode. (1)
5.3.5 The cathode. (1)
5.3.6 Where chlorine gas is formed. (1)
5.3.7 Where copper metal is formed. (1)
5.3.8 The electrolyte. (1)

5.4 How can the chlorine gas be identified? (1)
5.5 How can the copper metal be identified? (1)
5.6 Why will the reaction stop when the torch cell is removed? (1)

[35]

SERIES AND PARALLEL CIRCUITS

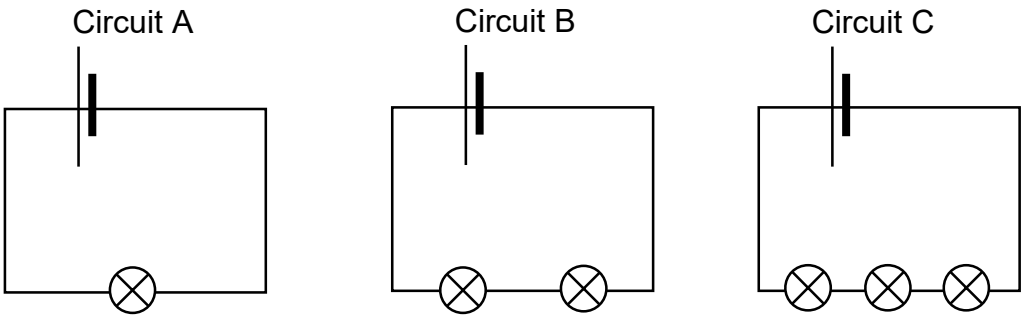
Series circuits
A series circuit provides only one pathway for the current passing through it.
The current is the same everywhere in the circuit but every time a resistor is added in series, the overall current in the circuit decreases (because the total resistance increases).

Parallel circuits
A parallel circuit provides two or more pathways for the current passing through it, but the overall current increases when more resistors are added in parallel (because the total resistance decreases).

Other output devices *(Optional for 2021)*
Other complex circuits are used for output devices such as beepers, buzzers, LEDs (Light Emitting Diodes) or motors.

INFORMAL ACTIVITY 4 – SERIES AND PARALLEL CIRCUITS

1. Study circuits A, B and C below. All cells and bulbs are identical.



1.1 How many bulbs are connected in circuit C? (1)

1.2 Are the bulbs connected in series or parallel? (1)

1.3 Give a reason for your answer in question 1.2. (1)

1.4 Redraw and complete the table of results below:

Circuit	Number of bulbs	Brightness of bulbs
A		
B		
C		

(4)

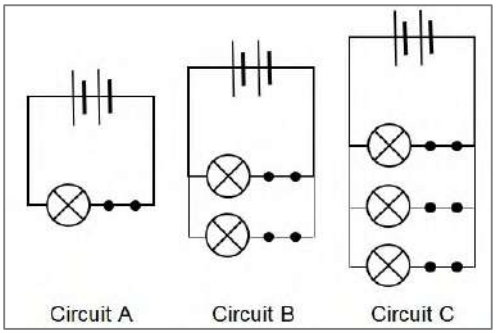
1.5 Formulate an investigative question for this investigation. (2)

1.6 Arrange circuits A, B and C from lowest to highest total resistance. (1)

1.7 Arrange circuits A, B and C from lowest to highest total current. (1)

1.8 Write down a conclusion to indicate the relationship between the number of bulbs in series and the brightness of the bulbs. (2)

2. Study the circuit diagrams below. All cells and bulbs are identical.



2.1 Compare the brightness of the bulbs in circuits A, B and C. (1)

2.2 How many bulbs are connected in circuit C? (1)

2.3 Are the bulbs connected in series or parallel? (1)

2.4 Give a reason for your answer in question 2.3. (1)

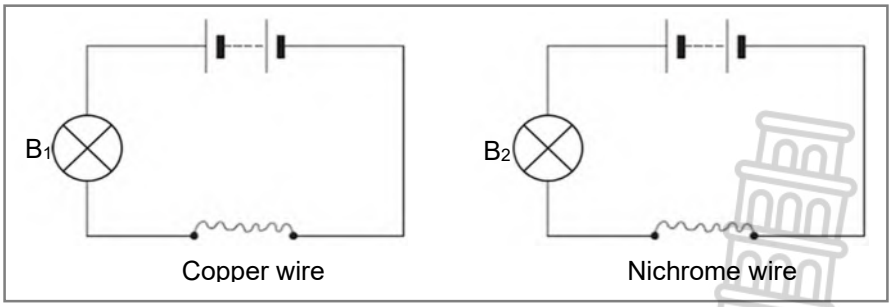
2.5 Arrange circuits A, B and C from lowest to highest total resistance. (1)

2.6 Arrange circuits A, B and C from lowest to highest total current. (1)

2.7 Write down a conclusion to indicate the relationship between the number of bulbs in parallel and the total resistance in the circuit. (2)

2.8 Redraw circuit C in your workbook. Make the necessary change(s) so that only **ONE** of the bulbs will glow. (2)

3. All conductors, like copper wire and nichrome wire have some resistance. Study the circuit diagrams. All bulbs and cells are identical.
Bulb B_1 GLOWS BRIGHTER than bulb B_2.



