

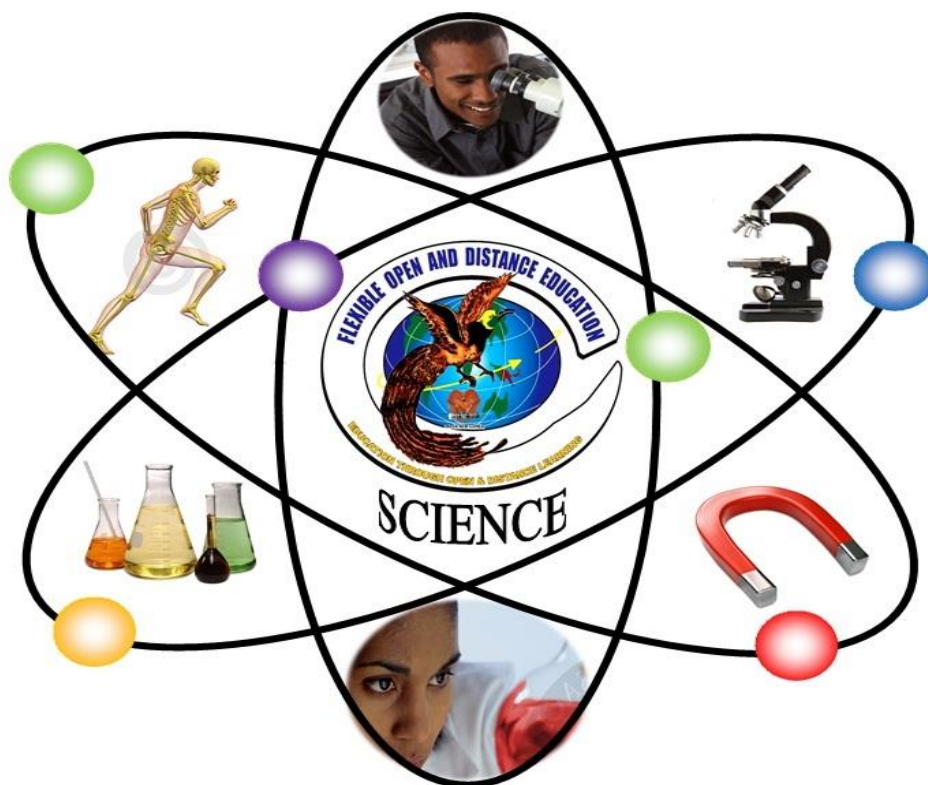


DEPARTMENT OF EDUCATION

GRADE 7

SCIENCE

STRAND 2



LIVING THINGS



FLEXIBLE OPEN AND DISTANCE EDUCATION
PRIVATE MAIL BAG, P.O. WAIGANI, NCD
FOR DEPARTMENT OF EDUCATION
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SCIENCE

GRADE 7

STRAND 2

LIVING THINGS

SUB STRAND 1:	PLANTS AND ANIMALS
SUB STRAND 2:	CLASSIFICATION OF PLANTS AND INVERTEBRATES
SUB STRAND 3:	CLASSIFICATION OF VERTEBRATES
SUB STRAND 4:	RESPIRATION AND BREATHING IN LIVING ORGANISMS
SUB STRAND 5:	PLANT AND ANIMAL NUTRITION
SUB STRAND 6:	BALANCE OF NATURE IN LIVING ORGANISMS

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We acknowledge the contributions of all secondary teachers who in one way or another have helped to develop this Course.

Our profound gratitude goes to the former Principal of FODE, Mr. Demas Tongogo for leading FODE team towards this great achievement.

Special thanks to the staff of the Science Department of FODE who played active roles in coordinating writing workshops, outsourcing lesson writing and the editing processes involving selected teachers of Central Province and NCD.

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DIANA TEIT AKIS

PRINCIPAL



Flexible Open and Distance Education
Papua New Guinea

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SECRETARY'S MESSAGE

Achieving a better future by individual students and their families, communities or the nation as a whole, depends on the kind of curriculum and the way it is delivered.

This course is part and parcel of the new reformed curriculum. The learning outcomes are student-centred with demonstrations and activities that can be assessed.

It maintains the rationale, goals, aims and principles of the national curriculum and identifies the knowledge, skills, attitudes and values that students should achieve.

This is a provision by Flexible, Open and Distance Education as an alternative pathway of formal education.

The course promotes Papua New Guinea values and beliefs which are found in our Constitution and Government Policies. It is developed in line with the National Education Plans and addresses an increase in the number of school leavers as a result of lack of access to secondary and higher educational institutions.

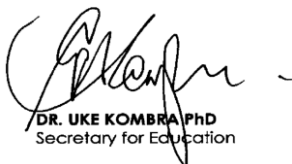
Flexible, Open and Distance Education curriculum is guided by the Department of Education's Mission which is fivefold:

- to facilitate and promote the integral development of every individual
- to develop and encourage an education system that satisfies the requirements of Papua New Guinea and its people
- to establish, preserve and improve standards of education throughout Papua New Guinea
- to make the benefits of such education available as widely as possible to all of the people
- to make the education accessible to the poor and physically, mentally and socially handicapped as well as to those who are educationally disadvantaged.

The college is enhanced through this course to provide alternative and comparable pathways for students and adults to complete their education through a one system, two pathways and same outcomes.

It is our vision that Papua New Guineans' harness all appropriate and affordable technologies to pursue this program.

I commend all the teachers, curriculum writers and instructional designers who have contributed towards the development of this course.



DR. UKE KOMBRA PhD
Secretary for Education

STRAND 2: INTRODUCTION



Dear Student,

Welcome to Strand 2 of your Grade 7 Science Course! I hope you have enjoyed studying the earlier Strand. I hope this Strand, on Living Things, will be interesting and enjoyable to study.

The strand comprises of 25 lessons divided into six sub-strands.

Sub-strand 1; **Plants and Animals**, classifies living things from non-living things and discusses their importance in the environment. It also looks at the differences between plants and animals and their characteristics that enable them to survive in their environment.

Sub-strand 2; **Classification of Plants and Invertebrates** studies and classifies plants and animals without backbone. These organisms are grouped and named according to their structure.

Sub-strand 3, **Classification of Vertebrates**, sorts vertebrates or animals with backbones and skeletons inside their body. This sub-strand describes the characteristics of the five groups of vertebrate animals – fish, amphibians, reptiles, birds and mammals.

Sub-strand 4, **Respiration and Breathing in Living Organisms**, explains how oxygen is used by plants and animals.

Sub-strand 5, **Plant and Animal Nutrition**, is about the study of food and how they are obtained and used in the body of organisms.

Sub-strand 6, **The Balance of Nature in Living Organisms**, lays out the role each organism plays in the environment and how each living thing contributes in maintaining the balance in nature.

Remember, you have to do all the activities and carry out the Practice Exercises after each lesson. Answers to Practice Exercises are at the end of each Sub strand.

.

You may study this strand now following the Study Guide on the next page.

All the Best!

STUDY GUIDE

Follow the steps given below as you work through the lessons.

- Step 1:** Start with Sub-strand 1, Lesson 1 and work through it.
- Step 2:** When you complete Lesson 1, do Practice Exercise 1.
- Step 3:** After you have completed Practice Exercise, check your work by looking at the answers provided at the end of each Sub-strand.
- Step 4:** Then, revise well and correct your mistake, if there is any.
- Step 5:** When you have completed all these steps, tick the check-box for Lesson 1 on the Contents page as shown below:

☒ Lesson 1: Living Things and Non-living Things

Go to the next lessons carefully repeating the steps given above until you complete all the lessons in Sub-strand 1.

As you complete each lesson, don't forget to tick the corresponding box for that lesson on the Contents page, like this ☒. This will help you to check on your progress.

Assignments: Sub strand tests and Strand test

- Step 6:** Revise Sub-strand 1 and do the Sub-strand Test in your Assignment book.

Go to the next Sub-strand repeating the same steps until you complete all the four Sub-strands in Strand 2.

The Assignment book contains four Sub-strand Tests and a Strand Test. Each Sub-strand Test is done after you complete all the lessons in each Sub-strand. The strand book tells you when to do each Sub-strand test.

The Strand Test is done after you have completed all the four Sub-strand Tests and have revised well. The Assignment book tells you when to do the Strand Test.

When you have completed the entire Assignment Book, check and revise well before sending it to the Provincial Centre.

If you have any questions, write them on the Student's page. Your teachers will advice you when he/she returns your marked Assignment.

The Sub-strand Tests and the Strand Test in the Assignment will be marked by your Distance Teacher. The marks you score in each assignment will count towards your final mark. If you score less than 50%, you will repeat the Assignment.

Remember, if you score less than 50% in three Assignments, your enrolment will be cancelled. So work carefully and make sure that you pass all the Assignments.

SUB STRAND 1

PLANTS AND ANIMALS

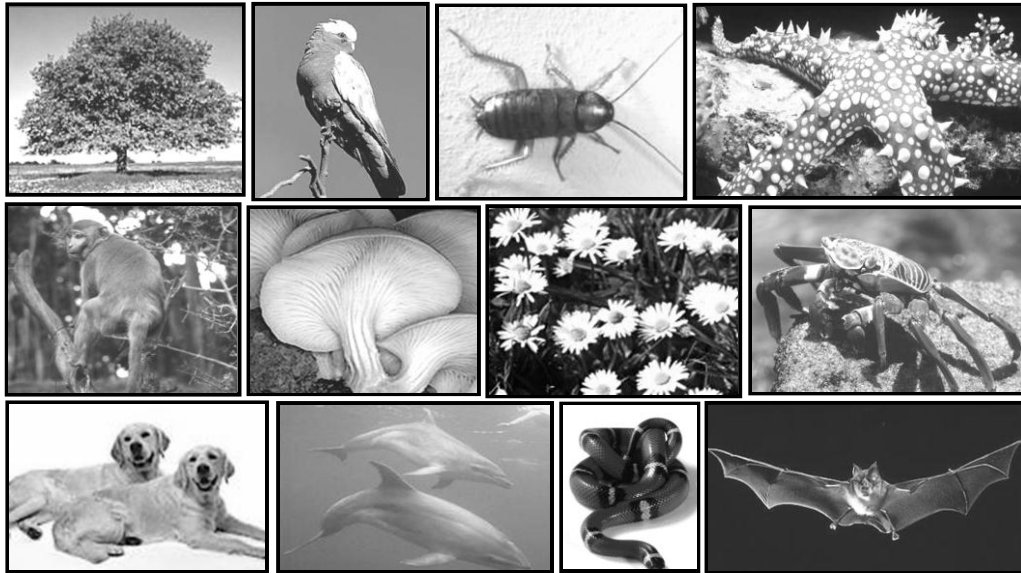
In this sub strand you will learn about:

- **living and non-living things**
- **characteristics of living things**
- **functions of body coverings**
- **sense organs of animals**
- **plant responses**

SUB STRAND 1: PLANTS AND ANIMALS

Introduction

In this sub-strand we will be looking at ways in which living things and non-living things can be grouped. You will also learn about the importance of non-living things and how they help us stay alive. You will then look at the differences between plants and animals.



In this sub-strand you will have the chance or opportunity to:

- Find out about the structure or what makes up the living things and how this helps them live in their environment.
- Compare the structure of the cells or little parts that make up the plants and animals.
- Tell or describe the body coverings of animals and explain how these coverings help the animals live in their environment.
- Find out how plants and animals respond to certain things or stimuli.

In this Sub-strand you will find the answers to these questions and all others relating to plants and animals.

Lesson 1: Living and Non-Living Things



Welcome to Lesson 1 of Strand 2. In this lesson you will learn about Living and Non-living things. Looking around you. Can you see houses, kunai roofs, flowers, trees and grasses? We made them from the bush materials around us and these things cannot grow anymore. Most of the materials used are taken from the environment made from imported materials.

Living things are trees, birds, grass, cats and dogs grow and make their young. There are many more living things but we cannot see them with our naked eyes.



Your Aims:

- tell living things from non-living things and by giving examples
- study the cell structure or what makes the living things
- name some parts of the cell and tell us what they do

Non-Living Things

Everything that is around you is your environment. If you look around, some things in your environment are not alive. They do not breathe, eat food, move, grow or reproduce. These are non – living things. These include water, soil, stones, rocks, and other things that cannot breath, move or talk.

There are also other non-living things that you cannot see but make up your environment. These include sunlight, heat from the sun, the wind and gravity or pressure or what make things fall.



Activity 1: Now test yourself by doing this activity.

Importance of non-living things

1. Name the non-living things that are around you right now.
2. Write the non-living things in the first column and the kind of work they do in the second column

Non-living thing	Work they do
a. _____	_____
b. _____	_____
c. _____	_____
d. _____	_____
e. _____	_____
f. _____	_____

Living things

Some things in your environment grow, and reproduce. Living things include plants, animals, and fungi which can be seen. Other living things that are very small and cannot be seen with our naked eyes are bacteria.

Living things are different in body shapes, sizes, or whether they are male or female. Most of these living things live on land and water while some live in trees and plants.



Activity 2: Now test yourself by doing this activity.

1. Identify and name as many living things as you can and describe whether they live on land, in water or in trees.
2. Write the name of living things in the first column and describe it where it lives in the second column.

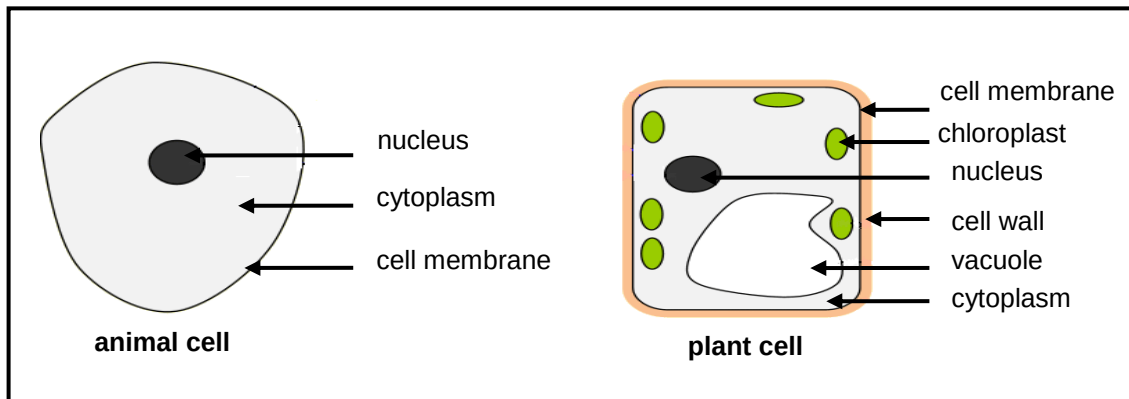
Living thing	Description	Living thing	Description
a. _____	_____	g. _____	_____
b. _____	_____	h. _____	_____
c. _____	_____	i. _____	_____
d. _____	_____	j. _____	_____
e. _____	_____	k. _____	_____
f. _____	_____	l. _____	_____

Living things are made of cells

Every living thing - maybe an insect, a pig or a standing tree - is made up of tiny building blocks called **cells**. The cells are so small that they can only be seen with the use of a microscope. Microscope is a machine used to look at very tiny things. Some microscopic organisms, such as bacteria, are made up of a single cell, but animals and plants are made of many millions of cells.

Cells come in different shapes for different jobs or functions. In our bodies for example we have muscles made of muscle cells, which are long and thin like hairs. We have skin cells shaped like flat paving stones, which protect our body surface. There are about 200 different kinds of cells in the body, each with a specialized design for its task. Despite their differences in size, shape and function, cells work together to allow the organism to survive. Each cell part plays

Below is a simple diagram showing the main parts of an animal and a plant cell.



Summary

You have come to the end of the lesson 1. In this lesson you have learnt that:

- living things grow, develop and reproduce. They are made of tiny building blocks called cells.
- living things include plants, animals and microscopic organisms that live on land. They are called terrestrial organisms while aquatic organisms live in or upon the water. Arboreal organisms are adapted to living on trees like birds.
- non-living things are not made of cells. They do not grow, develop or reproduce.
- cells are made up of even smaller structures called organelles.
- all cells have a cell membrane, cytoplasm, nucleus, and vacuole. Plant cells however have some extra structures.

NOW DO PRACTICE EXERCISE 1 ON THE NEXT PAGE.

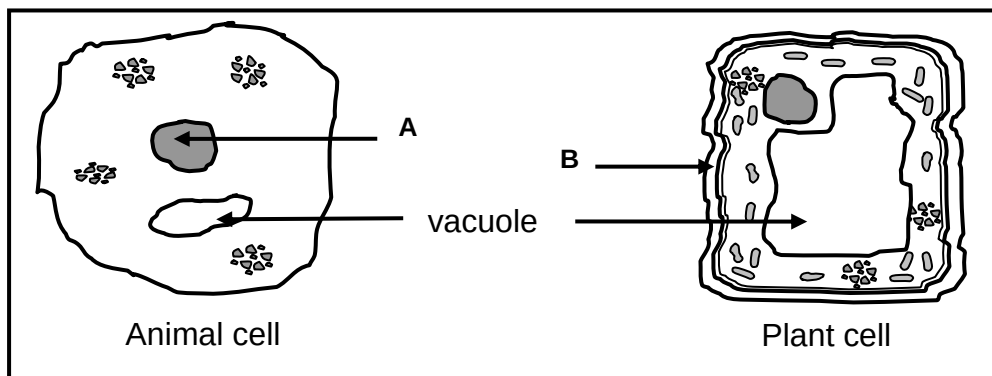


Practice Exercise 1

Part A. Multiple Choice

- Which of the following structures is the control centre of the cell?
 - Vacuole
 - Nucleus
 - Cytoplasm
 - Mitochondrion
- Living things that live on land are _____.
 - aerial
 - aquatic
 - arboreal
 - terrestrial
- Which one does not clearly describe living things?
 - All living things can move.
 - All living things reproduce.
 - Living things are made of cells.
 - Living things grow and develop.

Part B. Structural Questions



- Name the structures labeled **A** and **B**.
A _____ B _____
- How does the vacuoles in a plant cell differ from the vacuole in an animal cell?

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Suggested answers**Activity 1**

Non-living thing		Importance
a.	water	for drinking/cooking
b.	soil	for plants to anchor and develop
c.	stones	for building
d.	sunlight	provides heat and energy
e.	dried timber	material for making furniture and building houses
f.	wind	needed by birds for flight and by men in sailing
g.	paper	for writing and publication
h.	car	for transport

Activity 2

Living thing		Description	Living thing		Description
a.	tree	land	g.	flowers	land
b.	bird/eagle	tree	h.	crab	water
c.	cockroach	land	i.	dogs	land
d.	starfish	water	j.	dolphins	water
e.	monkey	tree	k.	snake	land/tree
f.	mushrooms	land	l.	bat	land/tree

Lesson 2: Characteristics of Living Things



Welcome to Lesson 2 of Strand 2. In the last lesson you learnt about living and non-living things. In this lesson you will learn the characteristics of living things. Living things include plants, animals, fungi and other microscopic organisms. Even if living things differ where they live, body shapes, sizes and internal organs, they all have seven common characteristics.

These common things can be used to identify the differences between living organisms and non-living objects.



Your Aims:

- identify the main common characteristics of living things
- define the different processes that characterise organisms
- tell the difference between plants and animals

Characteristics Of Living Things

In most animals, the characteristics show that they are alive. They move, feed, give birth, and respond to changes in their environment. These characteristics are not easily shown in plants and **microscopic organisms**. Microscopic organisms are very tiny living thing that can only be seen with a microscope. Scientist use microscope to test dirty water or still water to see if there are small organisms living in the water.

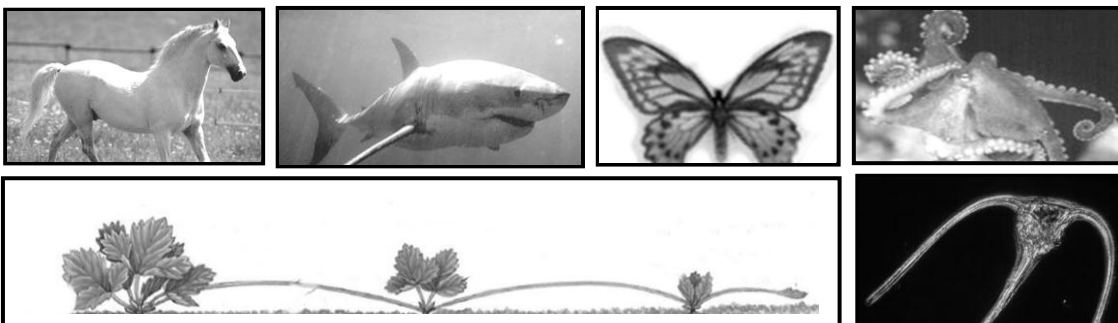
Plants and micro-organisms nevertheless are living things because they also possess the following living characteristics even if it does not show.

1. Movement

All organisms move from one point to another. Animals have developed all forms of specialized body features that enable them to move.

Although plants are rooted to the ground, they still move. Their movement however is restricted to certain parts like the opening and closing of petals and leaves in response to light or touch, or the movement of parts as a result of growth.

Microscopic organisms developed some tiny features that help them to move.



The pictures above show some features like legs (horse), fins and tail (shark), wings (butterfly), tentacles (octopus), runners (strawberry) and microscopic whip-like structures (microscopic animal) that allow movement in organisms.



Activity 1: Now test yourself by doing this activity.

Name the organ for movement used by each of the following organisms.

Living thing	Structure used For movement	Living thing	Structure used For movement
a. grasshopper	_____	f. shy grass/mimosa	_____
b. pumpkin	_____	g. bat	_____
c. whale	_____	h. grass	_____
d. crabs	_____	i. cassowary	_____
e. frog	_____	j. duck	_____

2. Feeding

Living things feed by taking in food in order to live.

Plants take in raw materials through their leaves and roots and use these to make their own food by photosynthesising in their leaves. Animals cannot make their own food so they search to get their food. The production of food in the leaves of a plant is less obvious than the feeding of an animal.

3. Breathing

Breathing is the process where organisms take in oxygen from its surrounding and give out carbon dioxide as waste.



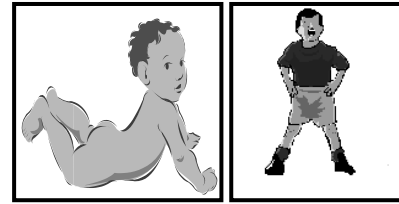
All living things need oxygen to breathe. If they had no oxygen, they would die. When divers are exploring under the water they need aqualungs that contain oxygen so that they can continue to breathe.

4. Excretion

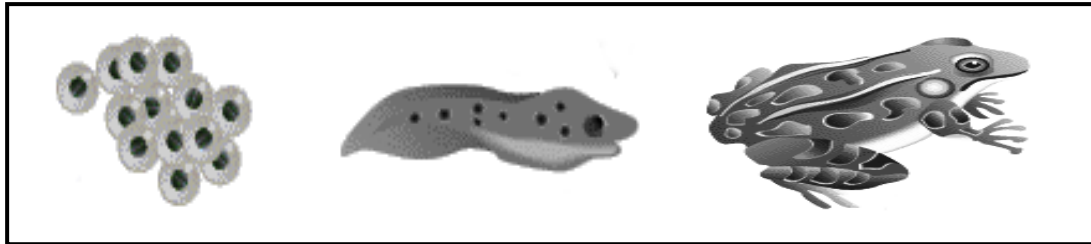
Life processes like feeding and breathing produce waste products that are poisonous when they increase in concentration in the body of an organism. Getting rid of these wastes is another important life process. The passing out of waste from the organism is called **excretion**. For instance our body releases waste by urinating or by sweating.

5. Growth

It is simply the increase in size brought about by the development of new cells and tissues. In some organism's growth is shown when the organism becomes more complicated and more efficient. A tree growing more leaves can make more food or a human growing more muscles can lift heavier loads. Growth can also be shown when an organism changes shape or form.



Growth is the increase in size.



Growth is also shown when a frog changes form and shape in metamorphosis

6. Reproduction

It is a process that occurs when living things make more of their own kind. This happens every 20 minutes with some of the micro-organisms, and every hundred years with some strange, slow-growing plants.

Reproduction to make offspring is followed by the growth of the offspring, which then reproduce to make their own offspring, and so on. This process ensures that organisms maintain their kind and sustain their generation resulting in their continued existence.



All organisms die sooner or later but their life is handed on to new individuals by reproduction resulting in the continued existence of their kind.



Activity 2: Now test yourself by doing this activity.

Name of young animals

The young of many animals have special names. A young male horse for example is called a colt while a young female horse is a filly.

Test your knowledge by matching the names of young animals on the second column with their correct adult names on the first column by ruling lines.

Adult Animals	Young Animals
1. fish	fawn
2. kangaroo	bunny/kit
3. horse/zebra	suckling/piglet
4. dog	cub
5. lion/tiger/bear/fox/shark	chick
6. spider	fledgling
7. cat	calf
8. rabbit	kid
9. cow/elephant/whale	fingerling/fry
10. deer	kitten
11. birds	elver
12. goat	joey
13. eel	spiderling
14. pig	foal
15. fowl	puppy

7. Response to stimuli

It is the ability of an organism to respond to a stimulus. A **stimulus** refers to any factor or changes in the environment that can cause an organism to respond.

Some stimuli come from outside the body of an organism in the form of sound, sight, taste, touch or smell or can also come from inside their bodies such as hunger, thirst or pain. These stimuli often lead to responses that involve movement.

Animals are quick to respond. Plants generally do not show fast responses but do respond slowly to light, gravity, moisture and other factors by opening or closing, or growing away or towards the source of the stimulus.

**Activity 3: Now test yourself by doing this activity.****Differences between plants and animals**

Both plants and animals have common characteristics as listed above, but there are some major distinctions between them.

Differentiate between plants and animals in terms of

1. feeding _____
 2. movement _____
 3. response to stimuli _____
-

**Summary**

You have come to the end of lesson 2. In this lesson you have learnt that:

- we can tell that some things are alive because they move, they need food and oxygen, and they excrete, grow, reproduce and respond to their environment.
 - feeding is a process that involves the taking in of nutrients by organisms and assimilating these in their cells for growth and to replace old or injured tissues.
 - breathing is a process that provides energy for organisms.
 - the passing out of waste from the organism is called excretion.
 - growth is the increase in size, shape or form in organisms brought about by the development of new cells and tissues.
 - reproduction is a process that occurs when living things make more of their own kind.
 - a stimulus refers to any factor or change in the environment that can cause an organism to respond.
-

NOW DO PRACTICE EXERCISE 2 ON THE NEXT PAGE.