3.1 Which one of copper OR nichrome, has the highest resistance? Explain your answer. (Refer to resistance, current, brightness.) (4)

3.2 Consider the following variables:
Type of wire; Length and thickness of wire; Brightness of the bulb

Identify the:
3.2.1 Controlled variable. (1)
3.2.2 Dependent variable. (1)
3.2.3 Independent variable. (1)
[30]

VISIBLE LIGHT

Radiation of light
- Light is emitted from luminous objects such as the Sun and light bulbs.
- Light is transferred by radiation.
- Light travels in straight lines.
- Light travels through empty space at a speed of 300 000 kilometres per second (the distance from the Sun to Earth is 150 million kilometres).

Spectrum of visible light
- White light consists of a spectrum (range) of different frequencies and wavelengths: RED, ORANGE, YELLOW, GREEN, BLUE, INDIGO, VIOLET (To remember: **ROYGBIV**)
- All these colours make up the spectrum of visible light.
  [Note: NO further detail on wavelengths and frequencies is required.]
- A rainbow is seen when light falls on water droplets in the air and is refracted and dispersed into the different colours (violet, indigo, blue, green, yellow, orange, red).
- Light on the violet/indigo/blue side of the spectrum has the highest frequency and shortest wavelength.
- Light on the orange/red side of the spectrum has the lowest frequency and longest wavelength.

Opaque and transparent substances
- Light cannot pass through opaque surfaces (such as metal, clay, bricks, wall paint, cardboard), therefore, it is either absorbed or reflected.
- Opaque substances cast shadows on the side facing away from the light source.
- Light passes through transparent substances (such as glass, clear plastic, cellophane, clean water), therefore some of the light is absorbed, some is reflected, but most passes through.

Absorption of light
- Light can be absorbed by surfaces of some materials.
- Light is absorbed differently by different materials.
- A material has colour because it absorbs some of the colours in the spectrum (some of the frequencies) and reflects other colours.
- The frequencies that are absorbed do not reach the eye: a red object reflects the frequencies we see as red and absorbs other frequencies / colours such as violet, indigo, blue, green.
- A **BLACK** object **ABSORBS ALL OF THE FREQUENCIES/COLOURS** and therefore looks black.
- A **WHITE** object **REFLECTS ALL OF THE FREQUENCIES/COLOURS** and therefore looks white.

Reflection of light
- Light is reflected off most surfaces, including mirrors.
- Light can change its direction when it is reflected.
- In reflection, the angle of incidence and the angle of reflection are equal (Law of Reflection).
- The angle of incidence and the angle of reflection are measured from the normal which is a line perpendicular to the surface. *[Actual measurement of angles not included here.]*
- On smooth surfaces, all light is reflected in the same direction.
- On rough surfaces, reflected light is scattered.

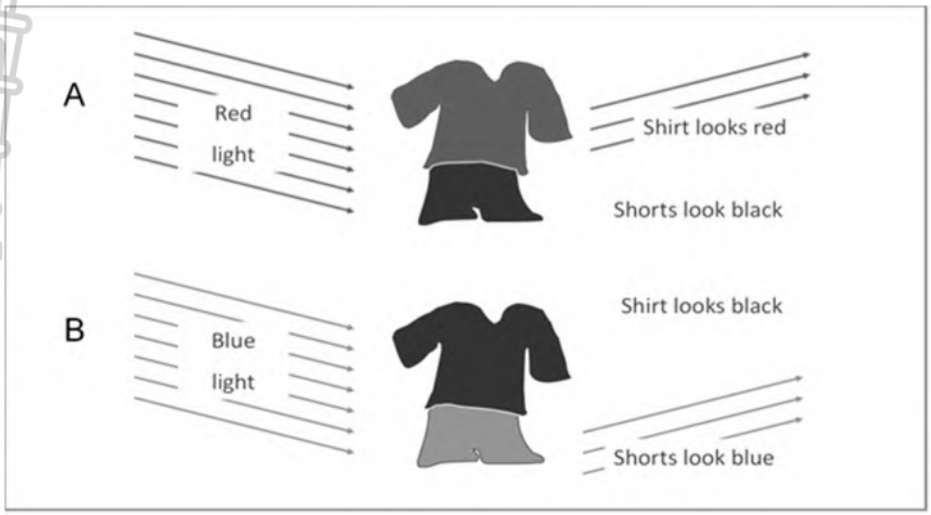
Seeing light
- The frequencies/colours that are reflected enter the eye.
- Specialised receptor cells in the eye's retina are stimulated by specific frequencies/colours.
- In the eye, light energy is converted to electrical nerve impulses.
- Impulses travel to the brain and the brain interprets them as our perceptions of light.
- The frequencies/colours of light that are absorbed by the surface of an object do not reach the eye.

Refraction of light

- Light can be refracted by transparent substances.
- Light can change its direction when it is refracted.
- Light entering a transparent medium (such as glass, water, perspex) at an angle, changes direction TOWARDS the normal in that medium.
- Light travelling out of the medium (back into the air) changes direction AWAY from the normal.
- A triangular prism is able to refract and disperse white light into the colours observed in a rainbow.
- A lens can refract and focus light.

INFORMAL ACTIVITY 5 – SEEING OF LIGHT / COLOUR

1. Study diagram A and B.



In A: Red light shines on a shirt and shorts. The shirt looks red and the shorts black.

In B: Blue light shines on the same shirt and shorts. Now, the shirt looks black and the shorts blue.

1.1 What is the real colour of the shirt? (1)

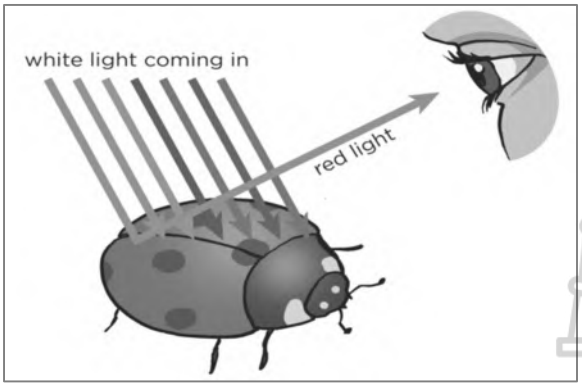
1.2 What is the real colour of the shorts? (1)

1.3 Explain your answer in 1.2. (2)

1.4 What must the colour of the light be to observe the real colours of the shirt and shorts? (1)

1.5 What will the colour of the shirt and shorts be in green light? (1)

2. In the diagram white light is shining on a red lady bird with black spots.



2.1 Explain why we see the red colour of the shell of the ladybird. (2)

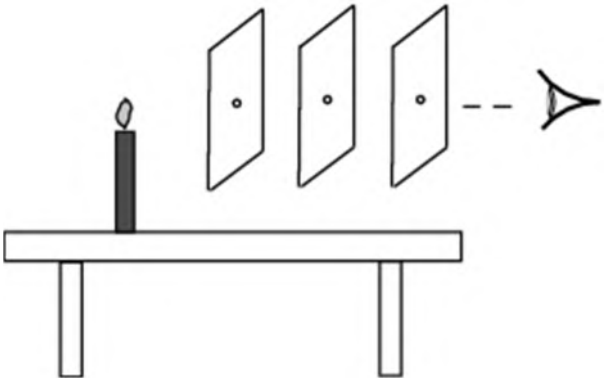
2.2 Explain why the spots appear black. (2)
[10]

INFORMAL ACTIVITY 6 – VISIBLE LIGHT

NOTE: This is a fill-in worksheet to PRACTISE THE DRAWING OF RAY DIAGRAMS. Make copies for learners.

1. Light travels in straight lines

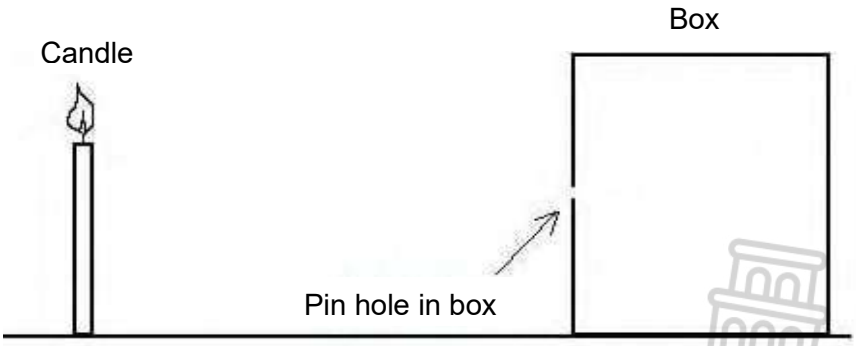
1.1 Draw a ray of light with a ruler and pencil to indicate how the light from the candle reaches the eye. Indicate the direction of the ray of light (always away from the object towards the eye). (2)