**Practice Exercise 2**

Answer the following questions:

Part A. Multiple Choices

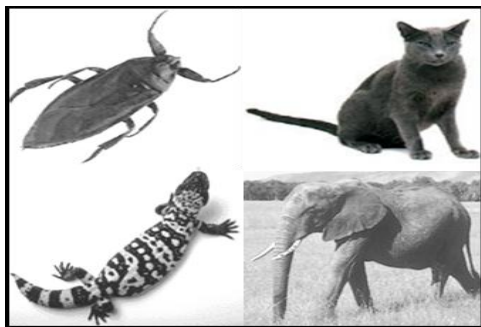
Circle the letter of the correct answer.

1. The characteristics of living things that allow them to respond to changes in their environment is called
 - A. feeding
 - B. movement
 - C. breathing
 - D. responds to stimuli
2. Which organ is not suited for movement in water?
 - A. Fins
 - B. Gills
 - C. Flippers
 - D. Webbed feet
3. Which one is not a product of excretion?
 - A. Sweat
 - B. Urine
 - C. Saliva
 - D. Faeces
4. Extinction of species is often caused by the inability of an organisms to _____.
 - A. move
 - B. respire
 - C. respond
 - D. reproduce

Part B. Short Answers

1. A motor car moves, takes in oxygen and gives out carbon dioxide, uses fuel but is not a living creature. Give two reasons why it does not 'qualify' as a living organisms.
 - a) _____
 - b) _____

2. Group **A** and Group **B** are two different collections of living things. Try to distinguish organisms in A and B by the way they



Group A



Group B

- a. move.

- b. are nourished.

- c. respond.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Answers to Activities

Activity 1

Living thing	Structure used for movement	Living thing	Structure used for movement
a. grasshopper	legs	f. shy grass/mimosa	leaves
b. pumpkin	tendrils/vines	g. bat	wings
c. whale	flippers	h. grass	runners
d. crabs	legs	i. cassowary	legs
e. frog	webbed feet	j. duck	wings/webbed feet

Activity 2

Adult Animals	Young Animals
1. fish	fingerling/fry
2. kangaroo	joey
3. horse/zebra	foal
4. dog	puppy
5. lion/tiger/bear/fox/shark	cub
6. spider	spiderling
7. cat	kitten
8. rabbit	bunny/kit
9. cow/elephant/whale	calf
10. deer	fawn
11. birds	fledgling
12. goat	kid
13. eel	elver
14. pig	suckling/piglet
15. fowl	chick

Activity 3

1. Feeding – Plants can nourish themselves because they can make their own food by photosynthesis. Animals cannot make their own food and get their nourishment by feeding on other organisms.
2. Movement – Plants are sessile while animals can move about.
3. Response to stimuli – Animals are quick to respond while plants are slow to respond.

Lesson 3: Functions of Body Coverings



Welcome to Lesson 3 of Strand 2. In the last lesson you looked at the common characteristics of living things. In this lesson we will look at the different body coverings on animals and how this body covering helps animals to live. Organisms have body coverings that help them survive in their natural environment. Different groups of animals and plants have their own type of body covering to suit their different needs. One of the characteristics is body covering.



Your Aims:

- identify the body covering of different groups of organisms
- describe the functions of the different types of body covering
- explain how the different body coverings help in the survival of organisms

Animal Body Coverings

There are a lot of different kinds of animals in the world. One way of grouping or identifying them is through their body covering. There are several types of body coverings like the hair, feathers, scales, shells and spines to name a few. Each of this enables a particular animal to adapt to its environment and help it to survive.

1. Fur

It is the hair growing or covering on the body of mammals. No animals other than mammals have true hair, and all mammals have hair.

When the individual hairs are fine and closely spaced, the coat of hair is called **fur**.



Monkeys are covered with hairs



Some furry mammals, from left to right: cat, wolf, fox, bear and rabbit

When soft, kinked, and matted together, the coat is called **wool**. Coarse, stiff hairs are called **bristles**; when they are also pointed, as in the hedgehog and porcupine, they are called **spines** (or, popularly, **quills**).



A domestic and wild sheep are covered with wool



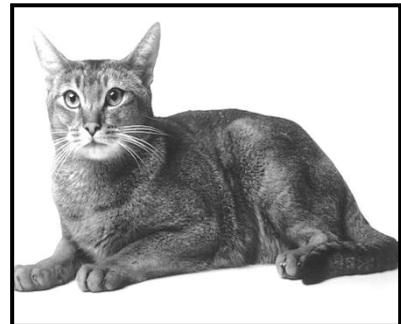
A wild boar has bristles



A porcupine and echidna are covered with spines

Functions of Fur

- i. To provide protection. Fur protects the skin from damage such as cuts and bruises.
- ii. To provide insulation. The layer of air held between the hairs reduces evaporation and heat loss. The thick fur of animals in colder regions retains their heat for a longer period of time.
- iii. To provide sensitivity. The furs are supplied with sensory nerve endings that detect movement and vibration. For example a cat's whiskers are very sensitive to touch and help a cat judge space and distance.
- iv. To camouflage. Some animals use their fur to camouflage or blend with their surroundings to avoid their enemies and find food.



In poor light, whiskers help a cat find its way around.

2. Feathers

These are the outgrowth coverings from the skin in birds. The feathers of birds are collectively called **plumage**.



The light and fluffy feathers of this pigeon trap air for flight.



The feathers of duck are water-resistant.



Male birds are generally more colourful to attract the females.



The white owl is almost completely camouflaged against its snowy background.

Functions of feathers

- i. To support the wings for flight. Feathers are light and with a large surface to provide lift.
 - ii. To trap air for flight or flying.
 - iii. To provide insulation. Feathers form an insulating layer around bird's body helping to keep its temperature warm and steady at around 41°C. Muscles work more efficiently when they are warm.
 - iv. To protect against water. Feathers serve as protection against water with their water-repelling characteristic.
 - v. To attract a breeding partner with its colourful feathers.
 - vi. To camouflage. Some birds are camouflaged to resemble their surroundings, thus escaping from their enemies or preying on other animals.
-

**Activity:****Now test yourself by doing this activity.**

Write the function or role of the fur or feathers found on following animals



1. The very thick fur on this polar bear.



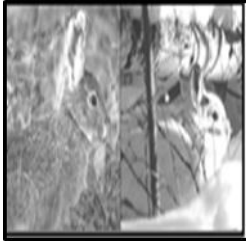
2. The long whiskers on this monkey's face.



3. The colourful feathers on this male bird of paradise.



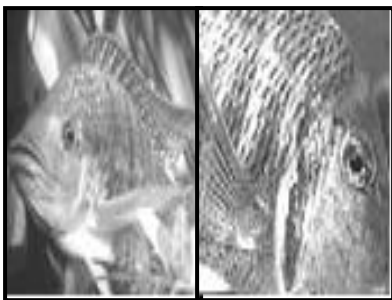
4. The water- resistant feathers of a swan.



5. The hair of this hare that is dark as the grass and shrubs during summer and white as snow during winter.

3. Scales

These are overlapping bony plates covering the skin of fishes, snakes and other vertebrates. In sharks, rays and dogfish the scales grow out through the skin but in other fish and reptile, the scales are covered by skin. Below are pictures of some animals covered with scales.



Talapia is a scaly fish that is cultivated around the world.



A rattle snake (left) and a snake shedding its skin



An armadillo is mammal. Its scales are like armoured plates.

Functions of scales

- i. To allow good movement. The backward-facing overlapping scales reduce friction against land or water allowing the animal to move easily.
- ii. To provide protection. Scales overlap each other and give a protective covering. The added mucus allows the animal to easily 'slip' away. Some snakes have colourful scales to warn other organisms that they are very poisonous.
- iii. To camouflage. Some scales are coloured to resemble the surroundings. This enables the animal to escape the notice of possible predators or may be used to prey on other animals.

4. Exoskeleton

What do sea snails, garden snails, clams, oysters, crabs, shrimps, lobsters, tortoises and turtles all have in common? They all have a hard body covering that acts as the exoskeleton. **Exoskeleton** refers to the hard materials that form outside the body.



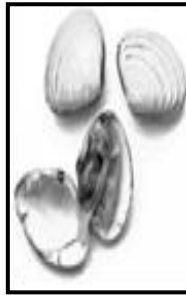
Hermit crab



Snail



Crab



Clams



Mussel



Crayfish



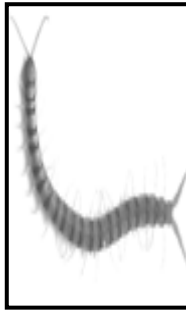
Lobster



Scorpion



Beetle



Centipede



Sea turtle



Tortoises

Some animals with exoskeleton

Functions of exoskeletons

- i. To support the body of the animal. An exoskeleton functions for support. It is where muscles and organs of animals are attached. Crabs, crayfish, clams, mussels and beetles use their exoskeleton to move.
- ii. To protect against the predators and the harsh environment. The hard exoskeleton acts like a case to protect delicate and important body organs. Hermit crabs, snails, turtles and tortoises retract or hide in their shells in times of danger. Clams and mussels prevent water loss during low tide by closing and trapping water in their shells.

5. Moist skin

Some animals have soft, moist skin. Amphibians and worms have smooth skin with no hair or scaly covering. The moist skin most of the time acts as an organ for gas exchange. They take in oxygen and give out carbon dioxide through their skin. In order to do these their skin must stay moist.



Frogs



Earthworm



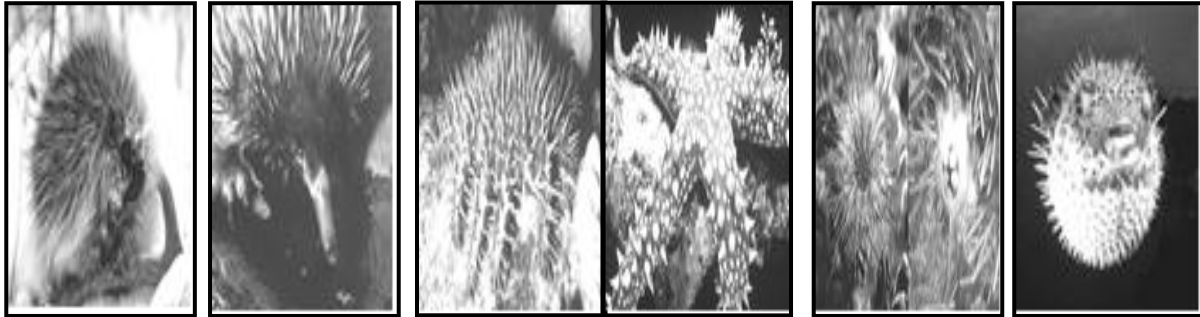
Salamanders

Some animals with moist skin

The skin also secretes mucus to maintain a wet skin surface. Some frogs and salamanders secrete a toxin or poisonous substance in their skin as a defensive mechanism.

6. Spiny body covering

Some animals are covered with spines. Obviously, this body covering functions for protection against potential predators.



Porcupine

Echidna

Starfishes

Sea urchins

Porcupine fish

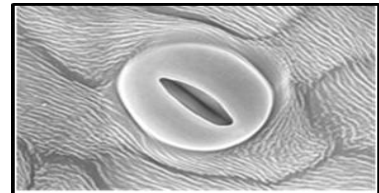
Some animals with spines

Plant body coverings

The **epidermis** is the outermost layer of the plant body. It forms the skin of the plant, covering the leaves, flowers, roots, fruits, and seeds.

i. Leaf covering

The **leaf cuticle** is a waxy layer above the leaf epidermis that functions to prevent water loss by evaporation.



A stoma is a tiny pore-like structure on the epidermis of a leaf. It allows gas

ii. Stem covering

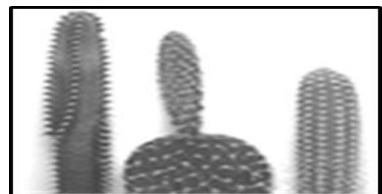
Non-woody stems have a thin epidermis that is effective in holding the inner cells in shape, preventing loss of water and providing protection against bacteria, fungi and mechanical damage.

In woody stems, the epidermis is often replaced by a dead, corky layer called **bark**.



tree bark

Thorns are needle-like structures that can grow in stems and leaves. They guard the plants and their water from animals. The sharp spines deter grazing animals.



Spiny Cacti

iii. Seed covering

Seed coat prevents the drying out of the seed embryo.

It also protects the seed from infection from fungi and bacteria.



Summary

You have come to the end of the lesson. In this lesson you have learnt that:

- animals have body coverings that help them survive in their natural environment.
- the fur refers to the slender, thread-like covering of mammals that functions to protect insulate and provide extra sensitivity to movement.
- feathers, collectively called plumage, are the outgrowths from the skin in birds that functions to support flight, insulate, repel water, attract a mate, camouflage, and allow birds to float in water.
- scales are overlapping bony plates covering the skin. Scales function for movement and protection.
- where the hard material is formed outside of the body it is often called an exoskeleton. Exoskeleton functions for support and protection.
- a moist body covering generally functions for gas exchange while a spiny body covering functions for protection.
- plant coverings vary greatly in function and structure.
- the outermost layer of the plant body, epidermis, forms the skin of the plant, covering the leaves, flowers, roots, fruits, and seeds. It helps retain water and the shape of the inner cells.
- the leaf cuticle is a waxy layer above the leaf epidermis that functions to prevent water loss by evaporation.
- the seed coat keeps the seed from drying out and protects it from infection and damage.

NOW DO PRACTICE EXERCISE 3 ON THE NEXT PAGE.



Practice Exercise 3

Answer the following questions:

Part A. Multiple Choices

Circle the letter of the correct answer.

1. The moist skin of amphibians and worms generally acts as an organ
 - A. for gas exchange.
 - B. used to attract the opposite sex.
 - C. used for protection against predators.
 - D. to protect the delicate internal organs.
2. Which of the following animals does not have a scale?
 - A. cobra
 - B. shark
 - C. goldfish
 - D. starfish
3. The waxy leaf cuticle
 - A. keeps away grazing animals.
 - B. specializes in gas exchange.
 - C. retains the shape of the leaf.
 - D. prevents excessive loss of water.
4. When soft, kinked, and matted together, the coat of hair is called _____.
 - A. fur
 - B. wool
 - C. quills
 - D. bristles
5. Some animals are camouflaged to resemble their surroundings. This is to
 - A. provides insulation and keeps the body warm.
 - B. hides from predators as well as to easily hunt for food.
 - C. gets protection from the unfavourable conditions in the environment.
 - D. easily catches the attention of the opposite sex and increases the chance to reproduce.

Part B. Short Answers.

1. A list of animals is given and from the list select by underlining the animals that have exoskeleton as their body covering.

frog, hawk, dog, boar, shrimp, taipan, lizard, orangutan, eel, earthworm, oyster, parrot, scorpion, wriggler, spider, ant, leech, buffalo, alligator,

2. Explain, using your knowledge of the body coverings, why

A. Ducks are well adapted to swimming in water.

B. Polar bears can withstand freezing temperatures in winter.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Answers to Activity

1. for insulation and camouflage
2. to provide sensitivity
3. to attract the opposite sex
4. to protect it from water by repelling it
5. for camouflage so it cannot be easily detected by predators

Lesson 4: Sense Organs of Animals



Welcome to Lesson 4 of Strand 2. In the last lesson you learnt about the functions of body covering on different groups of animals. In this lesson you will learn about the different organs in animals that are used for sensing. Now! go to your kitchen or garden and try to find a piece of ripe banana or mango. Take a sniff of the fruit to check if it is ripe. Peel it and have a bite. Does it taste sweet? Feel the texture of the food in your mouth. Is it smooth or rough? Close your eyes and savour the taste as you swallow. Did you hear the faint sound from the back of your throat as you engulfed the food? You have just tested your body's five main senses - vision (sight), hearing, smell, taste and touch.



Your Aims:

- identify the sense organs of animals
- state the functions of the sense organs
- identify and label the parts and functions of the human sense organs

What Senses Do?

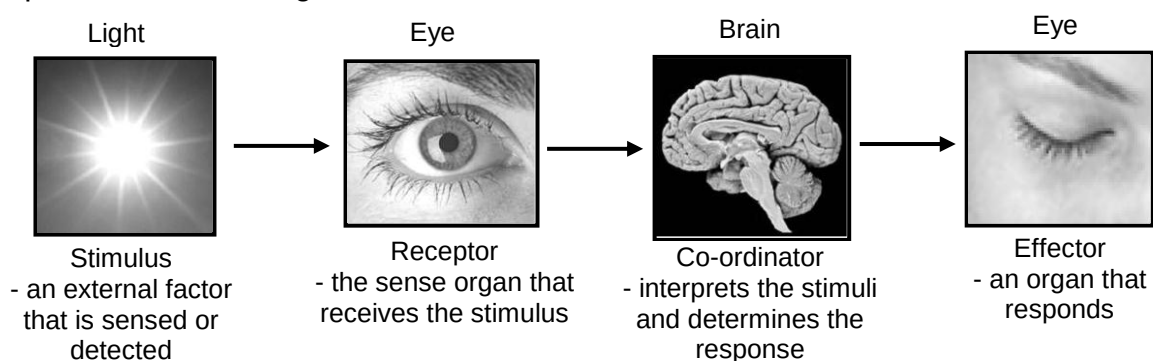
Senses tell you about your surroundings. You can sense some things around you by the help of your special detector organs called receptors. **Receptors** are the sense organs in your body that receive the information in your surroundings. The major sense organs or receptors are the eyes, ears, nose, tongue and skin. These information or messages that you sense or detect are termed as the **stimuli**.

A **stimulus** (plural - stimuli) is anything that you sense outside or inside your bodies that can make you respond. **Effectors** are organs that you use to respond. This can be a muscle or a gland. The glands include sweat, oil, tear and salivary glands.

For example when your eye detects a dust particle, your eye becomes the receptor and the dust the external stimulus. You respond by blinking and secreting tears. The muscles in your eyelid and your tear glands are the effector organs.

Senses and the brain

Your sense organ transmits the stimulus like a tiny burst of electricity, called a nerve signal, along a nerve to the brain. The brain interprets the signal from the receptor so that a correct response can be made in the effector. The **brain** co-ordinates the receptor and effector organs



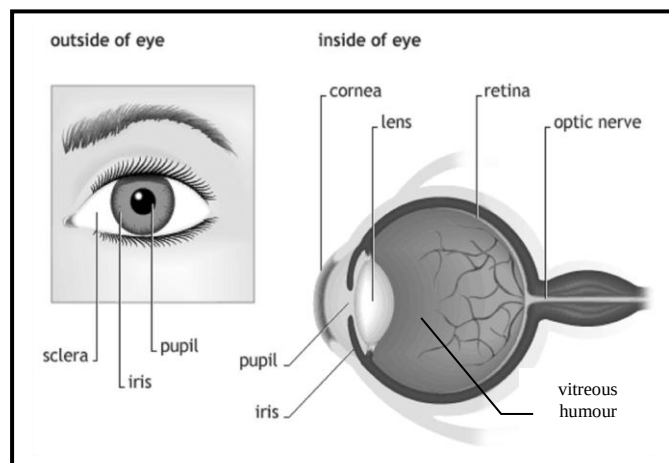
A flow diagram showing how a sense organ receives stimulus and how the message is relayed to the brain to bring about a response.

The eye

The eye senses light rays. These stimuli shine into the eye through an almost clear dome-shaped window at the front, called the **cornea**. Covering the cornea, and the rest of the front of the eye, is a much thinner clear layer, the **conjunctiva**. The conjunctiva is very sensitive and when dusts or other things touch it, we close our eyes and blink. Around the cornea is the **sclera**, a tough white layer that curves away to cover the rest of the eyeball.

Behind the cornea is what looks like a black hole. This is the **pupil**. The pupil is surrounded by a circular ring of tissue called the **iris**. This is the coloured part of the eye. It contains muscles which enables the pupil to get narrower or wider. The iris opens and closes to control the amount of light entering the eye.

The light rays that enter the pupil pass through the lens. The **lens** helps in focusing distant and near objects. After the lens, the light rays travel through the **vitreous humour** - a clear, jelly-like fluid filling the middle of the eyeball. The light then hits the curved layer inside the back of the eye, which is the **retina**. The retina is made of light sensitive cells that make a tiny pulse of electricity called a nerve signal. This travels along the **optic nerve** to the brain.



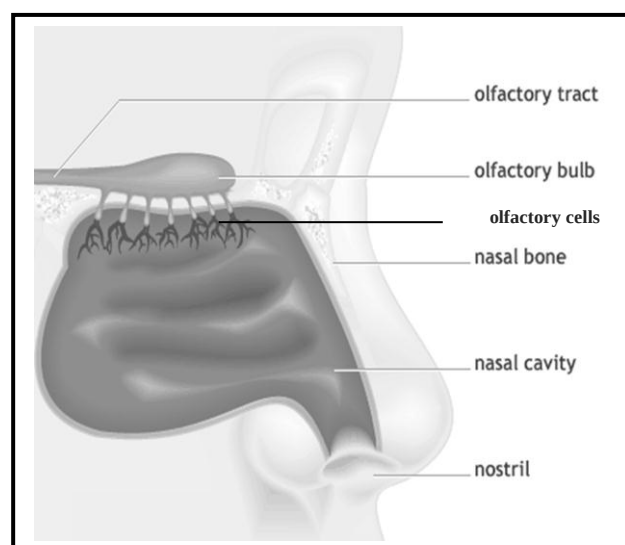
Structure of the human eye

It is in the brain where the nerve signals are sorted out according to shapes, colours and movements, and compared with information in the memory. This is how the brain interprets what we see.

The nose

Your **nose** helps you breathe and smell. Tiny bits of chemicals make up the smells and they float into the nose with air that is breathed in. Air enters the nose through the **nostrils** and passes into a large space called the **nasal cavity**.

The **olfactory (smell) cells** in the roof of the nasal cavity sense the chemicals in the air. The **olfactory bulb** then collects the information gathered from the smell-sensitive olfactory cells and sends a nerve signal to the brain through the **olfactory nerve** - and you smell that odour.



Structure of the human nose



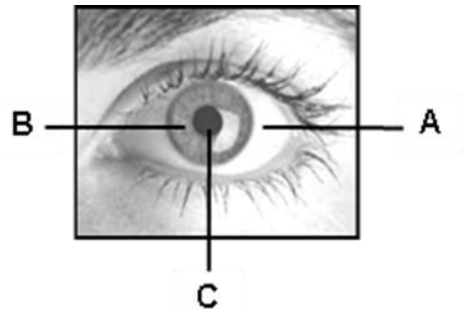
Activity 1: Now test yourself by doing this activity.

1. Name the parts of the eye marked

A. _____

B. _____

C. _____



2. Look at your eyes in a mirror. Point a torch towards your eye. Switch on the torch and watch your pupils. Describe how your pupils change. How is the change brought about, and why is it useful.

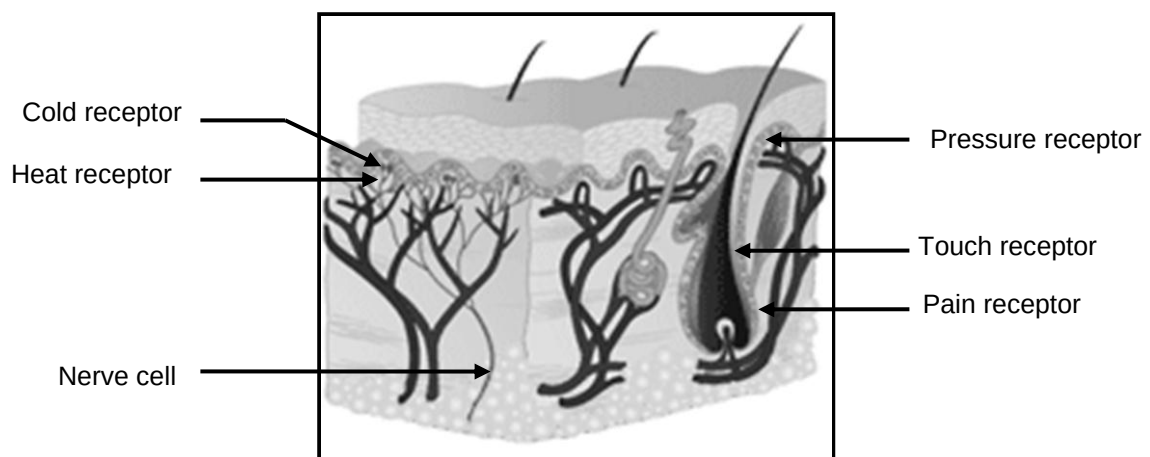
3. Complete the following sentence:

The upper lining of the nasal cavity is filled with _____ which respond to chemicals in the air and give a sense of _____.

The skin

The sense of touch comes from millions of **sense receptors** that have different shapes, like tiny onions, plates and trees. Some of these receptors can feel the lightest **touch**. Others feel **pressure, heat, cold, texture** or **movement**. One of the most sensitive areas of skin is the fingertip where the sense receptors are highly concentrated.

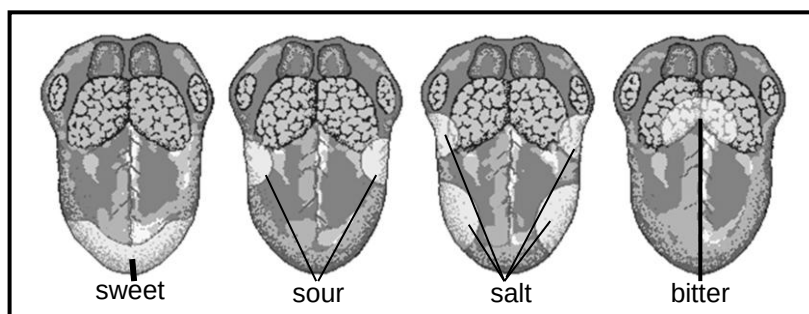
There is also sense receptors wrapped around the bases of hairs. They detect movement of the hairs like when the hair follicles are moved by a wind breeze or by the flapping of the wings of an insect as it flies close to the skin in the dark. When you feel the wind on your face or an insect passing by, you are really feeling the tiny hairs there swaying in the wind and wing vibrations.