(a) Why will the light from the candle NOT be seen if one of the cardboards is shifted slightly to one side? (1)

_____

1.2 Draw two rays of light, one from the top and one from the bottom of the candle, to indicate how the image of the candle is formed inside the box. The rays of light must go through the hole in the side of the box. Indicate the direction of the rays of light. (4)

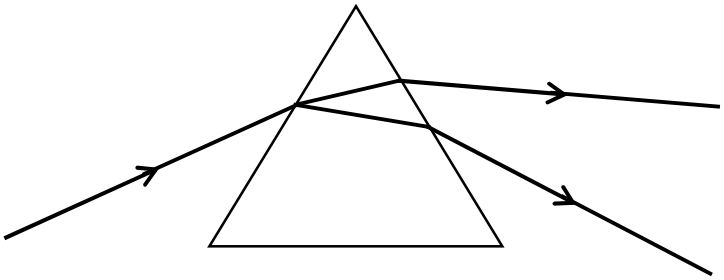


(a) What is a box like the one above, called? _____ (1)

(b) The image of the candle is (upright / upside down), proving that light only moves in _____ lines. (2)

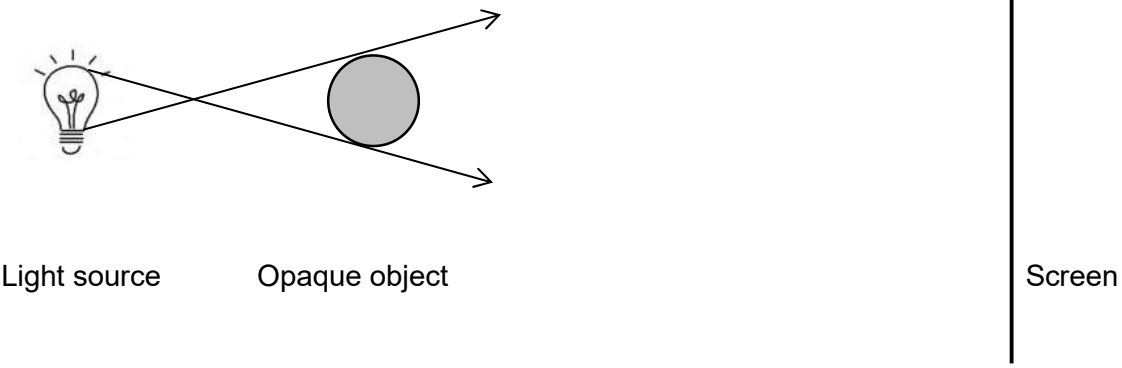
2. Spectrum of visible light

Use a ruler and a pencil (or coloured pencils) to complete the spectrum of white light. Label your drawing using the following words:
Ray of white light, Glass prism, **R**ed, **O**range, **Y**ellow, **G**reen, **B**lue, **I**ndigo, **V**iolet (9)



3. A shadow cast by an opaque object

3.1 **Object is close to the light source:**
Extend the two rays of light to show how the shadow is cast on the screen.
Label the shadow. (2)



3.2 **Object is further away from the light source:**
Draw two rays of light (like in number 3.1) to show how the shadow is cast on the screen.
Label the shadow. (3)

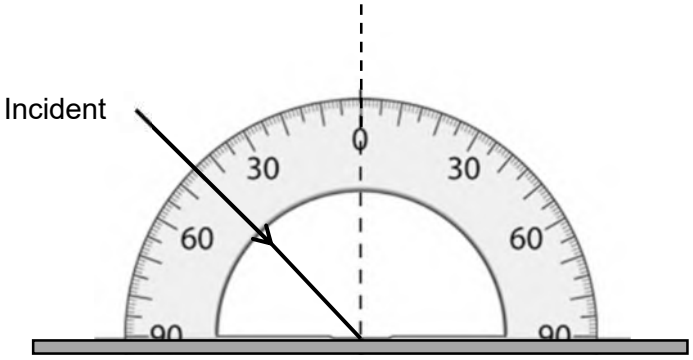
(a) The closer the object is to the light source, the (smaller / bigger) the shadow. (1)

(b) The further away the object is to the light source, the (smaller / bigger) the shadow. (1)

4. Reflection of light

4.1 Reflection of light off a smooth surface like a mirror:

A ray of light falls onto a mirror and is reflected so that the angle of incidence is equal to the angle of reflection. Draw the reflected ray with a ruler and a pencil.