Some sense receptors in the skin

The tongue

The tongue has **gustatory (taste) cells** that can sense chemicals in food and drinks. These taste sensitive cells are gathered in groups of about 100 to form the **taste buds**. There are approximately 10,000 taste buds in the tongue and they are grouped in areas sensitive to the four taste sensations: **sweet** (at the tongue's tip), **sour** (the rear sides), **bitter** (the back) and **salty** (the front and rear sides).



Taste regions of the tongue

When chemicals are detected by gustatory cells, collectively known as the taste buds, nerve signals are transmitted to the brain to interpret the taste sensation.

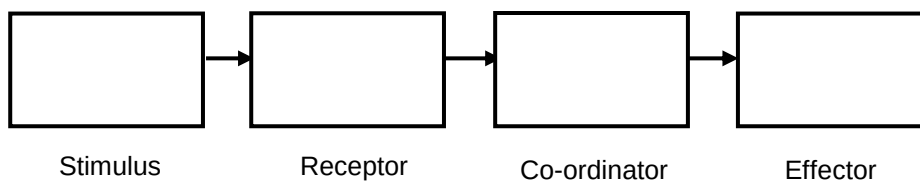
The **sense of flavours** such as vanilla, chocolate, strawberry, chicken and beef flavours come with the sense of smell. Chemicals from the food must enter the nose to help us determine the flavour of food. An orange juice and a strawberry juice will taste just the same (sweet) when you drink them with your nose closed.



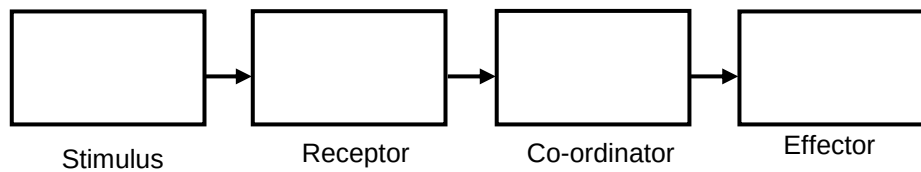
Activity 2:

Now test yourself by doing this activity.

1. Name four stimuli which are detected by the sense receptors in the skin.
 - a) _____
 - b) _____
 - c) _____
 - d) _____
2. Complete the flow diagram for each of the following situations by identifying the stimulus, receptor, co-ordinator and effector.
 - a. In a warm day you begin to sweat.



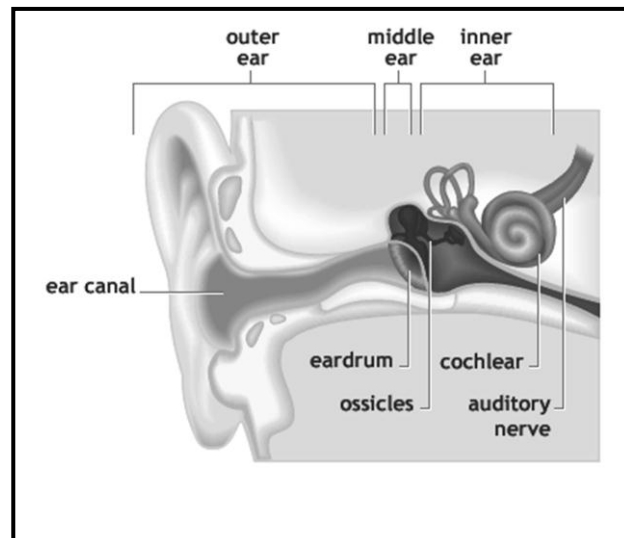
- b. A drop of lemon in your mouth makes you salivate and squirm or twist and turn your body in a snake-like movement.



The ears

The human ear is divided into three parts: the outer ear, the middle ear and the inner ear. The outer ear works like a funnel to gather sound waves into the dark hole in the middle. This is the start of the **ear canal**, which is a tunnel leading about two or three centimeters into the head.

The **eardrum** or tympanic membrane vibrates when hit by a sound wave. It also separates the outer ear from the middle ear, which is an air-filled cavity. Inside this cavity are the body's smallest bones, the **hammer**, **anvil** and **stirrup** that shake to and fro when sound waves pass through them.



These bones collectively known as the **ossicles** amplify and help send sound into the inner ear. The sound sensitive cells are found in the snail-like **cochlea**. Nerve signals are made when sound vibrations set up ripples in the fluid inside the cochlea. The signals travel along the **auditory nerve** to the brain. The brain interprets and works out what we hear. The inner ear also contains an organ that helps you keep your **sense of balance**.



Summary

You have come to the end of lesson 4. In this lesson you have learnt that:

- living things respond to stimuli such as light, sound, smell, taste, heat, cold, pressure, pain and touch.
- in order to respond to stimuli, an animal has to have receptors. A receptor is a structure which can receive a stimulus.
- the five major receptors are the five sense organs, the eyes, ears, nose, tongue and skin which give us the sensations of vision, hearing, smell, taste and touch respectively.
- effectors are organs that respond.
- the brain serves as a co-ordinator. It receives the nerve signals from the receptors and ensures that the right responses are given.
- light and vision are sensed by the light sensitive cells in the retina of the eye.
- the skin contains millions of sense receptor cells that are sensitive to touch, pressure, heat, cold and pain.
- the olfactory (smell) cells in the roof of the nasal cavity sense the chemicals in the air.
- The taste buds in the tongue have gustatory (taste) cells that are sensitive to chemicals in food and drinks.
- The sound sensitive cells are found in the snail-like cochlea in the inner ear.

NOW DO PRACTICE EXERCISE 4 ON THE NEXT PAGE.



Practice Exercise 4

Answer the following questions:

Part A. Multiple choices

Circle the letter of the correct answer.

- The sense receptors in the skin cannot detect _____.
A. pain
B. heat
C. touch
D. light
- Which two senses bring about the flavour of food?
A. taste and sight
B. taste and smell
C. smell and hearing
D. sight and hearing
- The vibration of sound waves in the ear is amplified or made louder by the _____.
A. throat
B. cochlea
C. ear canal
D. ossicles
- Closure of the pupil in bright light is caused by
A. the iris narrowing in size.
B. the lens becoming smaller.
C. blinking cause by dust particles.
D. the optic nerve not getting any signal.
- Which receptor is involved with the sense of balance?
A. Eye
B. Ear
C. Nose
D. Skin

Part B. Short Answers

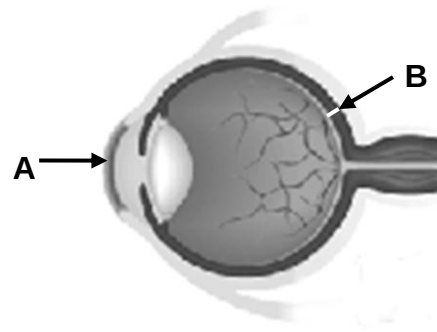
1. **A** is a transparent membrane while **B** contains the light sensitive cells.

a. Identify structures **A** and **B**.

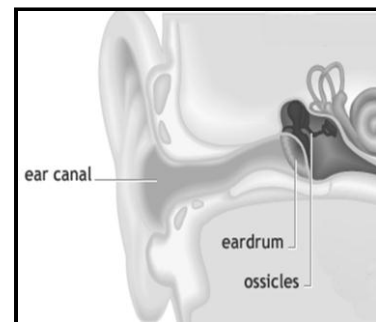
A - _____

B - _____

b. Why is it important for **A** to be transparent?



2. Why is it dangerous to use a pin or other sharp object to remove ear wax from the ear canal?



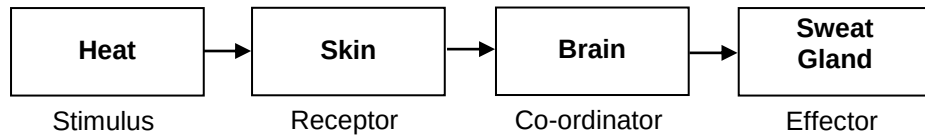
CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND

Answers to Activities**Activity 1**

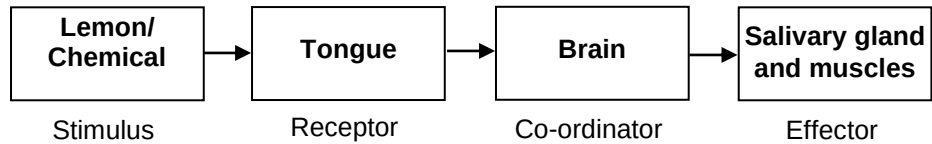
1. A - Sclera
B - Iris
C - Pupil
2. The pupils become narrower or smaller in size. This is brought about by the iris closing which is important so that the amount of light entering the eyes can be controlled.
3. The upper lining of the nasal cavity is filled with **olfactory cells** which respond to chemicals in the air and give a sense of **smell**.

Activity 2

1. touch, pressure, pain, heat or cold
2. a. In a warm day you begin to sweat.



b.



Lesson 5: Plant Responses



Welcome to Lesson 5 of Strand 2. In the last lesson you learnt about the different sense organs in animals. In this lesson you will learn about plant responses or how plants can sense their environment. Animals have organs to sense their environment. Do plants in your garden respond to stimuli? Your initial response will be no, after all if step on a grass it does not move away. However, as living things plants do respond to stimuli. They do this by growing in a particular direction.



Your Aims:

- know that plants respond to stimuli as shown in their growth patterns
- list the different factors in the environment that influence plant responses
- identify the different plant growth responses and appreciate their importance

Plants Respond To Their Environment

Plants show sensitivity or the ability to respond to their environment. Plants responses are rather slow compared with those of animals. They show positive or negative responses by growing towards or away from different types of stimuli.

Factors in the environment that affect plant responses

There are several external stimuli that plants can respond to. Plants respond to **light** (photo-stimulus), **gravity** (geo-stimulus), **water** (hydro-stimulus), **touch** or pressure (thigmo-stimulus), and **chemicals** (chemo-stimulus) to name a few.

Tropism refers to the growth response carried out by a plant in response to the direction of a stimulus.



Plants respond to many stimuli, but three are of particular importance: light, gravity and water.

Different types of tropisms or plant responses

Tropisms or growth responses in plants usually occur around the growing tips especially the developing shoot tips and the developing root tips.

When a plant part grows towards a stimulus, a **positive** response or tropisms is made. A **negative** response or tropism takes place when a growth response is away from the stimulus. For example

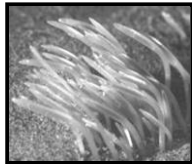
- a stem growing towards light is a positive phototropism
- a stem growing upwards, away from gravity, is a negative geotropism
- a root growing downwards, away from light but towards gravity, is a positive geotropism but a negative phototropism.

You can describe roots as positively geotropic as well as negatively phototropic.



Activity 1: Now test yourself by doing this activity.

Identify the plant response shown in each of the following situations.

1.		The stem of the sunflower bends towards the light allowing the large sunflower to follow the movement of the sun.	
2.		Beans have climbing stems called tendrils. Tendrils are thread-like, often in a spiral form, and are touch-sensitive, clinging to or coiling around an object that it comes in contact with.	
3.		The shoot tips of watercress creeps and thrives best in moist environments, near springs and in wet soils.	
4.		The leaves of Mimosa or 'shy-grass' are very sensitive and curl inwards when touched.	
5.		Plant shoots bend and grow towards an area with available sunlight.	
6.		The Venus flytrap's leaf closes when an animal touches the hairs inside its surface. The leaf traps and imprisons the intruder.	
7.		If the Venus flytrap senses that the animal prisoner contains nutritious chemicals like protein, the leaf closes further, and the plant begins to digest its meal.	
8.		The trunk and branches of this giant tree grow up towards the sky.	



Activity 2: Now test yourself by doing this activity.

1. Prepare a box and an empty tin milk or tin meat container. (Make sure the box is not less than twice the height of the tin container.)
2. Place a damp soil in a large, empty tin milk or tin meat container.
3. Plant at least 3 or 4 bean seeds or corn seeds in the container.
4. Cut out a small opening that will allow sunlight in at one end of the box. (The rest of the box should remain covered and dark.)
5. Put the tin container with seeds in the box and place the box near a natural light source (sunlight).
6. Make daily observations by carefully lifting off the cover of the box.
7. Draw or make a map of the direction of the growth and explain the reason for the growth behaviour of the plant.

Importance of plant growth responses

1. Response to light or Phototropism

When shoots move towards the light, the leaves will be in the right position to absorb light energy for photosynthesis. This will increase the rate of food production in the leaves of plants. The movement towards the sun lifts the flowers so that they will be in a position where they are likely to receive pollen.



Sweet potato or kaukau flowers open and close in response to light.

A special type of phototropism called **photoperiodism** takes place when plants open and close in response to the changing position of the sun.

Morning glory which belongs to the same family as the sweet potato or kaukau has flowers that open in the morning and close after a few hours.

2. Response to gravity

The positive response of roots to gravity allows them to grow into the soil, which provides a source of water and minerals. This response also enables roots to be properly anchored in the soil providing an extensive system of support to plants.

3. Response to water

One of the reasons that roots grow down is in search of water in the ground. Water just like light, is needed for photosynthesis. If the roots absorb more water, more food is also likely to be manufactured in the leaves of plants.



Oak tree roots grow as deep as 30 metres in search of water.

4. Response to touch

Climbing plants or creepers can easily find support on other plants or surfaces. Creepers may climb and support themselves by coiling their stems or tendrils around plants or other objects, as is the case with the pumpkin and snake beans.

Climbing enables plants to gain height or altitude and increase exposure to sunlight where they cannot when they are in the shade. Some leaves and flowers close to deter grazing animals or trap food. All these growth responses allow plants to make the most of the resources available in their environment and help them survive.



Summary

You have come to the end of lesson 5. In this lesson you have learnt

- plants show sensitivity or the ability to respond to their environment.
 - plants respond by growing towards, or away from, a stimulus. This growth response carried out by a plant in response to the direction of a stimulus is termed as tropism.
 - tropism refers to the growth response
 - plants show phototropism, geotropism, hydrotropism, chemotropism and thigmotropism when they respond to light, gravity, water, chemical and touch respectively.
 - positive tropism is shown when a plant part grows or bends towards a stimulus. Negative tropism takes place when the growth response is away from the stimulus.
 - tropisms or growth responses are important because they allow plants to make the most of the resources available in their environment and help them survive.
-

NOW DO PRACTICE EXERCISE 5 ON THE NEXT PAGE.



Practice Exercise 5

Answer the following questions:

Part A. Short Answers

1. Identify the stimulus (light, gravity, water, chemical or touch) that is responsible for the following growth responses in plants.

a.



This epiphyte finds support in climbing by easily attaching itself to any host tree that it comes in contact with.

stimulus _____

b.



To get a fair share of sunlight, the leaves of short rainforest plants grow wider leaves.

stimulus _____

c.



Colonies of hornworts increase in number and become greener the closer they grow to creeks and rivers.

stimulus _____

d.



The flower of some hibiscus variety opens at sunrise and closes when the sun sets.

stimulus _____

e.



The roots of a seedling still bend downwards even if the seedling is positioned to grow sideways.

stimulus _____

2. Complete the following paragraph.

When a potted plant is put on a windowsill, the _____ of the plant will bend towards the light. This response is called _____ and offers several advantages to the plant including more access to light energy to support the process of _____.

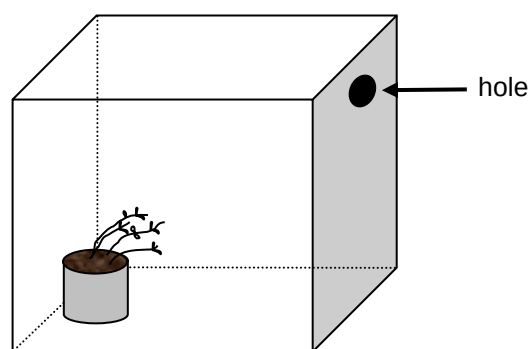
3. Give the two importance of geotropism in plants.

- a. _____
- b. _____

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Answers to Activities**Activity 1**

1. positive phototropism
2. positive thigmotropism
3. positive hydrotropism
4. negative thigmotropism
5. positive phototropism
6. positive thigmotropism
7. positive chemotropism
8. positive phototropism or negative geotropism



A diagram showing the direction of the growth response of the seeds in activity 2.

Activity 2

The germinated plants grow or bend towards the light source (small opening) because the shoot tips are positively phototropic - they respond to light by growing towards it whenever there is an unequal light distribution.

REVIEW OF SUB STRAND 1: PLANTS AND ANIMALS

Revise all the Lessons in this Sub Strand and then do **ASSIGNMENT 2**.
Here are the main points to help you revise.

Lesson 1: Living and Non-living Cells

- Living things grow, develop and reproduce. They are made of tiny building blocks called cells.
- Living things include plants, animals and microscopic organisms.
- Terrestrial organisms live on the land while aquatic organisms live in or upon the water. Arboreal organisms are adapted to living on trees.
- Non-living things are not made of cells. They do not grow, develop or reproduce.
- Cells are made up of even smaller structures called organelles.
- All cells have a cell membrane, cytoplasm, nucleus, and vacuole. Plant cells however have some extra structures.

Lesson 2: Characteristics of Living Things

- We can tell that some things are alive because they move, they need food and oxygen, and they excrete, grow, reproduce and respond to the environment.
- Feeding is a process that involves the taking in of nutrients by organisms and assimilating these in their cells for growth and to replace old or injured tissues.
- Breathing is a process that provides energy for organisms.
- The passing out of waste from the organism is called excretion.
- Growth is the increase in size, shape or form in organisms brought about by the development of new cells and tissues.
- Reproduction is a process that occurs when living things make more of their own kind.
- A stimulus refers to any factor or change in the environment that can cause an organism to respond.

Lesson 3: Functions of Body Coverings

- Animals have body coverings that help them survive in their natural environment.
- The fur refers to the slender, thread-like covering of mammals that functions to protect insulate and provide extra sensitivity to movement.
- Feathers, collectively called plumage, are the outgrowths from the skin in birds that functions to support flight, insulate, repel water, attract a mate, camouflage, and allow birds to float in water.
- Scales are overlapping bony plates covering the skin. Scales function for movement and protection.
- Where the hard material is formed outside of the body it is often called an exoskeleton. Exoskeleton functions for support and protection.
- A moist body covering generally functions for gas exchange while a spiny body covering functions for protection.
- Plant coverings vary greatly in function and structure.
- The outermost layer of the plant body, epidermis, forms the skin of the plant, covering the leaves, flowers, roots, fruits, and seeds. It helps retain water and the shape of the inner cells,
- The leaf cuticle is a waxy layer above the leaf epidermis that functions to prevent water loss by evaporation..
- The seed coat keeps the seed from drying out and protects it from infection and damage.

Lesson 4: Sense Organs of Animals

- Living things respond to stimuli such as light, sound, smell, taste, heat, cold, pressure, pain and touch.
- In order to respond to stimuli, an animal has to have receptors. A receptor is a structure which can receive a stimulus.
- The five major receptors are the five sense organs, the eyes, ears, nose, tongue and skin which give us the sensations of vision, hearing, smell, taste and touch respectively.
- Effectors are organs that respond.
- The brain serves as a co-ordinator. It receives the nerve signals from the receptors and ensures that the right responses are given.
- Light and vision are sensed by the light sensitive cells in the retina of the eye.
- The skin contains millions of sense receptor cells that are sensitive to touch, pressure, heat, cold and pain.
- The olfactory (smell) cells in the roof of the nasal cavity sense the chemicals in the air.
- The taste buds in the tongue have gustatory (taste) cells that are sensitive to chemicals in food and drinks.
- The sound sensitive cells are found in the snail-like cochlea in the inner ear.

Lesson 5: Plant Responses

- Plants show sensitivity or the ability to respond to their environment.
- Plants respond by growing towards, or away from, a stimulus. This growth response carried out by a plant in response to the direction of a stimulus is termed as tropism.
- Tropism refers to the growth response
- Plants show phototropism, geotropism, hydrotropism, chemotropism and thigmotropism when they respond to light, gravity, water, chemical and touch respectively.
- Positive tropism is shown when a plant part grows or bends towards a stimulus. Negative tropism takes place when the growth response is away from the stimulus.
- Tropisms or growth responses are important because they allow plants to make the most of the resources available in their environment and help them survive.

REVISE WELL AND THEN DO SUB STRAND TEST 1 IN ASSIGNMENT 2.

Answers to Practice Exercises 1- 5

Practice Exercise 1

Part A. Multiple Choice

1. **B** 2. **D** 3. **A**

Part B. Structural Questions

1. A is the nucleus while B is the cell wall
 2. The plant vacuole is bigger or larger than the animal vacuole.
 3. Cell wall and chloroplast
-

Practice Exercise 2

Part A. Multiple Choice

1. **D** 2. **B** 3. **D** 4. **A**

Part B. Short Answers

1. A motor car moves, takes in oxygen and gives out carbon dioxide, uses fuel but is not a living creature. Give two reasons it does not 'qualify' as a living organisms.
2. a. move.
A - can move about.
B - are sessile. /They move by opening, closing, or growing.
- b. are nourished.
A - feed on other organisms
B - make their own food
- c. respond.
A - quickly respond
B - slow to respond

Practice Exercise 3

Part A. Multiple Choice.

1. **A** 2. **D** 3. **D** 4. **B** 5. **B**

Part B. Short Answers.

1.

frog, hawk, dog, boar, shrimp, taipan, lizard, orangutan, eel, earthworm, oyster, parrot, scorpion, wriggler, spider, ant, leech, buffalo, alligator, tadpole
 2.
 - a. Ducks are well adapted to swimming in water. Fluffy feathers help ducks to float. Water-resistant feathers deter water and keep the ducks dry.
 - b. Polar bears can withstand freezing temperatures in winter. The bear's thick fur provides insulation and keeps the bear warm.
-

Practice Exercise 4

Part A. Multiple choice

1. **D** 2. **B** 3. **D** 4. **A** 5. **B**

Part B. Short Answers

1.
 - a. A - cornea
B - retina
 - b. So that light can easily pass through.
 2. The pin or sharp object can pierce, puncture or damage the eardrum and cause hearing loss.
-

Practice Exercise 5

Part A. Short Answers

1.

a. stimulus: <u>touch</u>	d. stimulus: <u>light</u>
b. stimulus: <u>light</u>	e. stimulus: <u>gravity</u>
c. stimulus: <u>water</u>	
2. shoot or stem, light, photosynthesis
3.
 1. It allows plants to grow into the soil, to look for water and minerals.
 2. It also allows roots to grow deep to anchor and support plants.

SUB STRAND 2

CLASSIFICATION OF PLANTS AND INVERTEBRATES

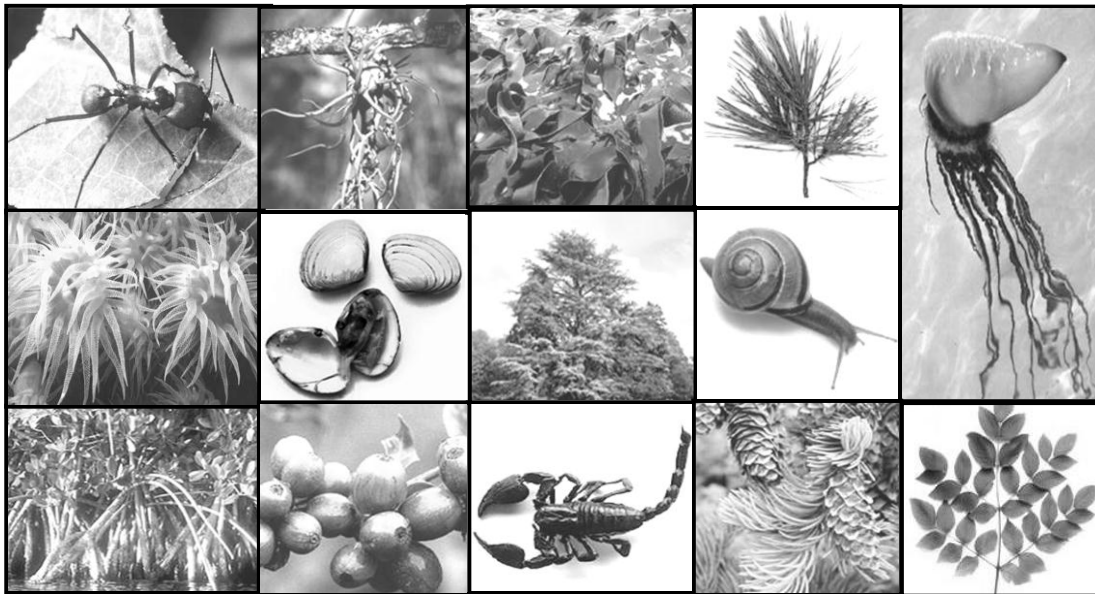
In this sub strand you will learn about:

- **simple plants**
- **flowering plants**
- **non-flowering plants**
- **invertebrates**

SUB STRAND 2:**CLASSIFICATION OF PLANTS AND
INVERTEBRATES****Introduction**

There are many different kinds of plants and animals on Earth. They come in a variety of shapes and sizes. Scientists have developed a way of studying and classifying plants and animals by arranging them based on their natural characteristics.

In this sub-strand you will group and name plants and animals according to their structure. You will learn how these structures help them to live in different environments. You will also find out their importance to the environment.



In this sub-strand you will have the opportunity to:

- Group plants into simple, flowering and non-flowering plants.
- Classify invertebrates according to their structure.
- Name and identify the different groups of invertebrates.
- List the importance of plants and animals without backbone to the environment.

In this Sub strand you will find the answers to these questions and all other questions relating to the classification of plants and invertebrates.

Lesson 6: Simple Plants



Welcome to Lesson 6 of Strand 2. In the last lesson you learnt about how plants respond to their environment. In this lesson you will learn about simple plants. Classifying plants and animals can be very difficult because there are a large number of different types of organisms. For example, there are about 700 000 different types of insects alone. Plants and animals are classified into groups based on physical characteristics. Some plants and animals are very simple and there are groups such as flowering plants and mammals which are very complex.



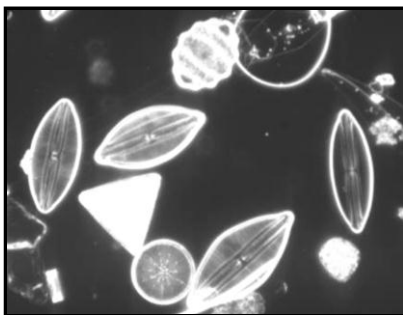
Your Aims:

- identify simple plants
- describe the structure of simple plants and describe their functions
- give the role played by simple plants to the environment

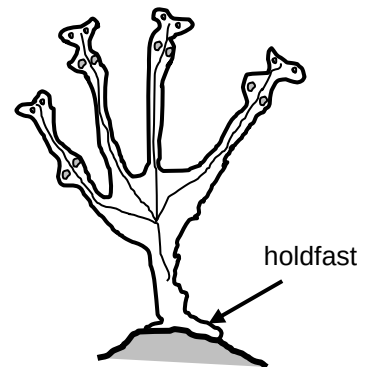
Algae

Algae are simple water plants that do not have roots, stems and leaves. They have green pigment chlorophyll that enables them to make their own food by photosynthesis.

All algae have a green pigment while other pigments that make them appear red, orange, yellow or brown. Algae varies in size from microscopic plant plankton to giant kelps which grows to lengths.



Algae vary in size from freely floating, single-celled, microscopically phytoplankton (left) to kelps that are attached to rocks and can grow to a length of over 60 metres (right).



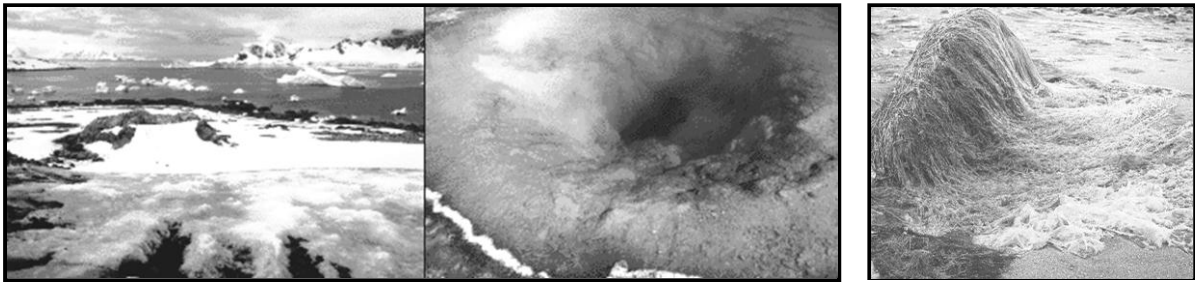
The holdfast has a sticky base to hold seaweed to a rock.

Plant planktons are smaller algae that float freely while larger algae's like the seaweeds fix themselves to rocks or other supports by root-like structures called **holdfasts**. You can see other smaller types of algae as the scum that forms on ponds or on aquarium walls.

Algae reproduce asexually that is when a new individual is produced from one parent only. They can reproduce by **simple fission** when cell divides into two cells producing two daughter cells that are exactly the same as the parent cell. Some algae can reproduce using **spores**. Spores are single cells and are produced in large numbers. They are light, microscopic and surrounded by a protective wall.

Other algae especially those that live in colonies simply divide by **fragmentation**. The colony simply divides when there is a strong current of water or when there is a bigger animal that creates a violent disturbance in water.

Algae are able to live in habitats where few other organisms could survive. They can live virtually wherever there is sunlight and adequate water or moisture. Algae are found in freshwater lakes, ponds, streams, swamps, on moist soil, wood and in any other marine environment wherever light can penetrate.



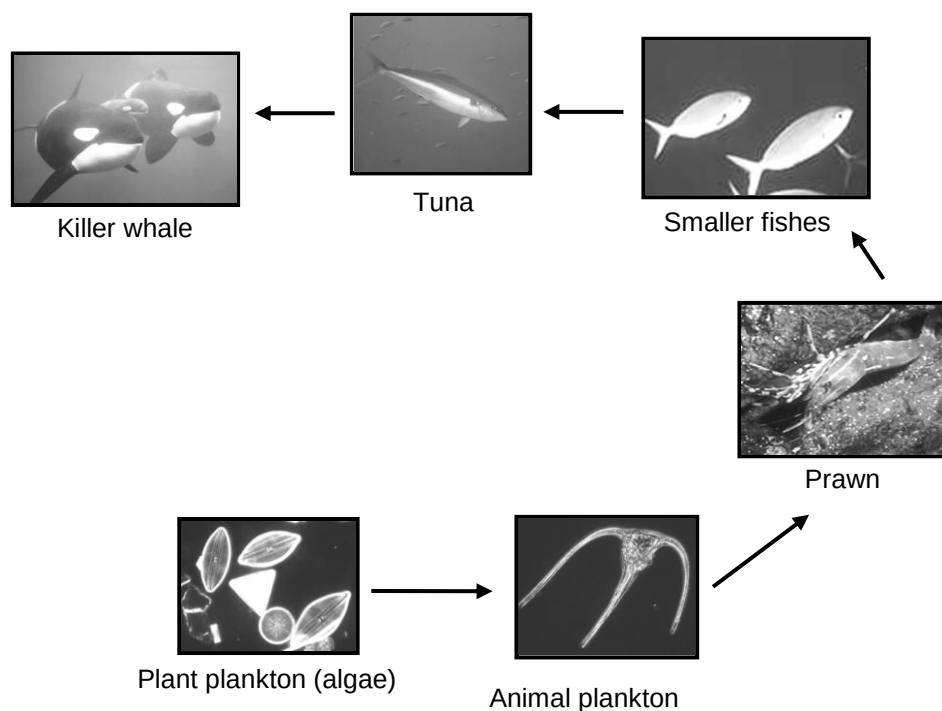
Algae can live even in the most difficult habitats like in the snowfields in Antarctica (left) and a thermal hot spring (right.)

A colony of green algae exposed at low tide. Algae can withstand violent wave action.

Importance of Algae

Algae are harvested and can be used as a food source, as fertiliser, as raw material for an antiseptic solution used for cleaning wounds. They are also used in the making of many lotions, creams, cosmetics, dairy products, and in printing, chemical and textile industries.

Dead remains of algae are collected from old lake beds, washed and cleaned and used to filter many liquids such as swimming pool water. Floating microscopic algae or plant plankton is an important food source for many water-living animals.



A diagram showing algae as the main source of food in a Baleen whale food web. The arrows show which animals prey on them.



Activity 1: Now test yourself by doing this activity.

The missing words in the sentences below can be found written across, diagonally, upwards, downwards, or in reverse in the following word maze. Fill in the missing words, and find them in the word maze. The first one is done for you.

1. Algae are simple water plants that do not have true roots, stems and leaves.
2. Algae like other plants have a green pigment _____ that enables them to make their own food by _____.
3. Algae also vary in size from extremely small and _____ plant plankton to giant _____ which can grow up to 60 metres in length.
4. Single-celled algae like plant planktons are free-floating while larger algae like the _____ fix themselves to rocks or other supports by root-like structures called _____.
5. Algae can reproduce by simple _____ when a parent cell divides into two daughter cells that are identical to the parent.
6. Some algae can produce a large number of _____ that are light, microscopic and surrounded by a protective wall.
7. Algae that live in colonies reproduce by _____ when there is strong water current or a violent water disturbance.
8. Algae can live virtually anywhere wherever there is _____ and adequate _____ or moisture.

Word Maze

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

Mosses and liverworts

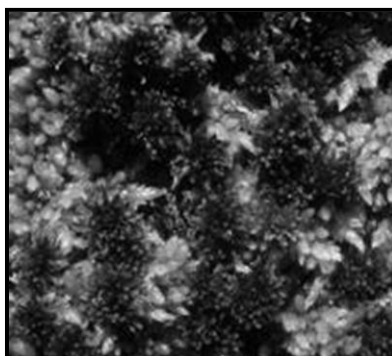
Mosses and liverworts are tiny plants that grow flat and very close to the ground like cushions or carpets. They do not have true leaves, stems or roots. This is why they need to live close to a water source or in moist areas on soil, tree trunks, and rocks.

These primitive land plants are held together by a root-like structures called **rhizoids** that fix them to the ground. Their leaf-like structures have no conducting tissues and absorb water and nutrients from the moist surrounding.

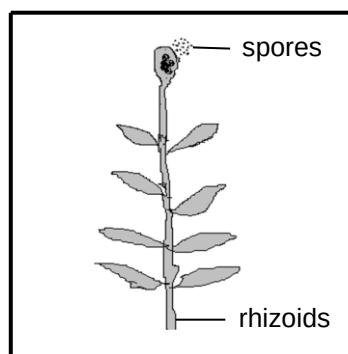
These simple plants reproduce sexually but they can also reproduce asexually by **spores**. Their resistant spores are spread by wind and other carriers and can survive for long dry periods without dying. During dry seasons, the plant dies off, but when wet season returns, the dried moss begins to absorb large amounts of water and starts growth.



Moss growing on a tree trunk



Sphagnum moss grows in swamps and bogs



Rhizoids are root-like structures which fix moss plants to the ground but do not absorb water.

Importance of mosses and liverworts

Mosses and liverworts can grow on rocks and play an important role in the process of weathering. They usually are the first organisms to colonize a new community and start the process of changing communities.

Living and dead mosses that turn into compost are used as good soil conditioners. Dried sphagnum moss absorbs water well and is used in babies' nappies.



Summary

You have come to the end of lesson 6. In this lesson you have learnt that:

- small and large algae are confined in water because they do not have true roots, stems and leaves.
- there are several methods of reproduction observed amongst several groups of algae. They are simple fission, spore production and fragmentation.
- mosses and liverworts are land plants that do not have proper roots, stems or leaves.
- mosses and liverworts reproduce by spores.

NOW DO PRACTICE EXERCISE 6 ON THE NEXT PAGE.



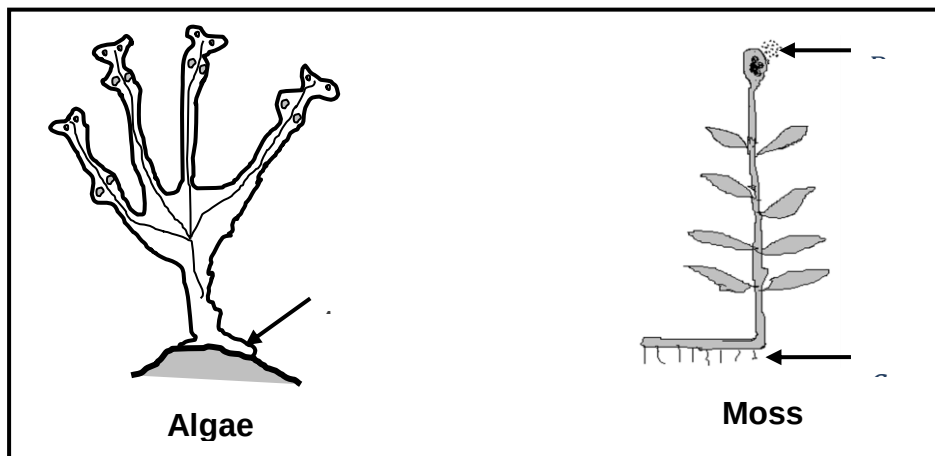
Practice Exercise 6

Answer the following questions:

1. Read the following statements about simple plants. Write **T** if the statement is true and **F** if it is false.

Statement	T or F
1. Mosses can reproduce asexually by their spores.	
2. Algae can live adequately in well lit, dry and windy areas.	
3. Rhizoids are root-like structures that fix algae to rocks.	
4. Simple plants have chlorophyll and can perform photosynthesis.	
5. Plant planktons are a primary source of food for many aquatic animals.	

2. The diagrams below illustrate some simple plants. Study them and answer the following questions



- a. Identify the parts labelled **A**, **B** and **C**.
 A. _____ B. _____ C. _____
 - b. Which structure, A, B or C, has an asexual reproductive function?

3. Explain how simple plants differ from complex land plants in terms of structure.

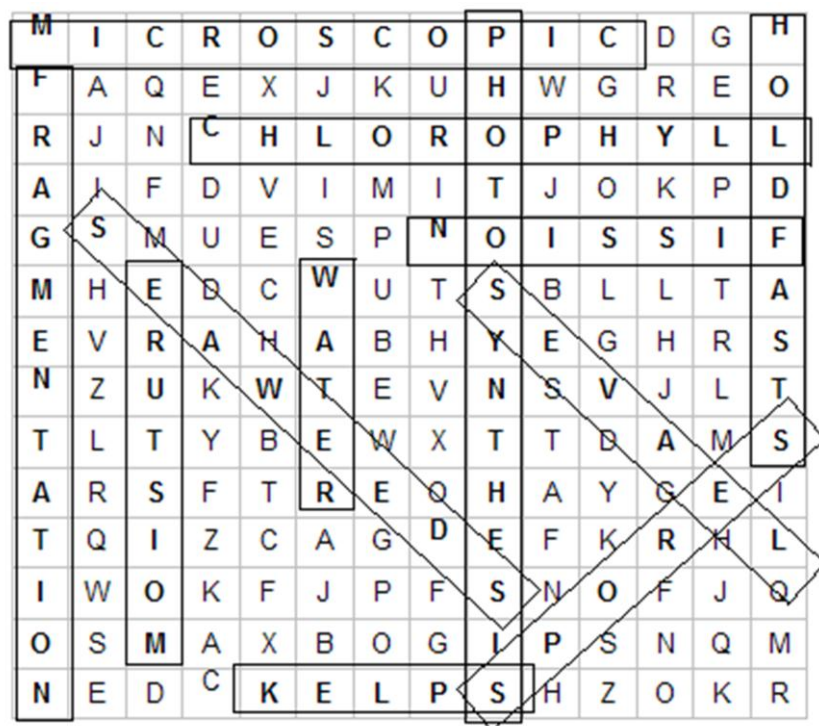
CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 2.

Answers to Activities

Activity 1

1. leaves
2. chlorophyll , photosynthesis
3. microscopic ,kelps
4. seaweeds, holdfasts
5. fission
6. spores
7. fragmentation
8. sunlight ,water

Activity 2



Lesson 7: Flowering Plants



Welcome to Lesson 7 of Strand 2. In the last lesson you learnt about the different types of simple plants. In this lesson you will learn about a more complex type of plants called Flowering plants. Scientists have counted about 260 000 different plant species on Earth altogether. This makes it easier to study, and groups them according to their structure. You have learned the structure of simple plants and their importance and functions in the environment. Now you will learn something about flowering plants.



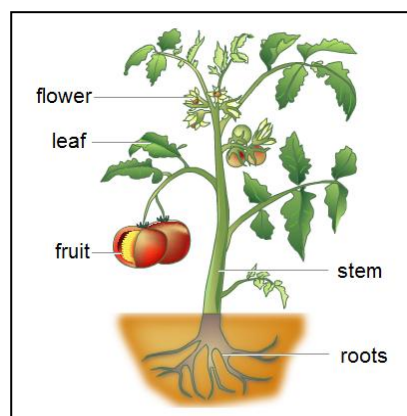
Your Aims:

- identify the structure of flowering plants
- describe the functions of the parts of flowering plants
- compare their method of reproduction with simple plants
- give their importance to the environment

Structure Of Flowering Plants

Flowering plants manufacture their own food from air, water and sunlight in a process called photosynthesis. All flowering plants have stems, roots and leaves.

The **stem** grows above the ground and functions to support leaves, buds, shoots, flowers and fruits. The **root** is the part below the ground that anchors the plant and absorbs the nutrients needed for growth and development. The root also specializes as a storage organ. It is in the **leaves** where the food production process called photosynthesis take place.



A flowering plant

Adaptations

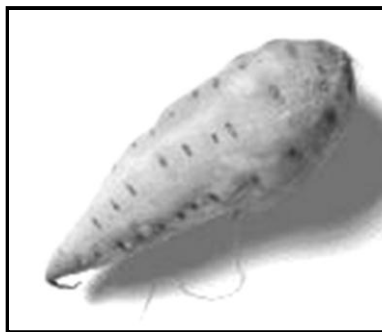
Plant organs have characteristics that help them become suitable for the kind of job they do and help plants survive in their environment. These characteristics are called **adaptations**.

The main function of the roots is to hold the plant in the ground and support the shoot. This is called **anchorage**. Roots also function to absorb water and minerals from the ground so that they can be conducted by special tubes to the shoots.

Many plants however developed roots that are adapted or are **modified** to perform special functions. Some examples are shown below:



Roots for support
(prop root of)



Roots for storage
(*'kaukau'*)



Aerial roots
(aerial plant)



Roots for breathing
(breathing roots of mangrove)



Parasitic roots
(*'pikus'*)



Roots for support
(buttress roots of a rain tree)



Activity 1: Now test yourself by doing this activity.

Match the descriptive functions to the type of adaptations observed in the following stems and leaves. Write the correct letter on the space provided.

Descriptive function	Adaptation
____ 1. mangroves secrete salts in their modified leaves	A. for food storage
____ 2. venus flytrap lures and traps insects in its leaves	B. for climbing
____ 3. onion bulbs are specialized leaves	C. for floating
____ 4. lemon grass leaves are sharp with repelling odour	D. against saltwater
____ 5. cactus stem swells up after a big rain	E. against loss of water
____ 6. african violet leaves develop roots and grow	F. for food getting
____ 7. waxy leaves of coconuts and spiny leaves of cactus	G. for vegetative reproduction
____ 8. snake beans' stems have curling tendrils	H. against grazing animals
____ 9. lilies have wide leaves with lots of air spaces	I. for capturing sunlight
____ 10. taro leaves have a large surface area under the shade	J. for water storage

Variations

If you are an observant student, you may have noticed differences in the root system and shape of leaves in various plants. This difference in features is called **variation**.

Variation can be observed in the growth of stems. Stems can be horizontal, underground, climbing or long and thin. Leaves can vary in the arrangement of their veins. Roots can have a tap root system or a fibrous root system.

Some pictures of variation are given below.

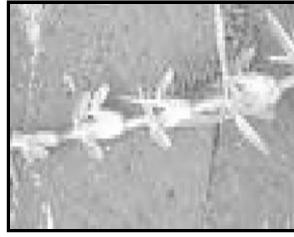
Variation in the stems



A mango is an Upright tree



Ginger is an Underground rhizome



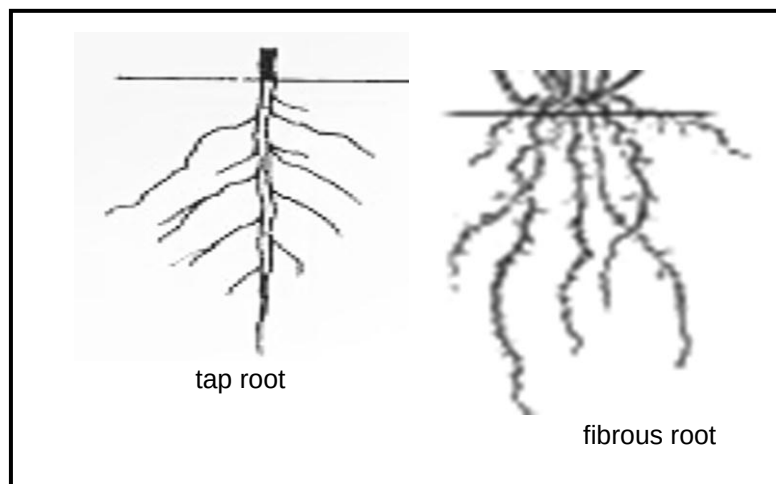
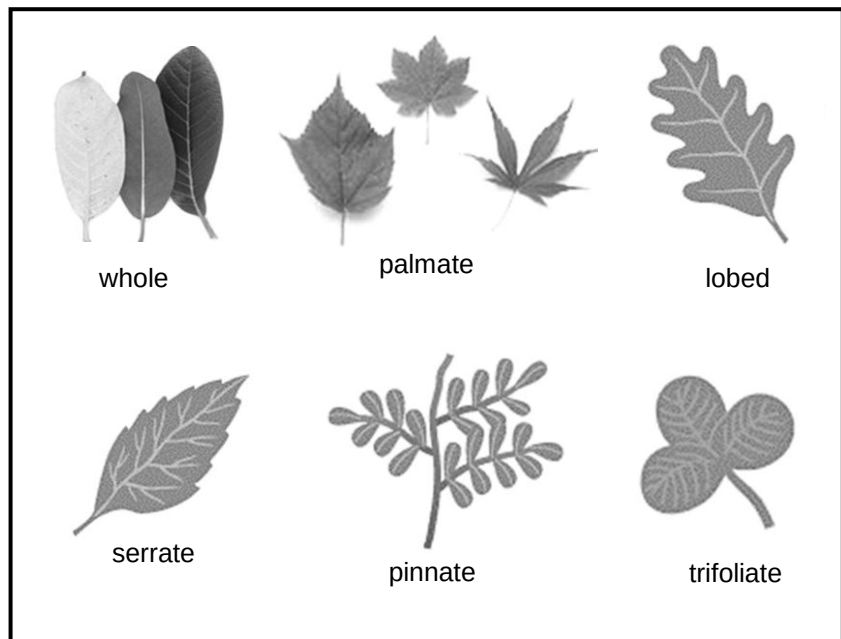
Pumpkin runner



Bean Vine



Variation in the arrangement of veins



Variation in the root system



Activity 2: Now test yourself by doing this activity.

1. Examine the leaves of the following plants: **pawpaw, mango, coconut, tapiok, kunai** and **five 'kona'**.
2. Study the arrangement of their veins and the variation in their shape and form and use these observations to complete the following table. The first one is given as an example.

leaf	arrangement of veins	shape and form
pawpaw	network	palmate
mango		
coconut		
tapiok		
kunai		
five 'kona'		

Reproductive process of flowering plants

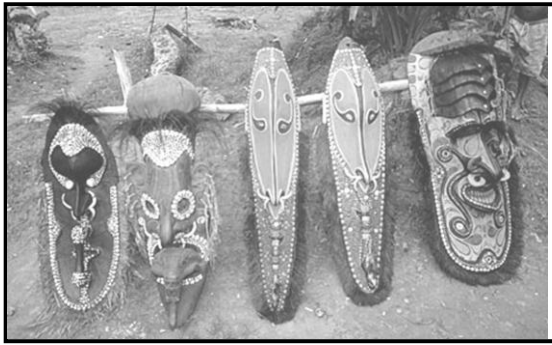
Their ability to produce flowers as organs for plant reproduction is another feature of flowering plants. This tells the difference from simple plants and non-flowering plants. When flowers are pollinated, they can ripen into a fruit that bears seeds. Each seed contains a potential plant or embryo and can germinate or grow into a new plant once dispersed. Some flowering plants can produce new plants asexually, by use of seeds or cuttings.

Importance of flowering plants

Flowering plants provide us with oxygen, food, materials for clothing and building, firewood, paper and medicine. Flowers are used to make expensive perfumes, herbs and spices, dyes and drinks. These plants provide shade and a habitat for some organisms. Flowers and attractive plants decorate houses. Flower farming is an important industry in many countries.



Popular drinks come from flowering plants. Chocolate, coffee, tea and wine come from (left to right) cocoa beans, coffee beans, tea leaves and grape fruits



Wood of flowering plants can be used to make traditional figure carving and masks.



Some flowers and leaves are used as 'bilas' often worn during cultural festivities.



Flowering plants provide a source of food, medicine and timber.



Because of their important uses many countries including PNG rely on plants such as (from left to right) coconuts, oil palm, cocoa and coffee for most of their jobs and wealth.



Summary

You have come to the end of lesson 7. In this lesson you have learnt that:

- flowering plants have well developed roots, stems and leaves. They have green pigment chlorophyll in their leaves and can make their own food.
- flowerings of the flowering plants are used for reproduction
- adaptation refers to the way living things change to make it suitable for its way of life.
- variation refers to the differences in the structures of a group of living things.
- flowering plants should be taken care of because of their importance to all living things.

NOW DO PRACTICE EXERCISE 7 ON THE NEXT PAGE.



Practice Exercise 7

Answer the following questions:

Part A. Multiple Choice

Write the letter of the best answer in the box provided.

1. The diagram on the right shows a



- A. prop root.
- B. climbing root.
- C. tap root system.
- D. fibrous root system.

2. Photosynthesis generally takes in which part of a flowering plant?

- A. stem
- B. root
- C. leaf
- D. flower

3. Waxy leaves is an adaptation to

- A. reflect sunlight.
- B. prevent too loss of water.
- C. repel insects and grazing animals.
- D. get rid of extra salt in the plant system.

4. Which is NOT likely a root function?

- A. support
- B. food storage
- C. absorb nutrients
- D. food production

5. The picture below shows rose flowers in different breed, shape and colour.

This is an example of _____.

- A. variation
- B. adaptation
- C. reproduction
- D. modification



Part B. Short Answers

1. Explain why flowering plants, unlike simple plants, are well adapted to growing in the soil.

2. Give three ways in which flowering plants help other animals.

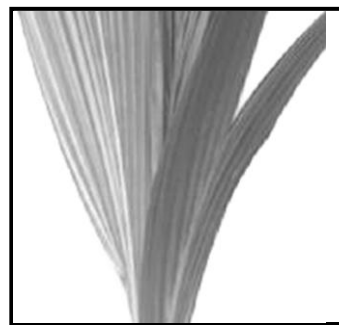
3. Tick the correct description of the following leaf variation.

- a. The palm leaf on the right have

parallel veins

☐

network veins

☐

- b. The compound leaf on the right is

palmate

☐

pinnate

☐

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 2.

Answers to Activities

Activity 1

Descriptive function	Adaptation
<u>D</u> 1. mangroves secrete salts in their modified leaves	A. for food storage
<u>F</u> 2. venus flytrap lures and traps insects in its leaves	B. for climbing
<u>A</u> 3. onion bulbs are specialized leaves	C. for floating
<u>H</u> 4. lemon grass leaves are sharp with repelling odour	D. against saltwater
<u>J</u> 5. cactus stem swells up after a big rain	E. against loss of water
<u>G</u> 6. african violet leaves develop roots and grow	F. for food getting
<u>E</u> 7. waxy leaves of coconuts and spiny leaves of cactus	G. for vegetative reproduction
<u>B</u> 8. snake beans' stems have curling tendrils	H. against grazing animals
<u>C</u> 9. lilies have wide leaves with lots of air spaces	I. for capturing sunlight
<u>I</u> 10. taro leaves have a large surface area under the shade	J. for water storage

Activity 2

leaf	arrangement of veins	shape and form
pawpaw	network	palmate
mango	network	whole
coconut	parallel	pinnate
tapiok	network	palmate
kunai	parallel	whole
five 'kona'	network	pinnate

Lesson 8: Non-flowering Plants



Welcome to Lesson 8 of Strand 2. In the last lesson you learnt about flowering plants. In this lesson you will learn about another group of plants that do not bear flowers called the non-flowering plants. There are hundreds of thousands of different types of plants. You have learned about simple plants and complex flowering plants. However not all plants bear flowers. There are two main groups of non-flowering plants – ferns and conifers.