Label the ray diagram, using the following words:
Angle of incidence (i), Normal (n), Angle of reflection (r), Reflected ray (5)

(a) The angle of incidence is the angle between the normal and the incident ray.
What is the size of the angle of incidence? _____ (1)

(b) The angle of reflection is the angle between the normal and the reflected ray.
What is the size of the angle of reflection? _____ (1)

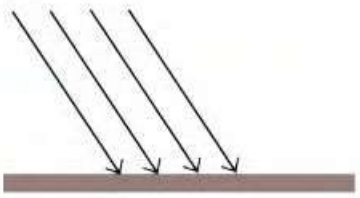
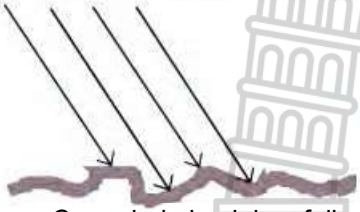
(c) State the Law of Reflection:

_____ (2)

(d) A second ray of light falls onto the mirror at an angle of incidence of 70°.
Use a different colour to draw both the incident ray and the reflected ray on the diagram above, according to the Law of Reflection. (2)

4.2 Reflection of light off a smooth surface compared to the reflection of light off a rough surface:

Complete the ray diagrams to show the reflection of light. (4)

Reflection of light of a smooth surface	Reflection of light of a rough surface
 Mirror	 Crumpled aluminium foil

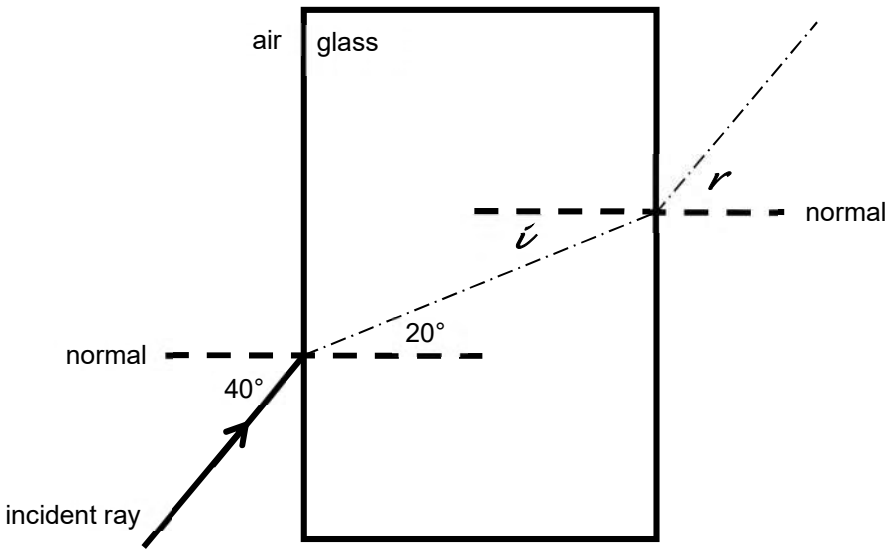
(a) On smooth surfaces, all light is (reflected in the same direction / scattered). (1)

(b) On rough surfaces, light is (reflected in the same direction / scattered). (1)

5. Refraction of light

5.1 Refraction of light through a rectangular glass block.

Use a ruler and a pencil and complete the ray diagram by clearly drawing the refracted ray inside the glass block and the emergent ray leaving the glass block (use the dotted line as a guide). Indicate the direction of the rays of light.
Add the following labels to your ray diagram: refracted ray, emergent ray. (4)



(a) Size of the **second** angle of incidence (*i*) = _____ (1)

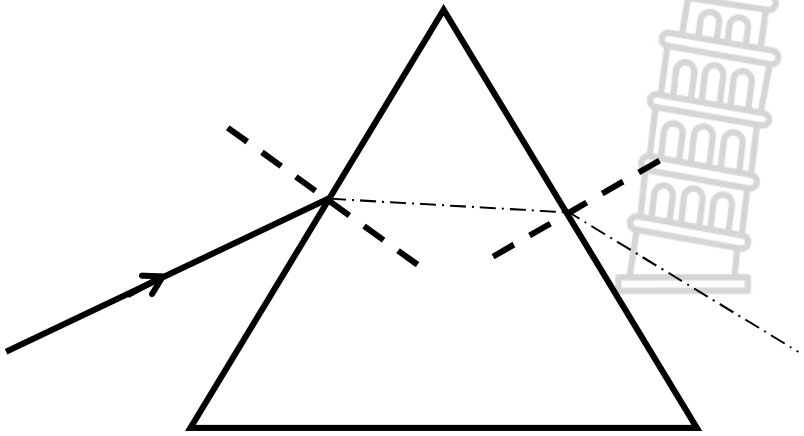
(b) Size of the **second** angle of refraction (*r*) = _____ (1)