Your Aims:

- identify the non-flowering plants
- describe their structure and explain how these help them to live in different environments
- compare their method of reproduction with flowering plants
- give their importance to the environment

Ferns

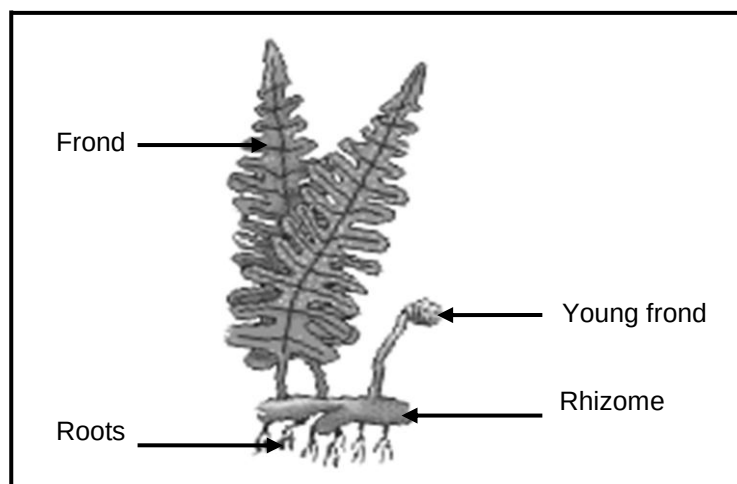
Ferns are non-flowering plants with roots and a short, thick underground stem called rhizome. Ferns have a feather-like leaves called **fronds** which are initially curled up in tight bundles but later unfold and open out above the ground.

These non-flowering plants also have hard veins or ribs that carry water and food for the plant. The veins also function for leaf support. Ferns are good for mumu especially in the highlands.



Fern leaves or fronds

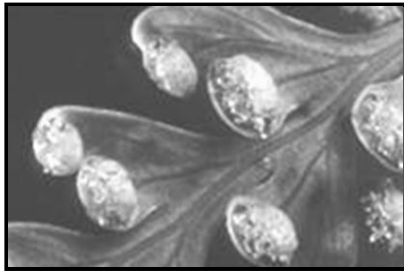
Ferns are found throughout the world. Most grow in damp, shady places, although certain species grow on dry ground or rocks. Some ferns, in fact, grow only in rocky places. Others grow as **epiphytes** or air plants, on trees. Giant ferns can grow up to about 20 metres.



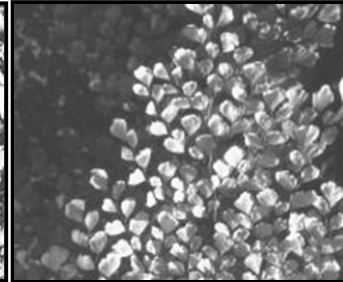
A fern showing the roots and stem underground and the leaves or fronds above the ground.

Ferns do not bear flowers or seeds. Mature ferns reproduce by growing **spores** on the underside of their fronds. Spores are small, light, numerous, sticky and are enclosed in a capsule underneath the leaves.

Upon drying out, the capsule enclosing the spores breaks open and in many cases catapults the spores into the air. The spores' size and weight allow them to be easily scattered by the wind. The spores' stickiness allows them to easily attach to passing animals that accidentally brush through the ferns. These are how the spores get dispersed.



spore-bearing capsules on the underside of a fern leaf



The soft shield fern (left) and the maidenhair fern (right) have become popular domestic plants in Papua New Guinea because of their beautiful leaves.

Conifers

Conifers are mostly evergreen trees that have narrow, **needle-like leaves**. These non-flower bearing plants live in temperate regions with very low precipitation. The needle-like leaves serve as an adaptation to lose less water so that the trees can survive long periods without rain.

Conifers do not bear flowers. They have **cones** instead. Cones come in two types – the male cone which produces pollen and the female cone which produces seeds.

The small male cones grow yearly in groups at the base of new shoots. Female cones grow for two years, slowly increasing in size.

When the female cones are matured, their **seeds** get exposed. Seed dispersal can be carried by the wind or can be mechanically dispersed when mature cones fall from great heights.

Conifers vary in size from shrubs to the giant sequoias. Cedar, cypress, fir, hemlock, juniper, larch, pine, sequoia, spruce and yew are examples of coniferous trees.



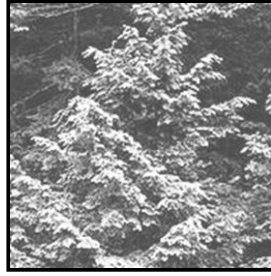
Each needle-like leaf has a waxy coating that helps prevent water loss.



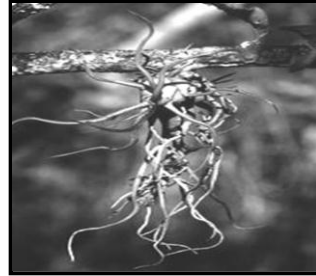
Cones bear naked seeds which when dispersed can develop into new conifers.



Pines



Spruce



Cedar



Juniper



Cones and needles on a fir tree



Northern coniferous forest



Yew

Importance of ferns and conifers

Some ferns are eaten as greens while other ferns are planted to decorate houses, parks and buildings. They can also be used to accentuate flower arrangements.

Evergreen conifers cover vast regions of the temperate places on earth. They provide shelter and protection to migrating animals during winter. Conifers are harvested for use as fuel and wood pulp, and in home construction, shipbuilding, and the manufacture of paper.



Activity: Now test yourself by doing this activity.

Examine the leaves of a non-flowering plant on the right and answer the following questions.



1. Describe the shape of the leaves.

2. Is the leaf familiar to you? Have you seen it before?

3. Name the tree where these leaves likely came from.

4. Where in PNG can this tree be found in abundance?

5. Suggest the type of environment these leaves is adapted or modified for?



Summary

You have come to the end of lesson 8. In this lesson you have learnt that:

- flowering plants have well developed roots, stems and leaves. They have green pigment chlorophyll in their leaves and can make their own food.
- flowering plants bear flowers and use them to reproduce sexually.
- adaptation refers to the way living things has changed to make it suitable for its way of life.
- variation refers to the differences in the structures of a group of living things.
- flowering plants should be taken care of because of their importance to all living things.

NOW DO PRACTICE EXERCISE 8 ON THE NEXT PAGE.



Practice Exercise 8

Answer the following questions:

- The following are words or phrases that may describe non-flowering plants. Classify whether they refer to ferns or conifers by writing them in their correct boxes below.

needle-like leaves fronds evergreens spores rhizomes
naked seeds pines maidenhair cones feather-like leaves

ferns	conifers

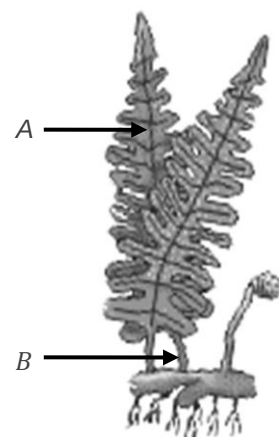
- Why are the leaves of conifers narrow and needle-like?

- The illustration on the right shows a soft-shield fern.

- Identify the parts of the fern labelled **A** and **B**.

A. _____ B. _____

- Describe how ferns reproduce.



4. Human activities such as logging and urbanization reduce the population of conifers in temperate parts of the world. How do these activities affect the animals that rely on the coniferous forest?

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 2.

Answers to Activity

1. The leaves are narrow; the leaves are needle-like
2. Yes/no
3. Pine
4. In the highlands
5. Cold or temperate environment

Lesson 9: Simple Invertebrates



Welcome to Lesson 9 of Strand 2. In the last lesson you learnt about non flowering plants. In this lesson you will learn about the different groups of animals. We will start with simple vertebrates. An invertebrate is an animal without a backbone or vertebral column. Some live on land, water and in the air. Can you believe that 97 per cent of all the animals on earth are invertebrates? This is because there are too many of them, so they are divided into nine major groups according to their characteristics.



Your Aims:

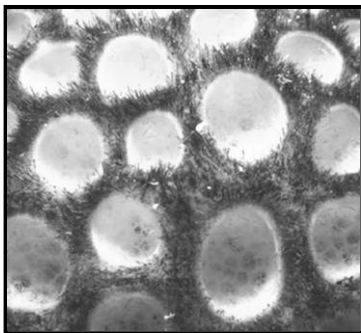
- identify the simplest and most primitive invertebrates
- describe the characteristics of each group
- list the importance to these simple animals to the environment.

Sponges, coelenterates, worms and molluscs are considered the simplest, most primitive invertebrates because they have little development in their internal systems and structures.

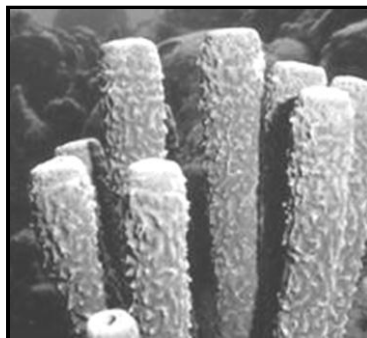
Sponges

This group of aquatic or water invertebrates, is covered with pores. Most sponges can be found in the sea although some are capable of living in freshwater habitats.

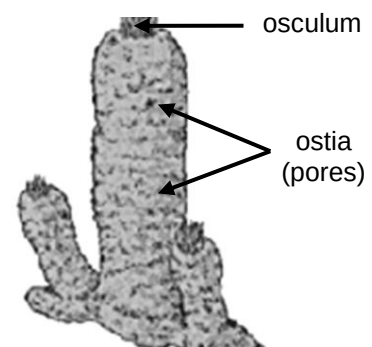
Sponges feed by moving water into their incoming pores and by filtering tiny plants and animals (planktons) and pieces of dead organisms. Water moves out through a large opening at their top called **osculum**.



Yellow globular sponges



Purple tube sponges



Structure of a sponge

The male and female sponges can produce sex cells which unite and form a young sponge during sexual reproduction. They can also reproduce asexually by **regeneration** where small parts break off and re-grow to form a new sponge.

Sponges are very important reef animals because they keep the water free of dead materials providing a good place for other animals to live. Some sponges are gathered by divers. They are dried, bleached and dyed, and sold commercially as bath and kitchen sponges.



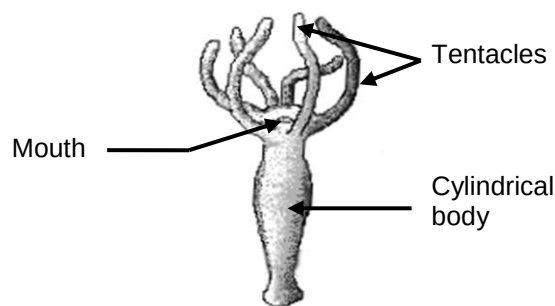
This skeleton of a sponge is cut into block, dyed and sold as a bath sponge in shops.

Coelenterates

Another simple invertebrates are Coelenterates. They have, cylinder-shaped, jelly-like bodies with mouths surrounded with **tentacles**. Many have **stinging cells** on their tentacles to help capture prey. Most live in oceans, and a few are known to live in fresh water.

They come in two forms: polyps and medusas (medusae). **Polyps** are sessile coelenterates that are attached to rocks or debris on the sea bottom. They live in colonies with a plant-like appearance, such as the **hydra**, **sea anemone** and the reef-building **corals**.

Medusae are coelenterates that swim freely. They include the **jellyfish**. Their prey is captured by the tentacles and killed by poisons ejected by the stinging organs. The food is then ingested in the mouth which also acts as an excretory organ. They reproduce both by **asexual** (budding or regeneration) and **sexual** reproduction.



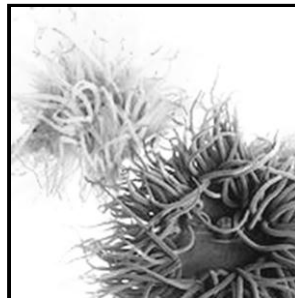
Structure of a coelenterate



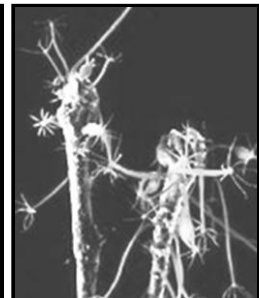
Coral polyp



Jelly fish



Sea anemone



Fresh water hydra



Activity 1:

Now test yourself by doing this activity.

1. What is the main difference in the generally body features of sponges and coelenterates?

2. Give three common features of sponges and coelenterates.

3. Explain why the tentacles of jellyfishes sting.

Roundworms

Roundworms are cylindrical, tapering and unsegmented worms. Most are found in the surface layers of moist soils and can live in marine and freshwater. Many roundworms are harmful living as parasites in plants and animals, including humans. A **parasite** is an organism that lives on or in another living organism known as the **host**. Parasites survive by getting their food from their hosts. Some may cause serious diseases.

The sizes of round worms range from microscopic to about 10 cm long. They are known to reproduce sexually. Roundworms include hookworms, eelworms, trichina and filarial.



Unsegmented roundworm

Flatworms

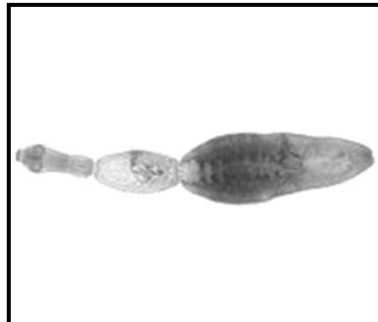
The flatworms are flat, soft and with bilateral (having two sides) bodies with heads. Some flatworms are free-living while others are parasitic.

Free-living flatworms, like **planaria**, are found in almost every kind of environment, on land and in fresh and salt water. They eat a variety of foods, including plankton, carrion, earthworms, snails, insect larvae, and small crustaceans.

The larvae of parasitic worms like **tapeworms** and **flukes** usually enter the mouth of their host animal from contaminated food or water. They develop inside their host's body and cause harm. The tapeworm is one of the biggest and most successful parasites. This worm lives inside the digestive system of another animal, such as a bird, fish or mammal. The tapeworm survives by absorbing some of its host's digested food. The longest tapeworm to infect humans can grow to an amazing 10 metres, at least five times longer than the person in which it lives.



Flukes



Tapeworm



Aquatic flatworm

Roundworms and flatworms can reproduce **sexually**. They are also able to reproduce **asexually** both by **binary fission** - that is, by pinching themselves apart to become two - and by **regeneration**, producing an entire new worm from a piece that has been cut off.

Segmented worms

Segmented worms have bodies made up of a number of segments. Which is the head, mouth and anus? They reproduce sexually.



Earthworm

Most **bristle worms** live in the sea. The **earthworms** generally live in the soil although some can survive in fresh water and their bodies are streamlined and well adapted to burrowing. Their thin and moist skin is well adapted for breathing and absorbing nutrients from the soil.

The flat **leeches** live in fresh water, but there are a few species on land and in the sea. Most leeches get their nutrients by sucking the blood of other animals.

Earthworms are very valuable in the garden. They aerate the soil and enrich it with nutrients. Leeches are used medically to facilitate blood flow after micro-surgery. Chemicals from their saliva are used as an anticoagulant to prevent the blood from clotting.



Parasitic leech



Activity 2: Now test yourself by doing this activity.

Read the following statements about simple plants. Write **T** if the statement is true and **F** if it is false.

Statement	T or F
1. All worms are harmful.	
2. Earthworms are segmented worms that generally live in the soil.	
3. A roundworm performs binary fission when it pinches itself apart to become two new roundworms.	
4. Earthworms are segmented worms that generally live in the soil.	
5. Parasitic worms rely on the nutrients of their hosts and cause them harm.	

Molluscs

These soft-bodied invertebrates usually have hard, protective shells, which is the second-largest in the animal kingdom. They are found in marine (salt-water), freshwater, and terrestrial (land) habitats.

Snails are molluscs with only one shell. The shell is used to hide its body in times of danger. **Slugs** look like snails but they don't have a shell. Snails and slugs are herbivores. An **herbivore** is an animal that gets its energy from eating plants only.



Snail



Garden slug



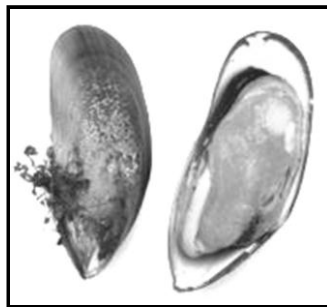
Sea slug

Clams, mussels and **scallops** are equipped with two shells hinged at one side. Some feed feeding on dead matter deposited on the bottom of bodies of water.

Others are **filter-feeders**. They filter and eat suspended materials like planktons and floating debris from the water.



Clams

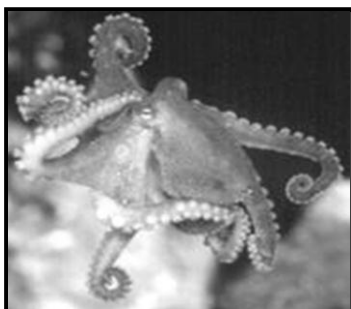


Mussels



Scallops

Octopuses, cuttlefish, and **squid** have no shells but have tentacles attached to their heads. They are active predators and are therefore carnivores feeding on other animals.



Octopus



Squid



Cuttlefish

These bigger molluscs are rather **advanced** and more complex in their behaviour and structure. They have highly developed muscles and sense organs and a nervous system that enables them to feel and learn from experience. They reproduce sexually.

Molluscs are abundant and therefore are important in food webs in many habitats. Numerous molluscs are important food sources for humans, but some like snails and slugs damage crops, and others harbour disease-causing parasites.



Summary

You have come to the end of lesson 9. In this lesson you have learnt that:

- invertebrates are animals without backbone or vertebral column.
- sponges, coelenterates, worms and molluscs are considered the simplest and most primitive invertebrates.
- sponges are animals with pores around their body.
- coelenterates are soft-bodied animals with tentacles around their mouth. They include hydra, jellyfish, corals and anemone.
- there are three types of worms: roundworms or nematodes, flatworms, and segmented worms or annelids.
- some worms are parasitic while others play an important role in the environment.
- molluscs are soft-bodied animals that usually have shells outside their body.

NOW DO PRACTICE EXERCISE 9 ON THE NEXT PAGE.



Practice Exercise 9

Answer the following questions:

Part A Multiple Choice

Write the letter of the best answer in the box provided.

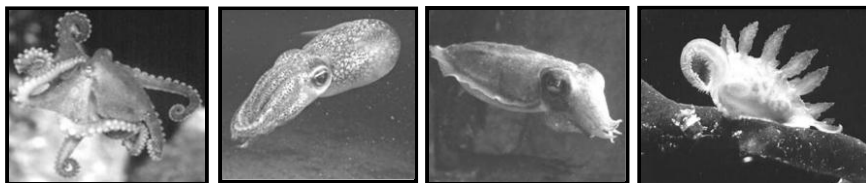
1. Invertebrates are animals with

- A. shells.
- B. tentacles.
- C. backbones.
- D. segmented bodies.

2. Which is a non-parasitic worm?

- A. Leech B. Fluke
- C. Filaria D. Earthworm

3. How are slugs, octopuses, squid and cuttlefish different from other molluscs?



- A. They are herbivores.
 - B. They have no vertebral column.
 - C. They have no protective shells.
 - D. They are perfectly adapted to any type of habitat.
4. Pick one that does not correctly describe octopuses, squid and cuttlefish.

- A. They are soft-bodied.
- B. They are large, free-moving and predatory animals.
- C. They have well-developed muscles and sense organs.
- D. They reproduce asexually by binary fission and regeneration.

5. Elephantiasis is caused by _____ and transferred by a mosquito to a _____ body.



- A. flatworms, host's
- B. roundworms, host's
- C. flatworms, parasite's
- D. roundworms, parasite's

Part B. Short Answers

1. What can parasites do to their host?

2. Give two benefits the soil can get from earthworms.

3. A coral and a jellyfish shown below belong to the same group of invertebrates. They have similar characteristics but at the same time have differences.



Coral polyp



Jelly fish

- a. Give one common characteristic between the two besides not having any backbone.

- b. Give one characteristic that differentiates one from the other.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 2.

Answers to Activities**Activity 1**

1. Sponges are covered pores while jellyfishes have tentacles around their mouth.
2. Both
 1. Have backbones
 2. Are aquatic
 3. Can reproduce sexually and asexually (by regeneration)
 4. Are generally free when they are young but become attached when they mature.
3. It helps them captures their prey.

Activity 2

1. **F**
2. **T**
3. **T**
4. **F**
5. **T**

Lesson 10: Advanced Invertebrates



Welcome to Lesson 10 of Strand 2. In the last lesson we looked at the simple invertebrates. In this lesson we will look at advance invertebrates.



Your Aims:

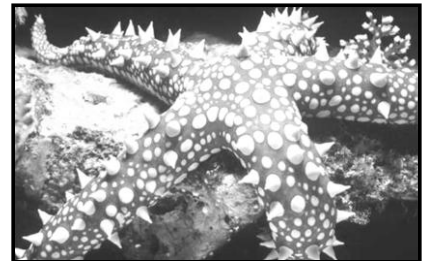
- identify the complex invertebrates
- describe the characteristics of each group
- give the importance to these animals to the environment

Advanced invertebrates have a more complicated structure, function, behaviour, and life cycle. They are grouped into **echinoderms**, **crustaceans**, **arachnids**, and **insects**.

Echinoderms

These are spiny-skinned invertebrates which show bilateral symmetry - their bodies can be divided into two sides. They also have a **tube feet** with suction that help them move around and look for food.

Echinoderms live in salt water and include **starfish**, **brittle stars**, **sea urchins**, **sand dollars**, and **sea cucumbers**. Although echinoderms are slow-moving and don't show complex behaviour patterns, their bodily functions and life patterns can be considered advanced. They reproduce by **sexual reproduction** although some like starfish can asexually reproduction by regeneration. They can grow back their limbs when they are cut off.



Starfish



Sea cucumber



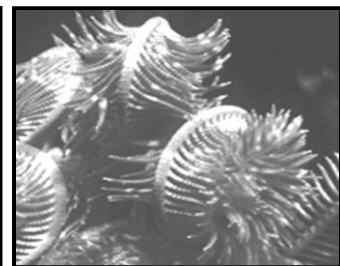
Brittle star



Sea urchin



Sand dollar



Sea lilies

Echinoderms generally live at the ocean bottom at all depths. In the deep sea they often make up the bulk of living material. Some are grazers or **herbivores** feeding on algae (most sea urchins), **filter-feeders** sifting small particles (many brittle stars), or **carnivores** preying on molluscs and smaller animals (most starfish). Starfish and a few others are pests or **parasites**, as when found in oyster beds. Sea cucumbers and sea urchins are eaten by human beings.

Crustaceans

Crustaceans are invertebrates with a hard external skeleton made of shell to protect their soft body. Crustaceans are generally aquatic with jaws, five pairs of legs, and two pairs of antennae such as the **crab**, **lobster**, and **shrimp**. They are among the most successful animals in any aquatic environment although a few, such as **woodlice**, are also abundant in moist land environments.

The body of crustaceans are usually divided into **thorax** and **abdomen**, each generally bearing a pair of branched limbs. The thorax is a fused head and neck region that holds the limbs that have become specialised for respiration, swimming, crawling, and feeding. Some of the limbs may form pincers. Prawns, shrimps, lobsters, and crayfish have tails which are used for swimming.



Crab



Lobster

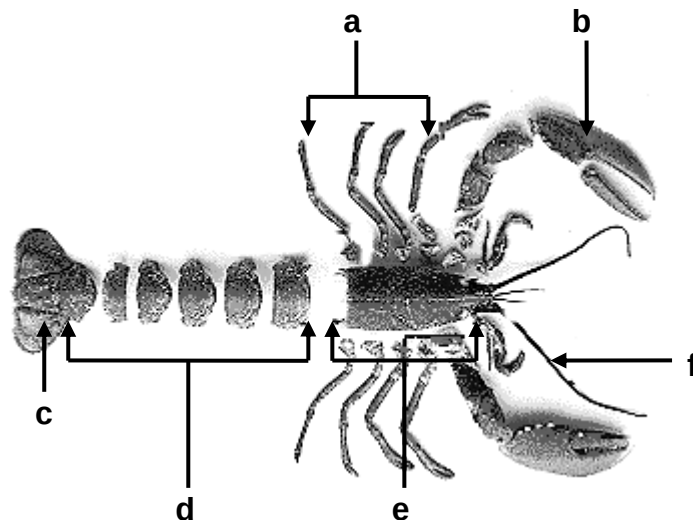
Most crustaceans breathe by means of their **gills** and reproduction is primarily sexual. A lot of crustaceans are mobile and free throughout their life cycle but some, like barnacles, become attached and sessile in their adult stage.



Activity 1: Now test yourself by doing this activity.

Use the words in the box to label the missing parts of a lobster.

thorax
abdomen
legs
pincer
tail
antenna



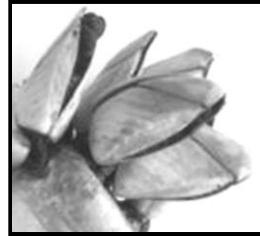
Crustaceans are important in the food chain because many of them eat small plants and animals. A lot of crustaceans are filter-feeders, straining small particles of food from the water. Larger crustaceans such as shrimp and crabs are often omnivores, scavengers, or predators. Several species are also parasites. Crustaceans, in turn, are eaten by many animals, including human beings, and are rich in protein.



Shrimp



Crayfish



Barnacles



Woodlouse

Arachnids

Arachnid is a scientific term to refer to invertebrates like **spiders, scorpions, ticks, and mites**. The arachnids' body tends to be divided into two parts: the head and neck or region which are fused and the abdomen.

The fused head and neck region or **thorax** usually has a pair of pincers, jaw, or poison fangs for cutting and biting, and a pair of feelers which may serve as feelers. They also have a four pairs of legs for walking. The **abdomen** bears the sexual organs and other structures



Scorpion

Most arachnids live alone except at the time of mating, when a variety of complex behaviour patterns may be observed. Sexes are separate, and females may guard the eggs or young.