(c) When the ray of light enters the glass block, it is refracted (towards / away from) the normal. (1)

(d) When the ray of light leaves the glass block, it is refracted (towards / away from) the normal. (1)

5.2 Refraction of light through a triangular glass prism.

Complete the ray diagram. Use the dotted line as a guide. Indicate the direction of the rays of light. Label the incident ray, normal lines, refracted ray, and emergent ray. (7)



(a) When the ray of light enters the prism, it is refracted _____ the normal,

and when it leaves the glass block, it is refracted _____ from the normal. (2)

[60]

DRAWING SKILLS IN NATURAL SCIENCES

Drawings and diagrams:

Drawings and diagrams are essential in all scientific subjects. A drawing or diagram is not just a picture – it is an easy-to-understand representation of what is seen or observed. For e.g., when a specimen is studied under a microscope, a learner will understand better but what is seen or observed must also be represented in an accurate drawing or diagram for future reference.

Learners should only be able to draw elementary/simple diagrams. **NO** complicated diagrams or drawings like food webs, the heart, the alimentary canal, etc. necessary. Rather provide learners with a copy of complicated diagrams for them to label, not draw.

Guidelines for drawings and diagrams

Drawings and diagrams must:

- have a heading or caption, above or below the diagram (except if the structure must be identified in a question).
- be drawn in pencil (a sharpened pencil for drawing solid and clear lines).
- be labelled in pen.
- be positioned more to left-hand side of the page, so that there is adequate space on the right-hand side for the labels.
- be large enough; at least 50 to 60 mm in length and breadth up to half an A4-page. (All structures in the drawing/diagram should be clearly visible).
- be two-dimensional; three-dimensional drawings NOT necessary.
- only be shaded (coloured in), where really necessary.
- be accurate and precise.

➢ **Circuit diagrams** must be drawn in pencil, using a ruler, with NO gaps between the components.

Label lines must:

- be drawn with a ruler in pencil (not freehand).
- not cross each other.
- just be a LINE, without arrowheads.
- touch the specific part/structure that is labelled.
- be aligned, one beneath the other, on the right-hand side of diagram.
- preferably be on the right-hand side of diagram, except if there are too many labels.
- allow for enough space between lines to fit in the labels and to write legibly.
- be written horizontally (not skew).

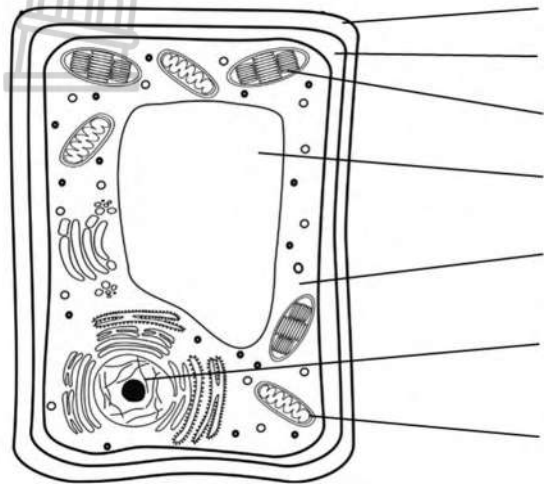
➢ *In a question paper:*

- parts must be labelled with words or LETTERS but NOT numbers.
- letters should be arranged alphabetically and clockwise around the drawing.
- only required parts must be labelled (do not label any part NOT required by the question) unless a learner is asked to choose between two parts.

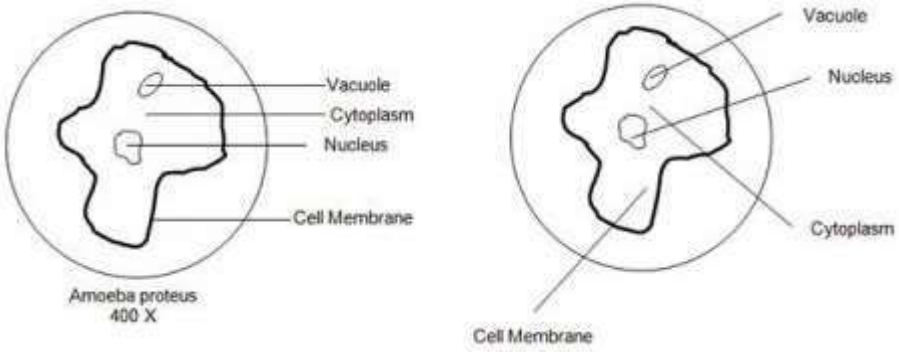
Study the examples:

Drawing/diagram to the left of the page to allow for labels and functions that must be provided.