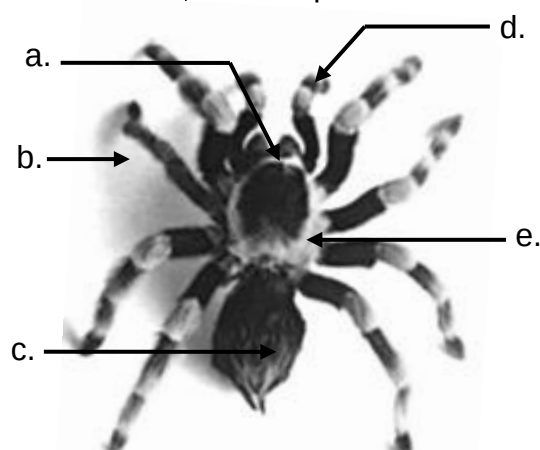
Arachnids are generally useful because they eat insect pests. Some scorpions are dangerously poisonous, however. Mites and ticks are parasites that infest human beings, domestic animals, and plants, thereby spreading diseases.



Activity 2: Now test yourself by doing this activity.

Use the words in the box to label the missing parts of spider.

thorax
abdomen
leg
feelers
jaw



Insects

With the exception of some molluscs, insects are the most highly developed of all the invertebrates. They have a nervous system and have a sense of sight, hearing, touch, smell and taste.

An insect's body is divided into three parts – the **head**, the **thorax**, and the **abdomen**. The three pairs of legs are attached to the thorax. Most insects also have two pairs of wings and a pair of antennae used to sense the surroundings.



Dragonfly

Insects such as the **bees**, **ants**, and **termites** have elaborate social structures in which different forms of activity important for the feeding, shelter, and reproduction of the colony are divided among individuals especially adapted for the various activities.



Mosquito



Ant



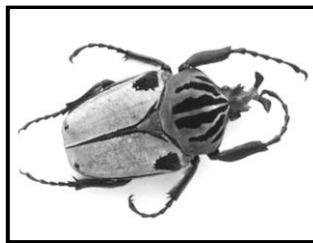
Locust

Insects also undergo **metamorphosis** which is a sudden change in development from larval to adult form. This means that they achieve maturity by metamorphosis rather than by direct growth. The butterfly metamorphoses from an egg (on a leaf), to a butterfly larva or caterpillar, then to a pupa or chrysalis, and finally into an adult butterfly or imago.

Insects are the most numerous of all animals. They are important agents of pollination. Some, like flies and beetles, are scavengers. They live in the decaying bodies of plants and animals and speed up the process of decomposition. Some species of bees are important source of honey.



Fruit fly



Beetle

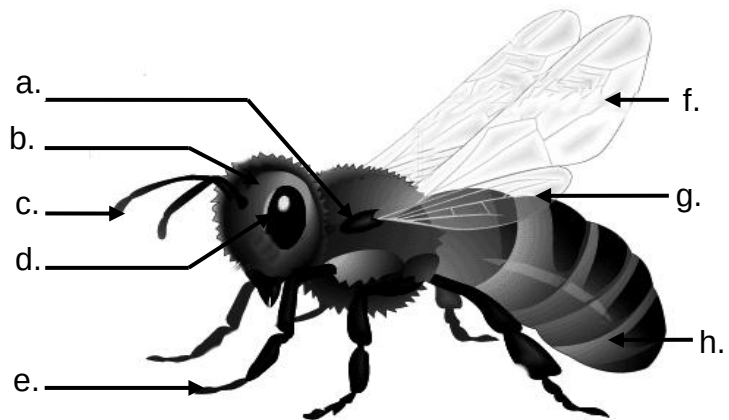
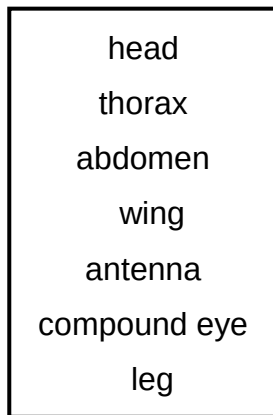


Bee



Activity 3: Now test yourself by doing this activity.

1. Use the words in the box to label the missing parts of a bee.



2. Use the following words - **larva**, **imago**, **egg**, and **chrysalis**, to identify and label the pictures showing the stages in a butterfly when it undergoes complete metamorphosis.





Summary

You have come to the end of lesson 10. In this lesson you have learnt that:

- any animal lacking a vertebral column, or backbone is an invertebrate.
- advanced invertebrates such as echinoderms, crustaceans, arachnids, and insects have a more complicated structure, function, behaviour, and life cycle.
- echinoderms are spiny-skinned invertebrates that include starfish, brittle stars, sea urchins, sand dollars, and sea cucumbers.
- crustaceans are invertebrates with a hard external skeleton made of shell. This group includes crabs, lobsters, crayfish, barnacles, prawns, shrimps and woodlice.
- arachnids are spiders, scorpions, ticks, and mites. They have four pairs of legs, pincers, and pair of feelers. Their body is divided into two regions - thorax and abdomen.
- insects are invertebrates with three pairs of legs, two pairs of wings and a pair of antennae. Their body is divided into three regions - the head, the thorax, and the abdomen.
- insects are the most numerous of all animals.

NOW DO PRACTICE EXERCISE 10 ON THE NEXT PAGE.



Practice Exercise 10

Answer the following questions:

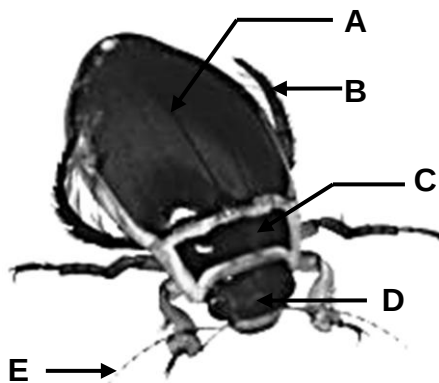
- Classify the invertebrates shown in these pictures into echinoderm, crustacean, arachnid, or insect.

picture	name	group
	hermit crab	
	ant	
	starfish	
	black scorpion	
	cockroach	

picture	name	group
	moth	
	lobster	
	ladybird beetle	
	black widow spider	
	sea urchin	

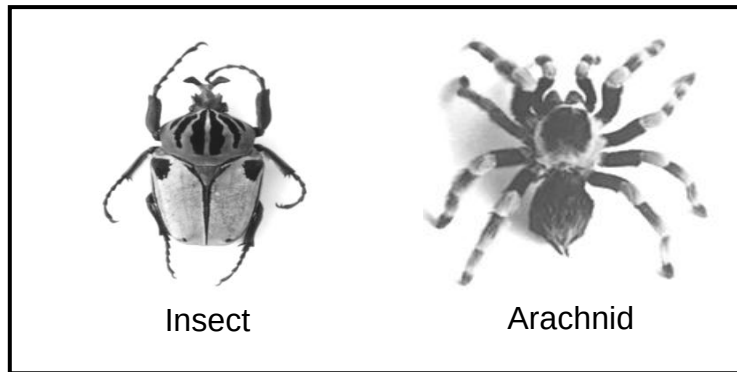
- The picture below shows a diving beetle.

Identify the structures labelled **A** to **E**.



- _____
- _____
- _____
- _____
- _____

3. Give the three major differences in the structure of the insect and arachnid in the images below.



4. What are invertebrates?

5. Explain how crustaceans are different from echinoderms base on their body covering.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 2.

Answers to Activities**Activity 1**

- a. legs
- b. pincers
- c. tail
- d. abdomen
- e. thoraxes
- f. antenna

Activity 2

- a. jaw
- b. leg
- c. abdomen
- d. feelers
- e. thorax

Activity 3

- a. thorax
- b. head
- c. antenna
- d. compound eye
- e. leg
- f. wing
- g. wing
- h. abdomen

2.



Egg



Larva



Chrysalis



Imago

REVIEW OF SUB STRAND 2: CLASSIFICATION OF PLANTS AND ANIMALS

Revise all the Lessons in this Sub Strand and then do **ASSIGNMENT 2**.
Here are the main points to help you revise.

Lesson 6: Simple Plants

- Small and large algae are confined in water because they do not have true roots, stems and leaves.
- There are several methods of reproduction observed amongst several groups of algae. They are simple fission, spore production and fragmentation.
- Mosses and liverworts are land plants that do not have proper roots, stems or leaves.
- Mosses and liverworts reproduce by spores.

Lesson 7: Flowering Plants

- Flowering plants have well developed roots, stems and leaves. They have green pigment chlorophyll in their leaves and can make their own food.
- Flowerings of the flowering plants are used for reproduction
- Adaptation refers to the way living things change to make it suitable for its way of life.
- Variation refers to the differences in the structures of a group of living things.
- Flowering plants should be taken care of because of their importance to all living things.

Lesson 8: Non - Flowering Plants

- Flowering plants have well developed roots, stems and leaves. They have green pigment chlorophyll in their leaves and can make their own food.
- Flowering plants bear flowers and use them to reproduce sexually.
- Adaptation refers to the way living things has changed to make it suitable for its way of life.
- Variation refers to the differences in the structures of a group of living things.
- Flowering plants should be taken care of because of their importance to all living things.

Lesson 9: Simple Invertebrates

- Invertebrates are animals without backbone or vertebral column.
- Sponges, coelenterates, worms and molluscs are considered the simplest and most primitive invertebrates.
- Sponges are animals with pores around their body.
- Coelenterates are soft-bodied animals with tentacles around their mouth. They include hydra, jellyfish, corals and anemone.
- There are three types of worms: roundworms or nematodes, flatworms, and segmented worms or annelids.
- Some worms are parasitic while others play an important role in the environment.
- Molluscs are soft-bodied animals that usually have shells outside their body.

Lesson 10: Advanced Invertebrates

- Any animal lacking a vertebral column, or backbone is an invertebrate.
- Advanced invertebrates such as echinoderms, crustaceans, arachnids, and insects have a more complicated structure, function, behaviour, and life cycle.
- Echinoderms are spiny-skinned invertebrates that include starfish, brittle stars, sea urchins, sand dollars, and sea cucumbers.
- Crustaceans are invertebrates with a hard external skeleton made of shell. This group includes crabs, lobsters, crayfish, barnacles, prawns, shrimps and woodlice.
- Arachnids are spiders, scorpions, ticks, and mites. They have four pairs of legs, pincers, and pair of feelers. Their body is divided into two regions - thorax and abdomen.
- Insects are invertebrates with three pairs of legs, two pairs of wings and a pair of antennae. Their body is divided into three regions - the head, the thorax, and the abdomen.
- Insects are the most numerous of all animals.

REVISE WELL AND THEN DO SUB STRAND TEST 2 IN YOUR ASSIGNMENT 2.
--

Answers to Practice Exercises 6- 10

Practice Exercise 6

1. **T** 2. **F** 3. **F** 4. **T** 5. **T**
 2. A - holdfast B – spores C - rhizoids
 b. B
 3. Simple plants do not have the true stems, roots and leaves that complex plants possess.
-

Practice Exercise 7

Multiple Choice Questions Write the letter of the best answer in the box provided.

1. **C** 2. **C** 3. **B** 4. **D** 5. **A**

Short answer questions

1. Flowering plants have a functional root system that can grow and absorb water and nutrients from the soil. (Simple plants have no proper roots so they must live in water to directly absorb it.)
 2. They provide food, oxygen, and shade or shelter.
 3. a. parallel veins ☒
 b. pinnate ☒
-

Practice Exercise 8

1.

ferns	conifers
fronds	needle-like leaves
spores	evergreens
rhizomes	naked seeds
maidenhair	pin
feather-like leaves	cones

2. To prevent water loss
 3. a. A - Fronds B - Rhizome
b. Ferns reproduce asexually by producing spores.
 4. Migrating animals will have no shelter and protection during winter season.
-

Practice Exercise 9

Multiple Choice Questions

1. **C** 2. **D** 3. **C** 4. **D** 5. **B**

Short answer questions

1. They can get nutrients from their hosts' body.
or
They can bring about serious diseases.
 2. The soil gets aerated.
The soil can get enriched with nutrients.
 3. a. Both have simple, cylinder-shaped, jelly-like bodies.
or
Both have tentacles (around their mouth)
or
Both are aquatic.

b. A coral is sessile (attached, not mobile) while a jellyfish is free-swimming.
-

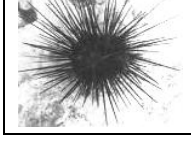
Practice Exercise 10

1. Classify the invertebrates shown in these pictures into echinoderm, crustacean, arachnid, or insect.

picture	name	group
	hermit crab	crustacean
	Ant	Insect

picture	name	group
	moth	insect
	lobster	crustacean

	starfish	echinoderm
	black scorpion	arachnid
	cockroach	insect

	ladybird beetle	insect
	black widow spider	arachnid
	sea urchin	echinoderm

2. A - abdomen B - leg C - thorax D - head E - antenna

3. The insect has three pairs of legs while the arachnid has four.

The insect has wings while the arachnid doesn't have any.

The insect's body is divided into three parts – the head, thorax, and abdomen; the arachnid's body is divided in only two parts – the thorax and the abdomen.

4. Animals with no backbone, or vertebral column.

5. Crustaceans are covered with shells while echinoderms are covered with spines.

SUB STRAND 3

CLASSIFICATION OF VERTEBRATES

In this sub strand you will learn about:

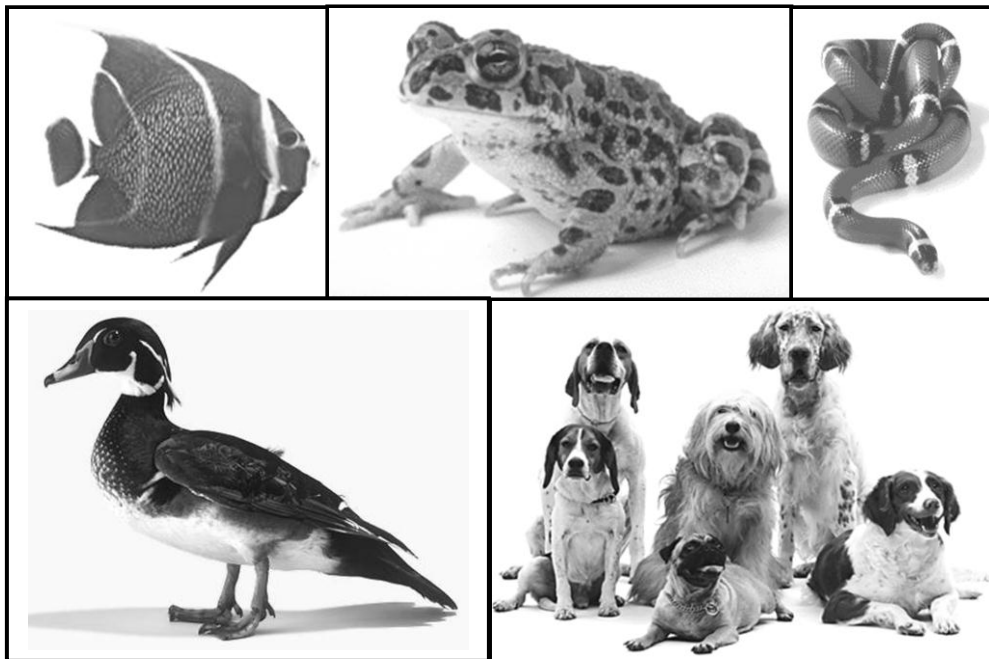
- **fish and amphibians**
- **reptiles**
- **birds**
- **mammals**

SUB STRAND 3: CLASSIFICATION OF VERTEBRATES

Introduction

About 3 per cent of all the animals on Earth are vertebrates. Vertebrates are animals with backbones and skeletons inside their bodies. They differ in their body structure, their type of body covering and in the manner in which they give birth to their young. Mammals are in fact easily grouped using these differences.

There are five groups of vertebrate animals – fish, amphibians, reptiles, birds and mammals. This sub-strand describes the characteristics of each group and also highlights how each group is sorted or classified.



In this sub-strand you will have the opportunity to:

- Name the different groups of vertebrates.
- Give examples of each group of vertebrate.
- Group vertebrates according to their characteristics.
- Give the importance of each group of vertebrates to humans and the environment.

In this Sub strand you will find the answers to these questions and all other questions relating to the classification of vertebrates.

Lesson 11: Fish and Amphibians



Welcome to Lesson 11 of Strand 2. In the last lesson you learnt about animals with backbones or vertebral column are called **vertebrates**. In this lesson you will learn about two other groups of animals called Fish and Amphibians.



Your Aims:

- describe the physical features of fish and amphibians
- compare the body coverings and other features of fish, amphibians and reptiles and find out how these help them live in their environment
- list down the importance of fish and amphibians

Fish

Vertebrates that are covered with **scales** are called Fish. Fish have gills that allow them to breathe in water. And they easily swim in water because they have fins and tail aided by their streamlined, body shape and overlapping scales.

Most fish have one or two fins on the back (**dorsal fins**). On the underside is a pair of fins near the gills (**pectoral fins**), another pair further back on the belly (**pelvic fins**) and one or more near the tail (**anal fins**). Other fish look very different. Some, such as eels, have long snake-like bodies. Flatfish have a very flattened shape with eyes on the same side of the head so they can lie on the seabed and look upwards

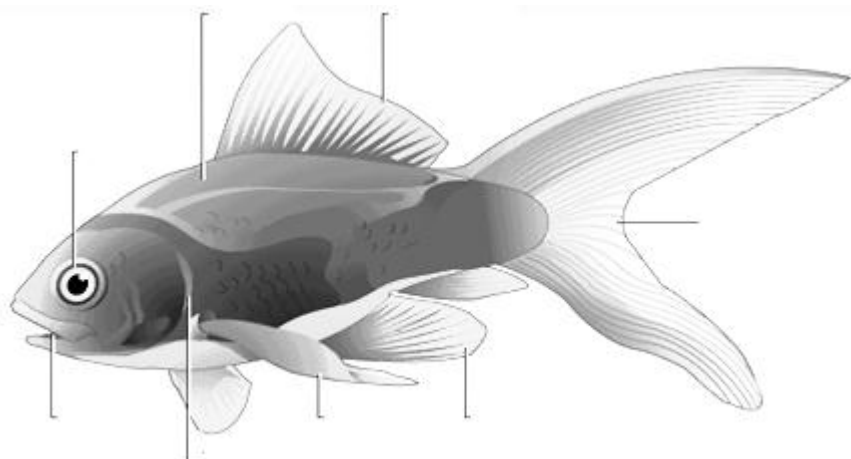


Activity 1: Now test yourself by doing this activity.

Most fish have the same features. Gills allow the fish to take oxygen from water. Its tail and fins help maintain its balance and also propel the fish through the water.

Use the words in the box to label the features of a fish.

mouth
eye
gills
scales
dorsal fin
pectoral fin
pelvic fin
tail fin



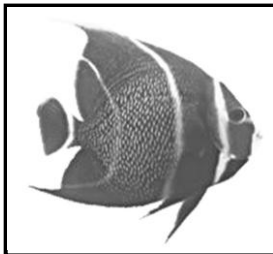
Fish are **cold-blooded**. This means that their body temperature is not constant but changes with the environment. Although most fish reproduce by laying eggs with no shell, there are some like sharks and rays that give birth to live young.

Most fish have a protective colouration that allows them to camouflage or blend with their surroundings. This helps them hide from their predators. Fish have good eyesight and a powerful sense of smell. They are also highly sensitive to vibrations caused by movement of objects in the water.

Types of fish

There are three types of fishes: bony fishes, cartilage fishes, and jawless fishes.

Bony fishes have bony internal skeleton and flat scales all over their body. They have swim bladder that can be filled with air which allows them to rise or sink in water. Most fish belong to this group.



Angelfish



Eel



Goldfish



Marlin

Cartilage fishes have a skeleton made of cartilage or gristle. They are covered with rough scales and have no swim bladder. They need to keep swimming to prevent sinking down to the bottom. Sharks and rays are examples of cartilage fish.



Sharks



Rays



Jawless fishes have no real jaws. They have a simple mouth like a slit and eat by pushing their tongue into a prey to tear off lumps of flesh. Jawless fish have a round, sucker-like mouth lined with teeth. They attach themselves to their victim and suck their blood. Jawless fish includes lampreys and hagfish.



Hagfish



Lamprey clinging to a fish



Open mouth of a lamprey

Importance of fish

Fish are one of the major sources of animal protein for humans, and many fishes are used as food. Fish and fish scraps are used to make fertilisers. Fish liver oil extracts is one of the sources of vitamin D. Fish is also used to manufacture pet food. Fish scales are sometimes used in making artificial pearls. Fish extracts are also used in making glues.

Fish also plays major functions in freshwater and marine environments. Different fishes have different roles in the food chain as 1. herbivores (plant eaters), 2. omnivores (feeds on plant and animals), 3. carnivores (feeds on other fishes), 4. detritivores (feeds on organic remains), and 5. filter feeders (feeds on floating microscopic plants and animals). A decline in a fish population will have a big effect in aquatic food webs.

Amphibians

Amphibians have moist skin that can either be smooth or rough. They have lungs but they can also take in oxygen through their skin. In order to do this their skin must stay moist.

This group of vertebrates are **cold-blooded**. This means that they cannot control their own body temperature. Instead they rely on warming themselves in the sun or cooling themselves in shade. Amphibians living in colder areas often hibernate - they sleep through the winter months.



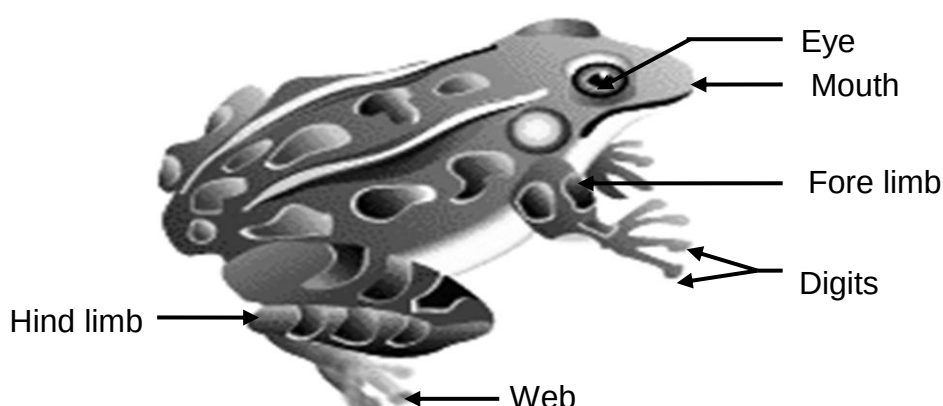
Bullfrog

Amphibians are the smallest group of vertebrates. This group includes frogs, toads, caecilian, newts and salamanders.



Activity 2: Now test yourself by doing this activity.

1. Find a large, transparent plastic or glass jar, a piece of paper and a rubber band. Make holes in a piece of paper. Collect a frog and put it in the jar. Close the jar using the paper and the rubber band.
2. Observe the frog and use the diagram below to answer the following questions.

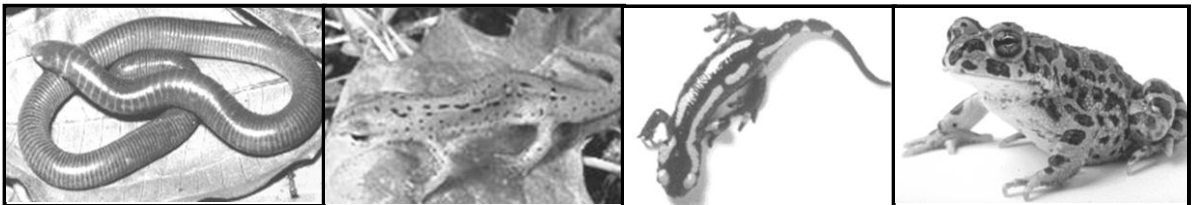


3. Underline the correct word or phrases to make the statements correct.
- a. The frog has (two/four) limbs.
 - b. The frog (has/does not have) toes.
 - c. The frog has (sunken/webbed) feet.
 - d. The hind limb is (shorter/longer) than the fore limb.
 - e. The (fore limbs/hind limbs) are used for jumping and swimming.
4. Explain why do you need to put holes in the paper?
-
-
-

Remember to put the frog where you caught it after you have finished.

Types of amphibians

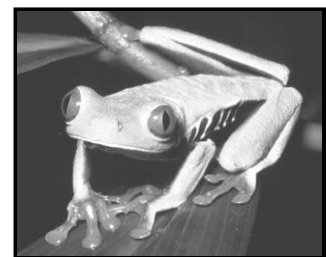
There are three groups of amphibians: the limbless, **worm-like** amphibians, which include the caecilians; the **tailless** amphibians which include the smooth-skinned frogs and the rough-skinned toads; and the **tailed** amphibians which include the newts and the salamanders.



Amphibians, from left to right: worm-like **caecilian**, tailed **newt** and **salamander**, and tailless **toad**.

The word amphibian actually means able to live both on land and in water. Amphibians lay their jelly-covered eggs in water.

Nearly all amphibians lay their eggs in water. The eggs have a **jelly-like coating**, which helps to protect them until they hatch. The eggs grow into larvae (tadpoles) that breathe using gills in water. The tadpoles develop into young adults that breathe using their lungs or moist skin when they move out of water.



Tree frog

Amphibians play an important role in aquatic and land food chains. Most amphibians are herbivores or plant-eaters on their larval stage. They feed on worms and insects in their adult stage.



Summary

You have come to the end of lesson 11. In this lesson you have learnt that:

- animals with backbones or vertebrates are classified into five groups: fish, amphibians, reptiles, birds and mammals.
- fish are vertebrates that are covered with scales.
- fish also have gills, fins and tail that enable to live in water.
- there are three types of fish: bony, cartilage, and jawless fishes.
- amphibians are vertebrates that have moist skin.
- the word amphibian actually means able to live both on land and in water.
- there are three types of amphibians: the limbless amphibians, the tailless amphibians, and the tailed amphibians.

NOW DO PRACTICE EXERCISE 11 ON THE NEXT PAGE.