1. **The plant cell**



2. Correct Incorrect



Criteria for the marking of diagrams:

Criteria	**Marks**
Correct heading / caption	1
Correct part with correct label	1 mark each
Optional:	
Correct diagram	*1*
Labels and label lines clear and neat	*1*

Introduction to graphs.

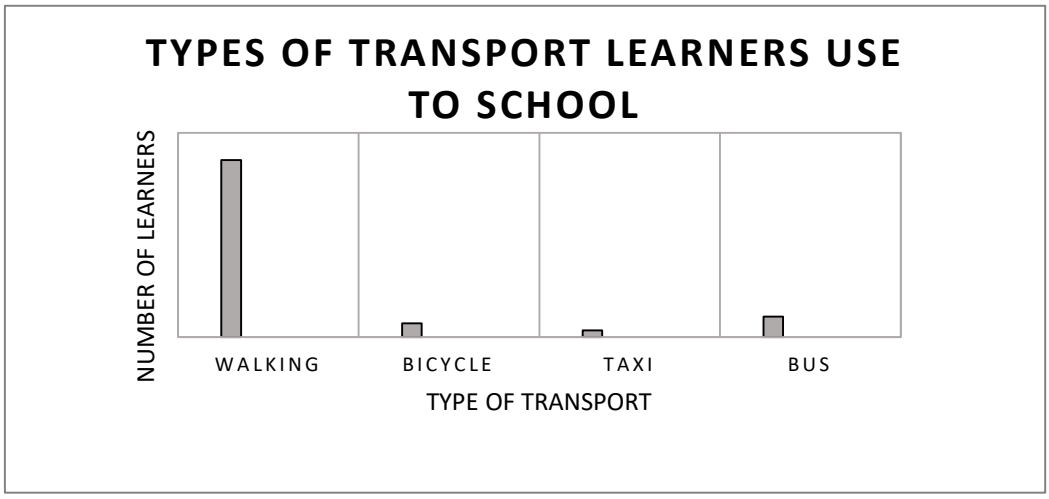
Scientists use different types of graphs to represent their findings in a concise way. Learners (depending on grade/phase) should be able to at least draw a bar, line and/or a pie graph/diagram.

- The **title/heading and labels** of the graph and axes done **in ink** (pen).
- The axes, plotting and line/bars done **in pencil** and drawn with a **ruler.**

Bar graph

A bar graph is a pictorial representation of data (discreet variables) that uses bars to compare different categories of data. Bars do not touch each other, hence there are spaces between bars. Bars can be arranged in any order.

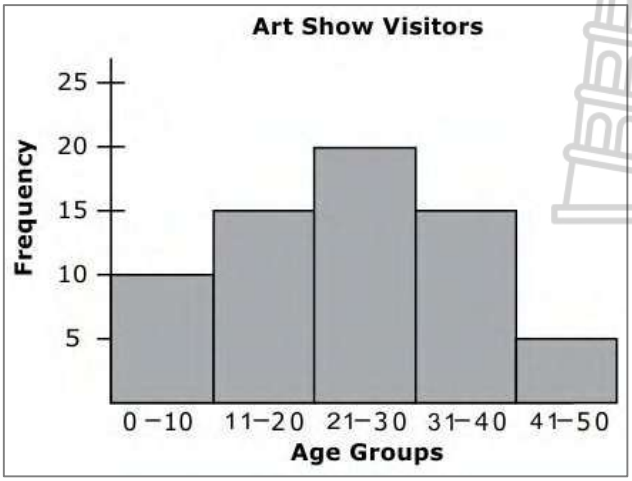
Example:



Histogram

A histogram refers to a graphical representation, that displays data by way of bars to show the frequency of numerical data (non-discreet variables). Bars show data that is related in some way to the other bars. Bars touch each other, hence there are no spaces between bars. The order of the bars cannot be changed.