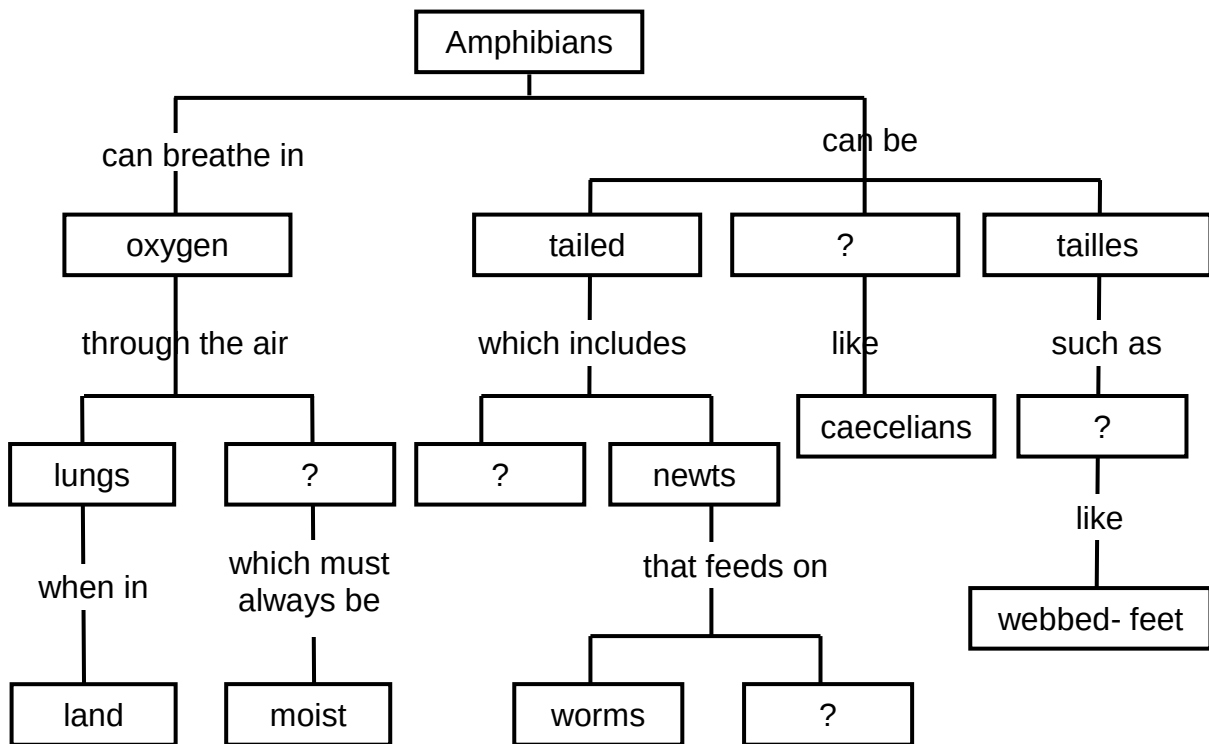


Practice Exercise 11

Answer the following questions:

Part A. Concept Mapping

Complete the concept map by writing the correct word or phrase in each box containing a question mark.



Part B. Multiple Choice Questions

Write the letter of the best answer in the box provided.

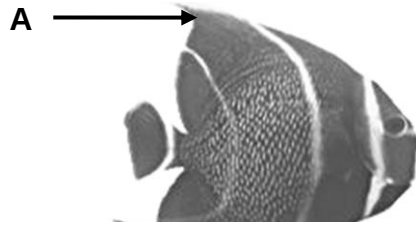
1. Which feature in fish does not help in swimming?

- A. fins
- B. gills
- C. streamlined body
- D. overlapping scales

2. Adult frogs can be described as

- A. producers.
- B. predators.
- C. insectivores.
- D. filter-feeders.

3. Identify the part labelled **A**



- A. dorsal fin
- B. pectoral fin
- C. pelvic fin
- D. anal or tail fin

4. Sharks and rays are

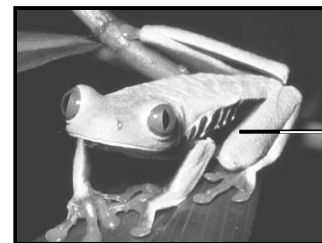
- A. jawless fish.
- B. cartilage fish.
- C. bony fishes.
- D. not fish but mammals.

5. How can vertebrates be easily classified?

- A. by looking at their body temperature.
- B. by looking at the type of food that they eat.
- C. by comparing their different body coverings.
- D. by looking at the composition of their internal skeleton.

Part C. Short Answers

6. The picture on the right shows a tree frog. Study it and answer the following questions.



a. Name the structure labelled **B**.

b. Give two functions in which structure **B** is used and is highly adapted for?

7. Briefly explain what these terms used to describe the fish mean.

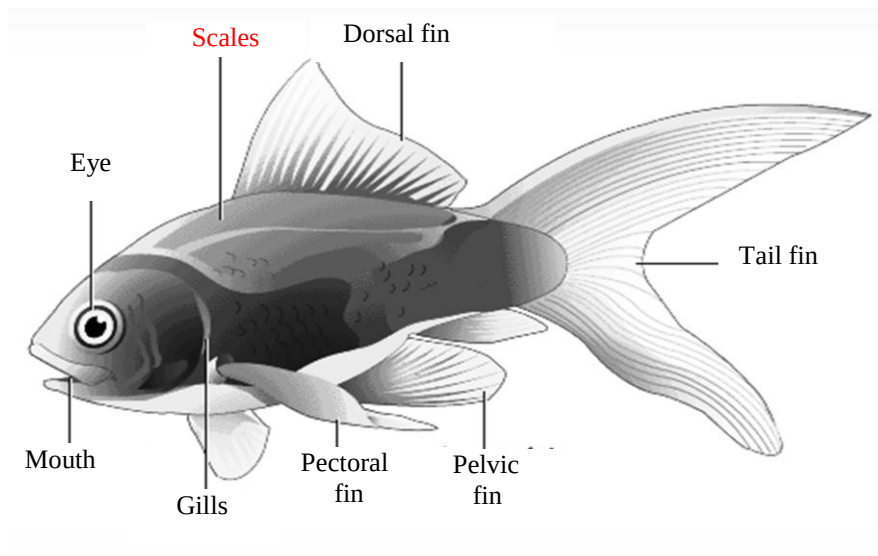
a. Cold-blooded

b. Camouflage

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 3.

Answers to Activities

Activity 1



Activity 2

3.
 - a. The frog has (two/four) limbs.
 - b. The frog (has/does not have) toes.
 - c. The frog has (sunken/webbed) feet.
 - d. The hind limb is (shorter/longer) than the fore limb.
 - e. The (fore limbs/hind limbs) are used for jumping and swimming.
4. To allow air to go inside the jar so that the frog can breathe.

Lesson 12: Reptiles



Welcome to Lesson 12 of Strand 2. In the last lesson you learnt about the two groups of animals called the fish and amphibians. In this lesson you will learn about another group of animals called the Reptiles. Did you know that giant reptiles called dinosaurs ruled the Earth for more than 150 000 million years ago? They became extinct or died away about 65 million years ago. But other reptiles, including snakes, crocodiles and tortoises, continued to survive.



Your Aims:

- describe the body covering and other physical features of modern day reptiles
- explain how these features help them live in their environment
- list down the importance of reptiles to their environment

Reptiles

Reptiles are vertebrates with **dry scaly skin**. They have lungs for breathing and have flickering tongue that is used to sense their environment. Some live on land while others live in water. Reptiles are **cold-blooded** animals. They cannot control their own body temperature. That's why they bask under the sun to get warm and move to the shade or their burrows to cool down.

Like amphibian, reptiles lay eggs, but a reptile's egg is protected by a **tough shell** so it does not have to be laid in water. Some reptiles however can give birth to live young. The eggs or the young ones are usually left by the parents as they do not take care of them.

Reptiles vary in their characteristics. For example they have different body structure and eats different types of food. The major groups of living reptiles are turtles and tortoises, crocodiles and alligators, and lizards and snakes.

Turtles and tortoises

Most turtles and tortoises have a hard **shell** that protects their soft body. Most turtles and tortoises can pull their head inside their shell when danger threatens.



A freshwater and wood turtle (left) has webbed, clawed feet for climbing and swimming, while a sea turtle (right) has flipper-like limbs also used for swimming.

Tortoises have a heavily scaled leg and stumpy, unwebbed, feet.

Some turtles and tortoises are herbivores; others hunt for their food and are carnivores. They all have a hard beak made of horn instead of teeth for chewing. All turtles and tortoises lay eggs.

Most bury their eggs in a pit in the ground and leave them to hatch. When the young hatch they must dig their own way out to the surface.

One of their biggest members is the sea turtle. It lives mostly in warm waters and is an expert swimmer, using its flipper-like limbs to propel itself through the water.

The land tortoises on the Aldabra Islands in the Indian Ocean and on the Galápagos Islands off the Pacific coast of South America can weigh over 250 kilograms and live for up to 150 years.

Turtles and tortoises are captured for food, used for traditional medicines and for pet trade.



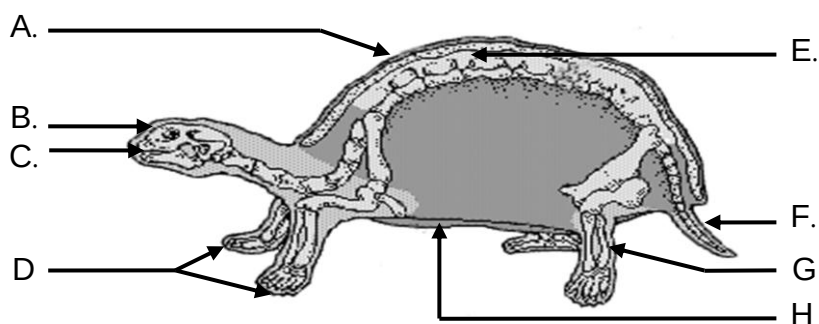
The giant tortoise of Ecuador's Galápagos Islands



Activity 1: Now test yourself by doing this activity.

1. Use the words in the box to label the features of a turtle.

head mouth tail webbed-feet backbone
carapace plastron hind limb



2. Which features protect the turtle from predators?

3. What is the function of the webbed-feet?

Crocodiles and alligators

Crocodiles and alligators have strong **jaws** and **sharp teeth**. Their long body is armoured with hard scales and thick bony plates. These set of characteristics make these animals top carnivores and predators.



Alligator

Alligators have broad, flat, and rounded **snouts** or nose tips while crocodiles have longer, narrow (sharper) snouts. Unlike other crocodiles, the lower teeth of alligators cannot be seen when their mouths are closed. Alligators feed on fish, frogs, snakes, turtles, birds, and mammals.

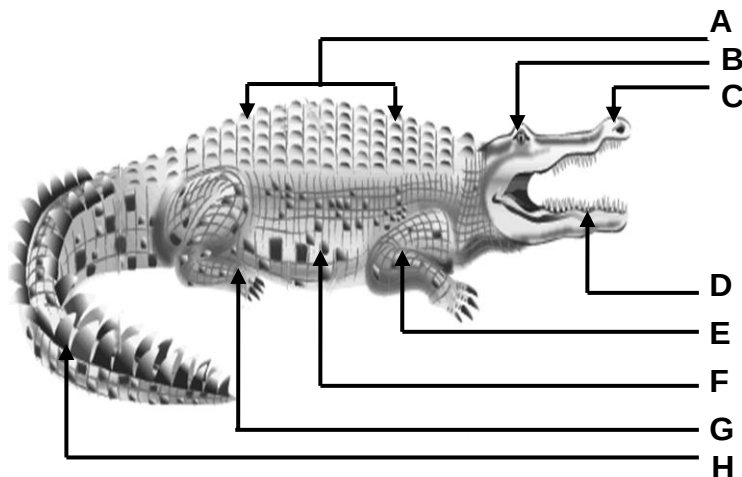
Despite their short legs, crocodiles can move fast on land over short distances expert swimmers in water. They rarely go far from rivers or swamps to avoid over-heating as they are cold-blooded.



Activity 2: Now test yourself by doing this activity.

- Use the words in the box to label the features of a crocodile.

smooth scaly stomach	eye	ridged bony scales
webbed hind foot	forelimb	snout jaw tail



- Give two differences between a crocodile and an alligator.

Like other reptiles, crocodiles lay eggs, which they cover with sand or mud. Most leave the eggs to incubate or to keep warm and hatch by themselves, but some stay close by their eggs guarding them from predators. When the young are about to hatch they call out to their mother who may help them escape from the nest. She then carries them in her mouth to a safe quiet pool where she looks after them while they grow.



Crocodile

Crocodile and alligator eggs are used for food in some parts of the world. Their thick skin is highly valued for leather, and the extract from the musk glands is used in the manufacture of perfumes. Most crocodiles and alligators are considered endangered species because for overheating.

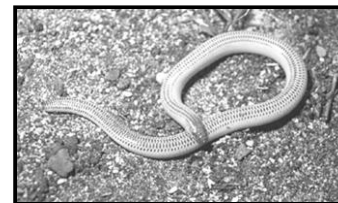
Lizards and snakes

Lizards have dry scaly skin, and most have clawed feet and external ear openings. Most lizards are small with four legs and a long tail. The tail in many species is delicate and easily broken but will regenerate. The tail of some **arboreal** (tree-dwelling) species as the chameleon is **prehensile**, which means adapted for grasping branches.



Chameleon

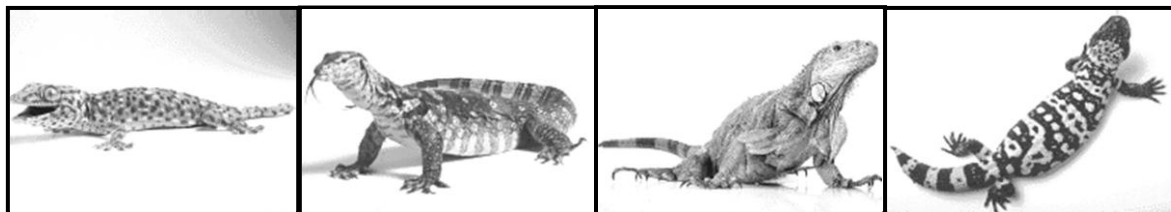
Some lizards are snake-like in appearance but they are distinguished from true snakes by their movable eyelids and lower jaw that does not separate when swallowing large food items.



Legless lizard

The lizards' tongue is thicker than snakes' and unlike snakes, they have ear openings.

Lizards move in different ways, depending on their structure and where they live. Some can run quickly on well-developed hind legs. Other lizards can also run across the surface of water using their greatly developed back legs and whip-like tail. Geckos have specialized toes that enable them to cling to smooth surfaces. Some lizards are good swimmers, and a number are adapted for climbing trees.



Pictures of some lizards: (left to right) **gecko**, **monitor**, **iguana** and **gila monster**.

Most lizards benefit humans by controlling insect populations. Some species are a source of food; some are killed for their skins, although it is now illegal to do so in many countries. A number of species are threatened by destruction of their habitat, and the largest living lizard, the Komodo dragon, is on the endangered species list.

All **snakes** have a long body and no legs. Their body is covered with **scales** and they lack movable eyelids. All snakes eat other animals. Some, like coral snakes, rattlesnakes and the king cobra, kill their prey by injecting poisonous **venom** when they bite with their **fangs**. Others like pythons and boa's wrap their victims by coiling their bodies on their prey and squeeze them until they suffocate or ran out of air.

Some snakes shake a horny **rattle** at the end of the tail to warn off intruders. A new rattle section is added each time the snake **moults** or sheds its skin.

Egg-laying snakes cover their eggs with earth or rotting leaves to keep them warm and hidden. Others give birth to living young. They keep their eggs inside their bodies until they hatch. Snakes lack parental care.



Coral snake

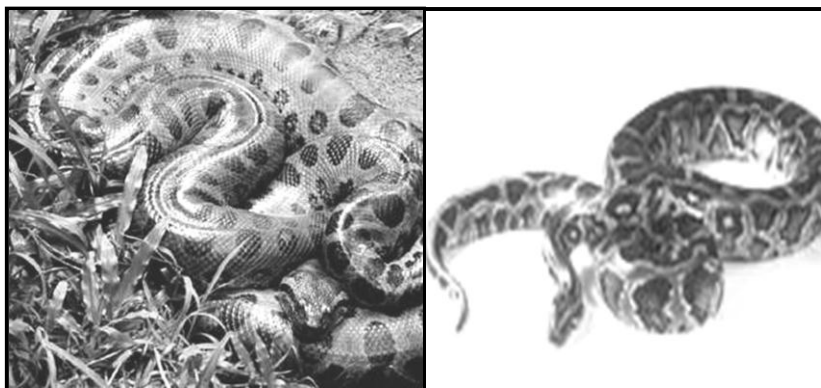


Rattle snake

Venomous snakes



Pit viper (left) and **garter snake** (right) can give birth to live young.



The two largest snakes, **anaconda** (left) and **python** (right) are not venomous. They kill their prey by constriction and suffocation.

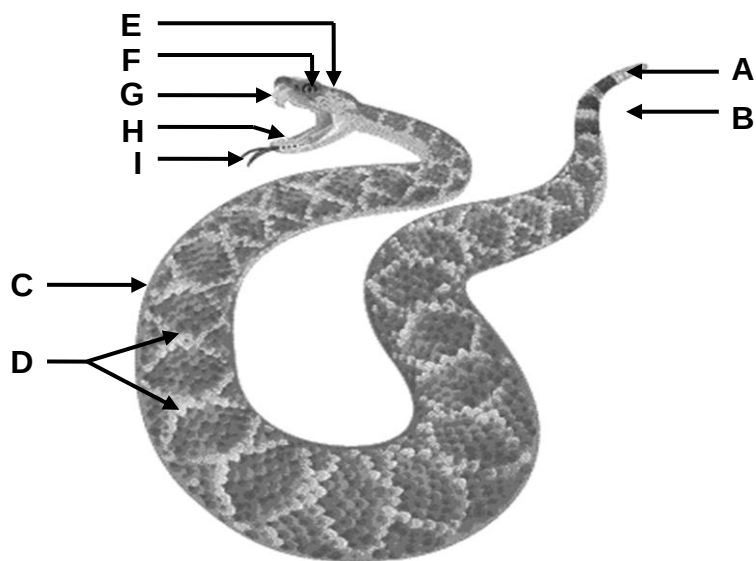
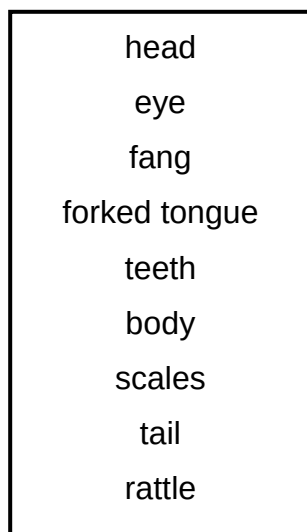
Snakes, through their carnivorous habits, often play an important part in preserving the balance of life, particularly in controlling pests such as rats and mice which tend to multiply at a rapid rate.

Other reptiles are a good source of food. They also provide raw materials of economic value. Some reptiles are threatened or endangered because of over-hunting and habitat destruction.



Activity 3: Now test yourself by doing this activity.

1. Use the words in the box to label the different parts of a snake.



2. Describe two ways snakes can kill their prey.



Summary

You have come to the end of lesson 12. In this lesson you have learnt that:

- reptiles are vertebrates with dry scaly skin.
- reptiles are cold-blooded animals and most produce eggs with shell.
- the major groups of living reptiles are turtles and tortoises, crocodiles and alligators, and lizards and snakes.
- most turtles and tortoises have a hard, protective shell made up of two parts - an upper section called a carapace and a flatter shell called a plastron underneath.
- crocodiles and alligators have strong jaws, sharp teeth and their long body is armoured with hard scales.
- lizards have dry scaly skin, and most have clawed feet and external ear openings. Most lizards are small with four legs and a long tail.
- all snakes have a long body and no legs. Their body is covered with scales and they lack movable eyelids.
- some lizards and snakes at times loose their outer skin or moult. A new skin grows under the old one before moulting.
- reptiles play an important role in food webs in most habitats. Some are herbivores while bigger reptiles are some are carnivores.

NOW DO PRACTICE EXERCISE 12 ON THE NEXT PAGE.



Practice Exercise 12

Answer the following questions:

Part A. Multiple Choice Questions

Write the letter of the best answer in the box provided.

1. Which is **not** a characteristic of reptiles?

- A. dry, scaly skin
- B. soft, moist skin
- C. cold-blooded
- D. lay eggs with shell

2. Reptiles that hunt and feed on other animals are

11

- A. parasites.
- B. herbivores.
- C. carnivores.
- D. omnivores

3. The picture on the right shows a sea turtle. The structures labelled A and B are adaptations for

11

- A. swimming and protection.
- B. feeding and reproduction.
- C. swimming and sensing.
- D. feeding and protection.



B

A

4. Pick an animal that is not a lizard.

- A. Iguana B. Gecko
- C. Salamander D. Chameleon

5. Which statement does not properly describe snakes?

10

- A. All snakes have venom.
- B. All snakes possess backbones.
- C. All snakes lack movable eyelids.
- D. All snakes cannot control their body temperature.

Part B. Short Answers

1. What major feature differentiates turtles and tortoises from other reptiles?

2. What is the difference between?

- a. a sea turtle from a tortoise by their limbs.



Sea turtle



Tortoise

- b. a legless lizard from a snake.



Legless lizard



Snake

3. What are the two major reasons why some reptile species are being endangered or threatened?

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 3.

Answers to Activities**Activity 1**

1. A. Carapace
 B. Head
 C. Mouth
 D. Webbed-feet
 E. Backbone
 F. Tail
 G. Hind limb
 H. Plastron
2. Carapace and plastron
3. Swimming

Activity 2

1. A. Rigged, bony plate
 B. Eye
 C. Snout
 D. Jaw
 E. Fore limb
 F. Smooth, scaly stomach
 G. Webbed, hind foot
 H. Tail
2. Crocodiles have longer, narrow snouts while alligators have broad, flat, and rounded snouts.
 Thee lower teeth of crocodiles can still be seen when their mouths are closed while the lower teeth of alligators cannot be seen when their mouths are closed.

Activity 3

1. A. Rattle
 B. Tail
 C. Body
 D. Scales
 E. Head
 F. Eye
 G. Fang
 H. Teeth
 I. Forked tongue
2. By biting and injecting a poisonous venom or by constriction and suffocation.
3. Snakes can kill farm pests such as rats and mice.

Lesson 13: Birds



Welcome to Lesson 13 of Strand2. In the last three lessons you have studied the first three groups of vertebrates – the fish, amphibians, and reptiles. These three groups of vertebrates are all composed of cold-blooded animals. In the next two lessons, you will learn about the warm-blooded vertebrates – the birds and the mammals.



Your Aims:

- describe the body covering and other physical features of birds
- explain how these features help them live in their environment
- list down the importance of birds to their environment

Birds

Birds are vertebrates that have **feathers**. The feathers have several functions. It covers and protects the birds and also keeps them warm and dry. Birds have a gland that secretes oil in their feathers to keep them **waterproof**.

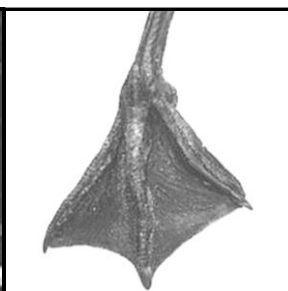
Almost all birds can fly because they have large wings, tail feathers and light bones. Some large birds however, like cassowary, ostrich, kiwi and emus are flightless.

Birds have no teeth. They have **beaks** instead. Different birds have different beak shapes and sizes because they feed on different types of food. Some feeds on seeds and fruits while others prey on worms, insects, or smaller animals.

Birds also have different types of feet depending on their functions and habitat. Predatory birds like eagles and owls have long, sharp, clawed feet called **talons** that are adapted to grab and kill their prey. Aquatic birds like ducks and goose have webbed-feet for swimming. Chickens have short, pointed feet for scratching and perching while woodpeckers have claws that can cling to tree trunks.



A harpy eagle can pick up a monkey or small mammal with its sharp talons.



A goose's webbed-foot is adapted for swimming.



A woodpecker's foot is adapted for clinging to tree trunks.



A chicken's foot is adapted for **scratching** and **perching**.



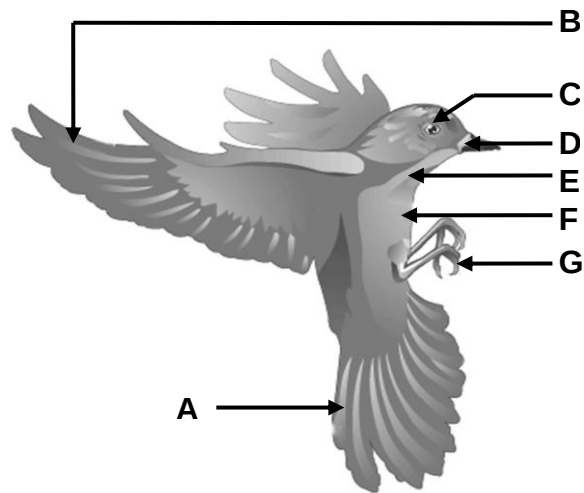
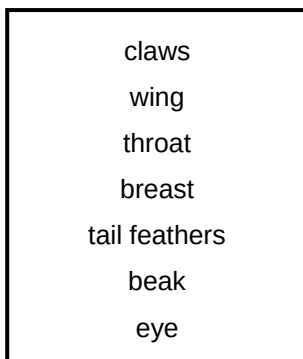
An owl's foot is adapted for **grasping** and **killing**.



Activity

Now test yourself by doing this activity.

1. Use the words in the box to label the different parts of a bird.



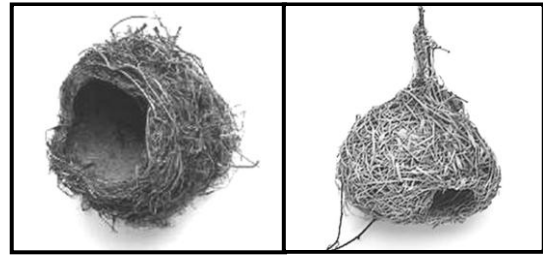
2. Give three features that aid birds to fly.

3. Why do birds have different types of feet?

More features of birds

Birds breathe by means of their lungs. They lay eggs with shell. They keep the eggs incubated and warm in the nests that they build.

Most take care of their young. Birds are **warm-blooded** animals. This means that they can regulate their body temperature so that it is always constant and never changes with the air temperature.



Nests are designed for incubating and protecting the eggs and for housing the young birds.

The feathers of birds, collectively called **plumage**, vary in their colours. Bright coloured feathers are often used to identify each other and to attract mates. Birds also use their colour and pattern to camouflage and make them difficult to see. This is an adaptation to hide from predators or to hunt for food. Some birds are known to sing to communicate with each other.



Bird plumage can have brilliant colours to attract females (peacock, left) or may be used for camouflage (snowy owl, right) to remain undetected.