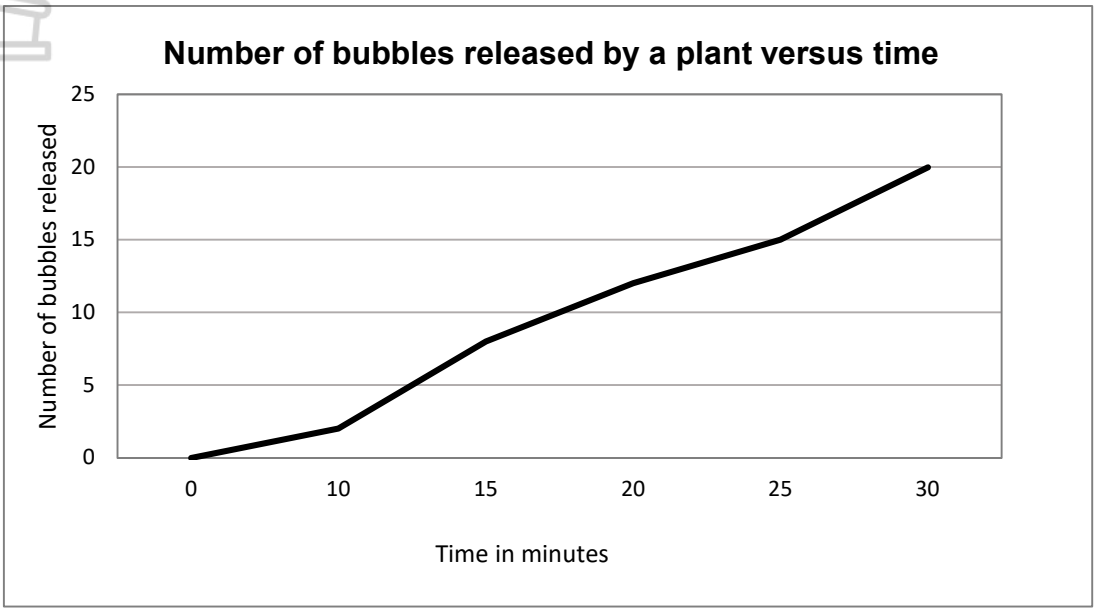
Example:



Line graph

This graph is used when the relationship between the independent and dependent variables are represented in a continuous way (line).
The independent variable (x-axis) is the variable the scientist controls. The dependant variable (y-axis) is the evidence collected by the scientist (result/outcome).

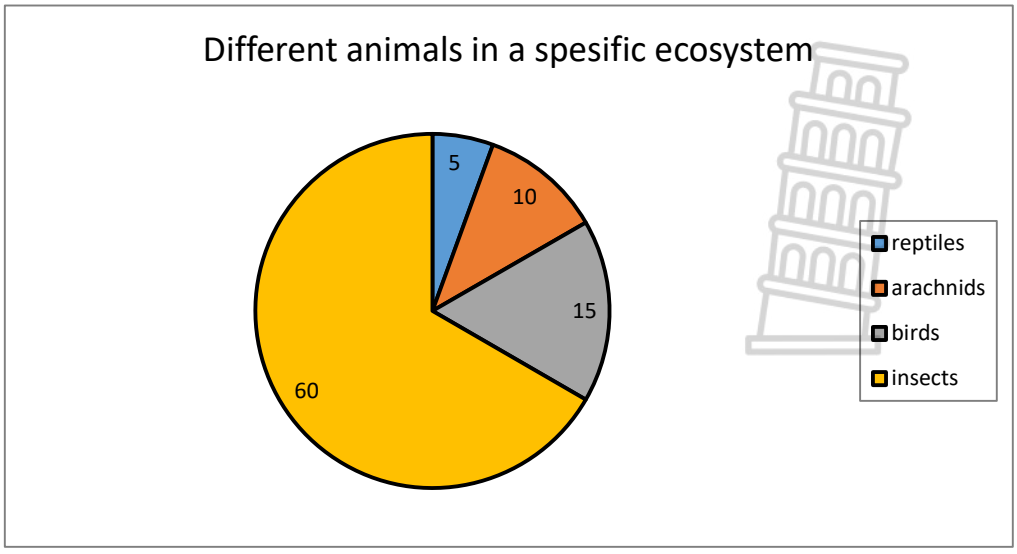
Example:



Pie chart

A pie chart shows data as a percentage or as a relative proportion of the total of the circle. This is a circle divided into sectors (think of a pizza / pie). The complete circle should represent 100% of what it represents.

Example:



Criteria for the marking of a graph

Criteria	Marks
Title/heading of graph containing BOTH variables	1
Type of graph	1
Title/label and scale on x-axis	1
Title/label and scale on y-axis	1
Plotting of half of the points / bars correctly	1
Plotting of other half of the points / bars correctly	1
TOTAL MARK	**6**

NOTE:
Correct **measuring units** must also be indicated on the x- and/or y-axis where applicable e.g., Time (s), Length (m), etc.