Importance of birds

People have used birds for food. Some birds like chickens, turkeys, guinea fowl, ducks, geese, and pigeons however are bred and raised for human food. Eggs are also obtained from this domestication.

Birds have played a major role in legends, religious customs, and literature. Feathers have been used for ornamental and ritual purposes by nearly all cultures. Birdsongs and calls have inspired tribal and religious chants.

Watching birds in their natural habitats boost tourism and economy in some countries.



The domestic chicken provides meat and egg.



Bird feathers are used in tribal headdress.



Summary

You have come to the end of lesson 13. In this lesson you have learnt that:

- birds are vertebrates that have feathers that cover and protect as well as keep them warm and dry.
- birds have a pair of wings, beak and a pair of legs.
- some bird legs have claws or talons adapted to capture prey. Others developed feet adapted to other range of functions.
- birds are warm-blooded. They keep a constant body temperature that does not rise or fall with the atmospheric temperature.
- birds lay eggs with shell. They build nests to incubate their eggs. They nurture and take care of their young.
- bird feathers are collectively called plumage. It may be colourful to attract mates in during courtship display or may blend and camouflage with the environment to help it remain undetected either by a predator or prey.
- birds have a lot of importance. Their meat or egg can be a source of food for other animals.

NOW DO PRACTICE EXERCISE 13 ON THE NEXT PAGE.



Practice Exercise 13

Answer the following questions:

Part A. Multiple Choice Questions

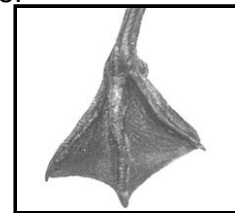
Write the letter of the best answer in the box provided.

1. Which is **not** a function of the birds' feathers?

- A. It helps incubate the egg.
- B. It keeps them warm and dry.
- C. It covers and protects the birds.
- D. It may help attract a mate or help hunt for food by providing camouflage.

2. The webbed feet of ducks and geese are specialised for

- | | |
|---------------|-------------|
| A. grasping | B. perching |
| C. scratching | D. swimming |



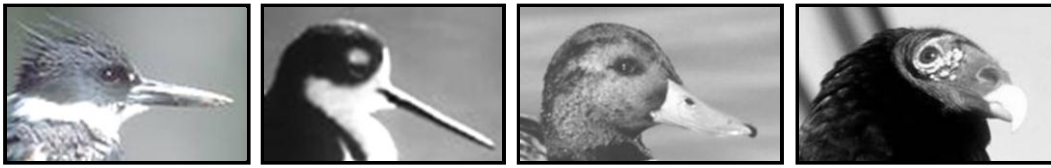
3. Birds are like reptiles because they

- A. are warm-blooded.
- B. produce eggs with shells.
- C. keep their young in nests.
- D. they have two pairs of legs.

4. Pick one characteristic that birds share in common with the other vertebrates.

- A. Feathers
- B. They build nests
- C. They have a pair of legs
- D. Backbone or spinal column.

5. The photos below show differences in the structure of beaks in birds.



Birds have different beak shapes and sizes

- A. because they eat different types of food.
B. so they can easily recognise one another.
C. so they can protect themselves from different types of predators.
D. to produce various sounds that can help them attract a breeding partner.

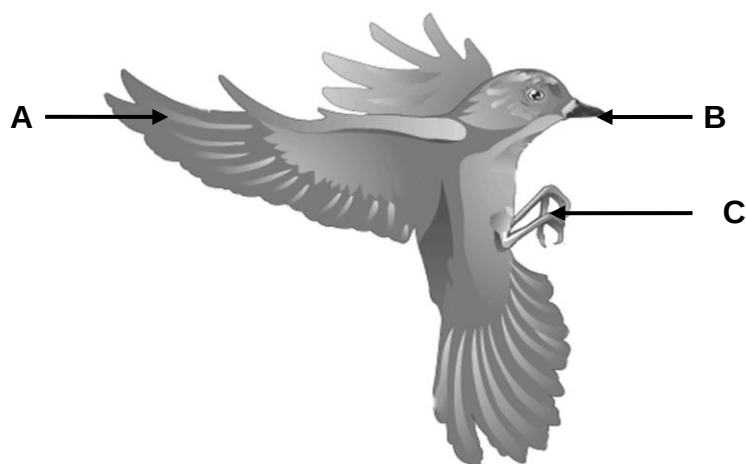


Part B. Short Answers

1. Give a major feature that differentiates birds from other reptiles?

2. What is the function of the bird nest?

3. Identify the bird feature labelled **B** and **C**.



4. Give one importance of birds.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 3.

Answers to Activity

1.
 - A. Tail feathers
 - B. Wing
 - C. Eye
 - D. Beak
 - E. Throat
 - F. Breast
 - G. Claws
2. Their large wings, tail feathers and light bones helps birds to fly.
3. Birds have different types of feet to adapt to different functions and habitats.

Lesson 14: Mammals



Welcome to Lesson 14 of Strand 2. In the last lesson we learnt that birds are vertebrates and are warm blooded animals. In this lesson we will learn about Mammals. Of all the animals, mammals have a highly developed nervous system including the brain. Mammals are amazingly a varied group of animals with backbone. They may be found in almost every type of environment. Mammals with four legs generally live on land. Those with webbed legs and flippers are aquatic or water-dwellers while some have wings and are able to fly.



Your Aims:

- describe the body covering and other physical features of mammals
- explain how these features help them live in their environment
- list down the importance of mammals to their environment

Mammals

Mammals have **hair** or fur on their bodies. They are warm-blooded and most have sweat glands to help them cool down when they are hot. All mammals feed their young with **milk** and adult females have **glands** for producing this milk. Parents care for their young for a certain period of time. Mammals are intelligent animals with highly developed nervous systems.

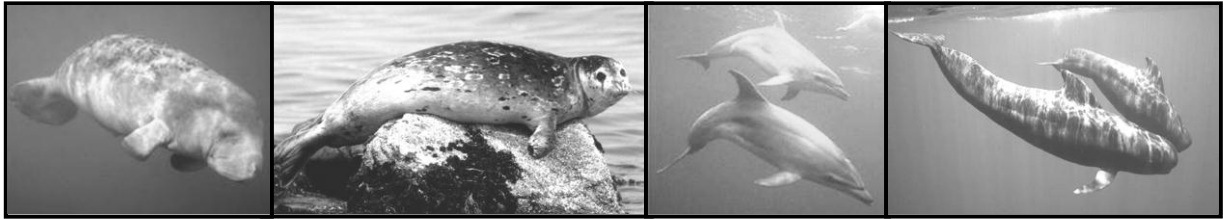
Most mammals possess four limbs usually legs. For some, they have adapted the flippers for swimming (seals, whales and dugongs) and even wings (bats).



Different types of appendages or limbs in mammals

Limbs in mammals have become adapted to walking (elephant), running (horse), gliding (flying squirrel), flying (bat), climbing (monkey), and swimming (dugong).

All mammals have lungs to breathe, including whales. Seals, dolphins and dugongs can hold their breath for a long time under water but need to go to the surface to get oxygen.



Aquatic mammals

Most mammals live on land but (from left to right) a sea cow or manatee, seal, dolphins and whales are among those that have become adapted to living in water.

Groups of mammals

Mammals are divided into three groups – monotremes or egg-laying mammals, marsupials or pouched mammals and placental mammals.

Monotremes lay leathery shelled eggs. Once their young hatch, they feed on their mothers' milk. Monotremes include the platypus and the spiny anteater or echidna.



Duck-billed platypus

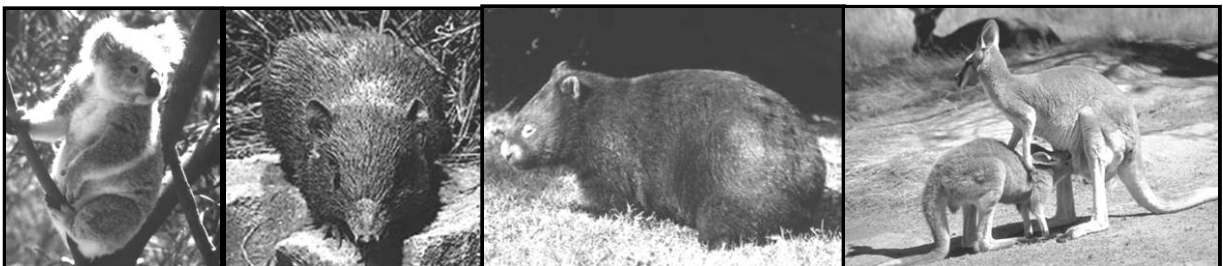


Echidna

Marsupials are mammals with pouch on their body. Marsupial young are born very early and instead complete their development inside the mother's pouch. The pouch may open to the front or back and a few marsupials only have a pouch during the breeding season. Some have no pouch at all - the young just cling on to their mother.



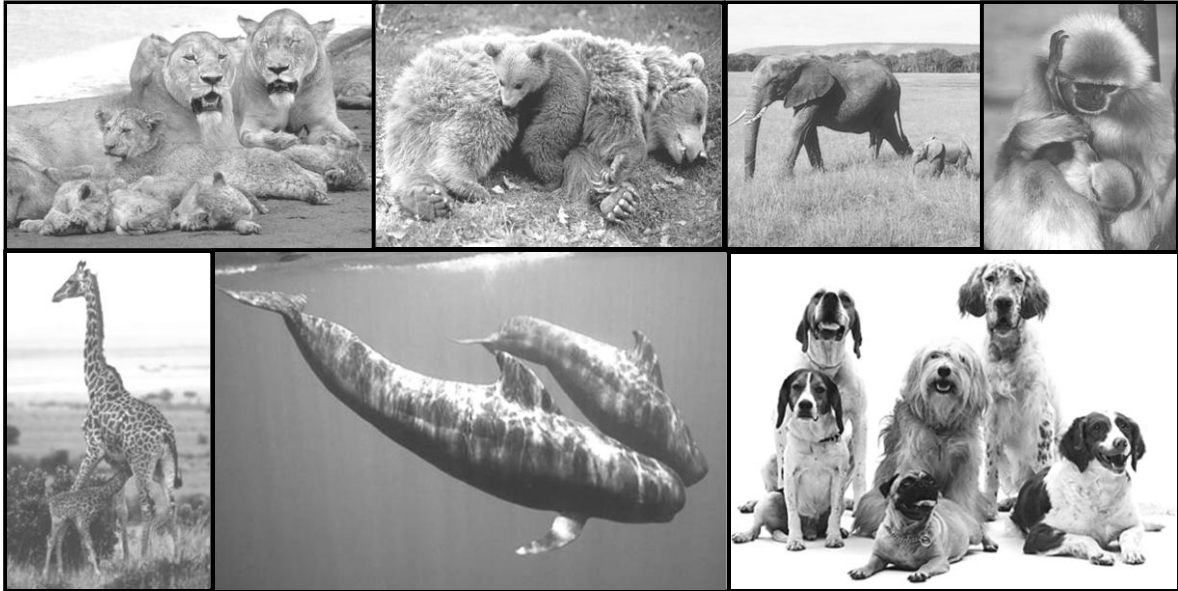
Wallaby in a pouch



Some marsupials

Marsupials include (from left to right) koalas, bandicoots, wombats, and kangaroos.

Placental mammals have their young develop in their mother's womb before being born alive. The name is obtained from the word placenta - an organ that gives food and oxygen from the mother's body to the young in the womb. At birth, some placental mammals such as young cow and deer are able to stand and walk almost right away. Others, such as cats, dogs and monkeys, are helpless as newborns need to be cared for by their parents until big enough to live on their own.



Placental mammals include (clockwise from top left) lions, bears, elephants, apes, dogs, whales and giraffes.



Activity: Now test yourself by doing this activity.

Complete the table about groups of mammals by filling in the boxes using the word or groups of words listed below.

egg laying young develop in mother's womb before being born alive

dog kangaroo monotreme placental bandicoot pig

echidna young develop in pouch marsupial platypus

mammal type	main feature	examples

Humans

Humans can be sorted or classified as mammals. Humans have a vertebrate or backbones, possess hair on their bodies and produce milk for their young. Parents look after and care for their babies after they are born.

Humans are the most developed of all animals. Humans have a large complex brain and nervous system that enables them to do many things other animals cannot. Humans for example are able to think, talk, read and write.

Humans are also able to make and use tools. Humans have produced works of art, and invented machines and gadgets. Humans cultivated the land, grew plants and raise animals as food. All these features and more set humans apart from other animals.

**Summary**

You have come to the end of lesson 14. In this lesson you have learnt that:

- mammals are animals that have fur or hair on their body.
- mammals usually have two pairs of limbs.
- mammals are warm-blooded. This means that they have a constant body temperature that does not rise or fall with the air temperature.
- young mammals are fed on mother's milk and parents take care of their young for a period of time.
- most mammals possess four limbs that may be used for different functions like walking, swimming, grasping or flying.
- mammals can be divided into three groups – monotremes, marsupials and placentals.
- monotremes or egg laying mammals are hatched from leathery-shelled eggs.
- marsupials or pouched mammals are born very early and develop in their mother's pouch.
- placental mammals develop in their mother's womb before being born alive.

NOW DO PRACTICE EXERCISE 14 ON THE NEXT PAGE.
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Practice Exercise 14

Part A. True or false

Read the following statements about simple plants. Write T if the statement is true and F if it is false.

Statement	T or F
1. All mammals have a constant body temperature.	
2. Placental mammals develop from their mother's womb and are born alive.	
3. Mammals are divided into two groups - egg laying and placental.	
4. Humans are the most intelligent group of animals because they can think, talk, read and write.	
5. Marsupials are born very early and develop in the nest that their mothers make.	

Part B. Short answers

Read the following questions and write your answers on the space provided after each item.

1. Give three characteristics that all mammals have in common.

2. How are the marsupials like the possum and bandicoot different from other mammals?

3. Bats are mammals.

- a. In what ways are they like birds?

- b. In what ways are they like other mammals?

4. Name two mammals that have become adapted to living in water. Describe how these aquatic mammals differ from fishes in the way they breathe.

5. Briefly explain why mammals are considered the most intelligent of all animals.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 3.

Answers to Activity

mammal type	main feature	examples
monotreme	egg laying	echidna, platypus
marsupial	young develop in pouch	kangaroo, bandicoot
placental	young develop in mother's womb before being born alive	dog, pig

REVIEW OF SUB STRAND 3: CLASSIFICATION OF VERTEBRATES

Revise all the Lessons in this Sub Strand and then do **ASSIGNMENT 2**.
Here are the main points to help you revise.

Lesson 11: Fish and Amphibians

- Animals with backbones or vertebrates are classified into five groups: fish, amphibians, reptiles, birds and mammals.
- Fish are vertebrates that are covered with scales.
- Fish also have gills, fins and tail that enable to live in water.
- There are three types of fish: bony, cartilage, and jawless fishes.
- Amphibians are vertebrates that have moist skin.
- The word amphibian actually means able to live both on land and in water.
- There are three types of amphibians: the limbless amphibians, the tailless amphibians, and the tailed amphibians.

Lesson 12: Reptiles

- Reptiles are vertebrates with dry scaly skin.
- Reptiles are cold-blooded animals and most produce eggs with shell.
- The major groups of living reptiles are turtles and tortoises, crocodiles and alligators, and lizards and snakes.
- Most turtles and tortoises have a hard, protective shell made up of two parts - an upper section called a carapace and a flatter shell called a plastron underneath.
- Crocodiles and alligators have strong jaws, sharp teeth and their long body is armoured with hard scales.
- Lizards have dry scaly skin, and most have clawed feet and external ear openings. Most lizards are small with four legs and a long tail.
- All snakes have a long body and no legs. Their body is covered with scales and they lack movable eyelids.
- Some lizards and snakes at times lose their outer skin or moult. A new skin grows under the old one before moulting.
- Reptiles play an important role in food webs in most habitats. Some are herbivores while bigger reptiles are some are carnivores.

Lesson 13: Birds

- Birds are vertebrates that have feathers that cover and protect as well as keep them warm and dry.
- Birds have a pair of wings, beak and a pair of legs.
- Some bird legs have claws or talons adapted to capture prey. Others developed feet adapted to other range of functions.
- Birds are warm-blooded. They keep a constant body temperature that does not rise or fall with the atmospheric temperature.
- Birds lay eggs with shell. They build nests to incubate their eggs. They nurture and take care of their young.
- Bird feathers are collectively called plumage. It may be colourful to attract mates in during courtship display or may blend and camouflage with the environment to help it remain undetected either by a predator or prey.
- Birds have a lot of importance. Their meat or egg can be a source of food for other animals.

Lesson 14: Mammals

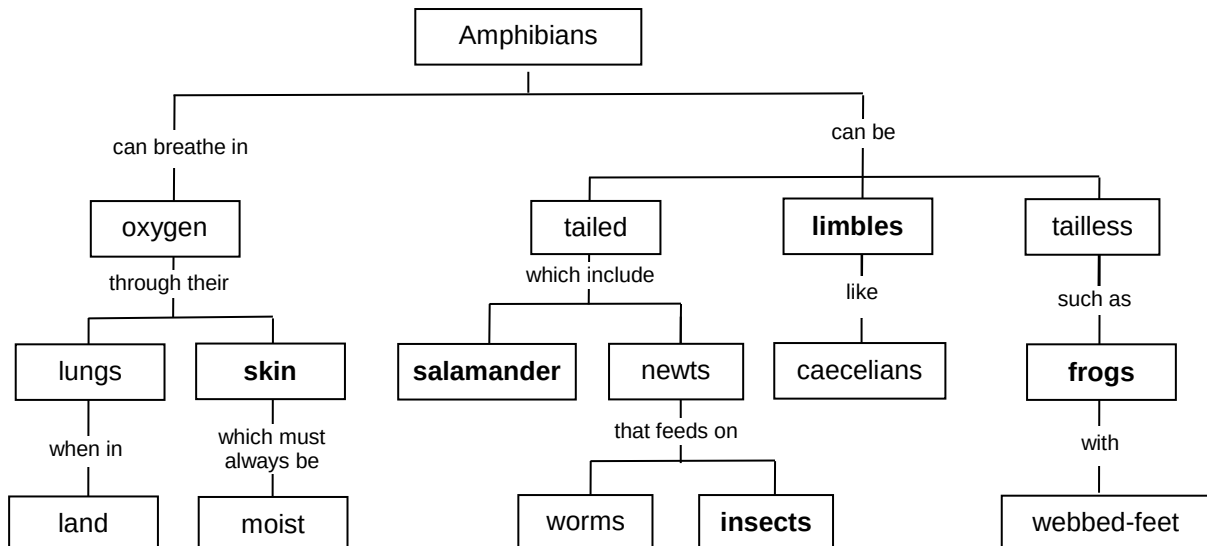
- Mammals are animals that have fur or hair on their body.
- Mammals usually have two pairs of limbs.
- Mammals are warm-blooded. This means that they have a constant body temperature that does not rise or fall with the air temperature.
- Young mammals are fed on mother's milk and parents take care of their young for a period of time.
- Most mammals possess four limbs that may be used for different functions like walking, swimming, grasping or flying.
- Mammals can be divided into three groups – monotremes, marsupials and placentals.
- Monotremes or egg laying mammals are hatched from leathery- shelled eggs.
- Marsupials or pouched mammals are born very early and develop in their mother's pouch.
- Placental mammals develop in their mother's womb before being born alive.

REVISE WELL AND THEN DO SUB STRAND TEST 4 IN YOUR ASSIGNMENT 2.
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Answers to Practice Exercises 11- 14

Practice Exercise 11

Part A. Concept Mapping



Part B. Multiple Choice Questions

1. **B** 2. **D** 3. **A** 4. **B** 5. **C**

Part C. Short Answers

6. a. The structure labeled **B** is Hind limb or hind leg
 b. For jumping and swimming
7. a. Cold blooded refers to animals like fish that cannot control their body temperature. Their temperature changes with the environment.
 b. Camouflage means blending with the background. This enables an organism like a fish to hide from its predator.
-

Practice Exercise 12

Part A. Multiple Choice Questions

1. **B** 2. **C** 3. **A** 4. **C** 5. **D**

Part B. Short Answers

1. Their hard protective shells (which are absent in other reptiles).

2. a. a sea turtle has flipper-like limbs while a tortoise has stumpy feet.
b. A legless lizard has movable eyelids while snakes don't have any.
or
Unlike a snake, a legless lizard's jaw does not separate when swallowing large food items.
3. Over-hunting and habitat destruction.
-

Practice Exercise 13

Part A. Multiple Choice Questions

1. A 2. D 3. B 4. D 5. A

Part B. Short Answers

1. Birds have feathers. Birds have wings.
Birds are warm-blooded. Birds have two pairs of legs.
Birds have beaks.
2. To incubate and warm eggs. To protect and house the eggs/ young hatchlings or chicks.
3. **B** - Beck and **C** - claws.
4. They provide a source of food. Their feathers are used as ornaments.
-

Practice Exercise 14

Part A. True or false.

1. **T** 2. **T** 3. **F** 4. **T** 5. **F**

Part B. Short answers

1. All mammals 1.) have a backbone, 2.) have hair or fur, 3.) feed their young with milk, 4.) are warm-blooded. (*Any 3 of these suggested answers are correct*)
2. Their females have pouches for the young to develop/ their young develop in pouches.
3. a. They have wings./ They can fly.
b. They have hair/ They feed their young with milk.
4. Whale/ dolphin/ manatee/ seal/ sea lion/ dugong (Any two are correct).
Unlike fishes that have gills, aquatic mammals breathe using their lungs.
5. Mammals have a large complex brain that enable them to think, talk, read and write.

SUB STRAND 4

RESPIRATION AND BREATHING IN LIVING ORGANISMS (LUNGS AND LEAVES)

In this sub strand you will learn about:

- **respiratory system**
- **the lungs as organs of respiration**
- **structure of leaves**
- **leaves as organs for gas exchange**

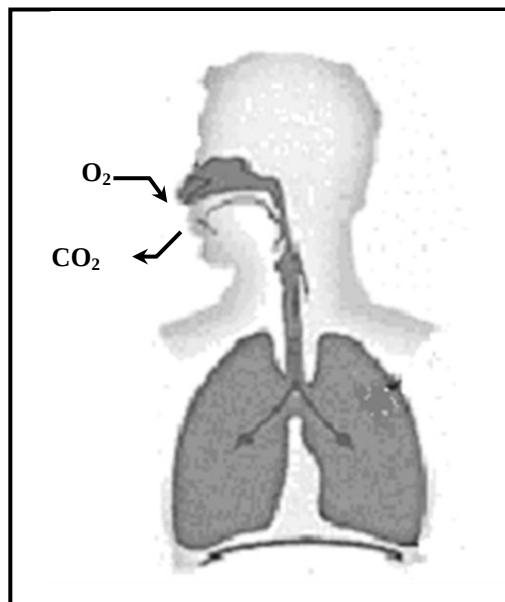
SUB STRAND 4: RESPIRATION AND BREATHING IN LIVING ORGANISMS (LUNGS AND LEAVES)

Introduction

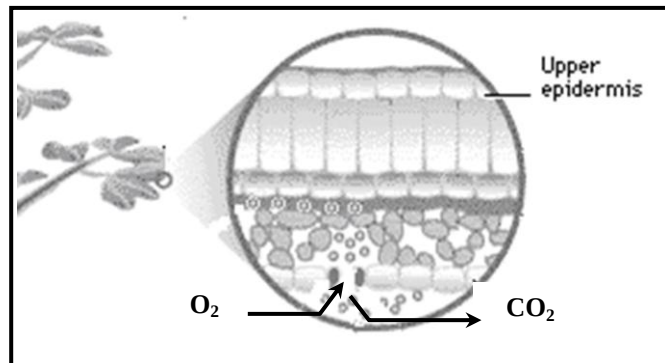
All living things need oxygen in order to live. The oxygen is used to burn the food in cells and release energy in a living process called respiration. The process produces carbon dioxide gas as a waste product.

Animals get oxygen from air that they have breathed in. The carbon dioxide in the air actually comes from their body when they breathe out.

Plants do not make observable breathing movements. However, they do take in oxygen from the air, carry out cell respiration, and release carbon dioxide. The oxygen simply floats or passes through tiny holes in the leaves, to the cells inside. The carbon dioxide passes out the opposite way.



Gas exchange in man involves the human respiratory system



Gas exchange in the leaf of a plant

In this sub-strand you will have the opportunity to:

- define the processes of breathing and respiration
- study the respiratory system in animals
- identify the parts of the respiratory system in humans
- study the process of respiration in plants
- analyse the structure of a leaf as an organ for respiration in plants

In this Sub strand you will find the answers to these questions and all other questions relating to the respiration and breathing in living organisms (lungs and leaves).

Lesson 15: Respiratory System



Welcome to Lesson 15 of Strand 2. In the last lesson you learnt about a group of animals with a back bone called mammals. In this lesson you will learn about the respiratory system. Did you know that all living things need energy in order to be able to move, reproduce, grow and develop and to maintain their body temperature and sensitivity (the ability to feel and respond to their surrounds)? We get energy from the food that we eat. This is where respiration becomes important to all living things.



Your Aims:

- define the process of respiration, breathing and transpiration, and
- describe the function and state the importance of the respiratory system

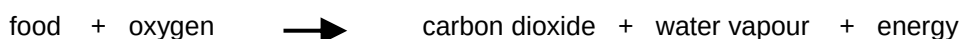
What Is Respiration?

It is the process of converting stored food into energy that can be used by organisms.

Respiration using oxygen

Most living things use oxygen to 'burn' (oxidize) food to release energy that cells need to stay alive. It is similar to burning wood to release stored energy as heat and light. Just as fire requires oxygen to burn, respiration, or the "breaking down" of stored food, requires oxygen to release energy. This type of respiration produces carbon dioxide and water as waste products.

Below is the equation of respiration



The amount of energy released by complete breakdown of one gram of carbohydrate or protein can give about 16 kilojoules (kJ) of energy.

Fatty foods can therefore give more energy than carbohydrates and proteins.

Heavy work requires energy. The energy for this comes from respiration using oxygen. Our muscles can release energy from food without using oxygen.



Muscular activity requires energy that comes from respiration.

The process of respiration continues even if an organism is asleep. The energy produced is used by the brain to control other important processes, like breathing, heartbeat, and maintaining a constant body temperature.



Activity 1: Now test yourself by doing this activity.

Answer the following questions:

1. What is respiration?

2. Briefly explain why respiration is important?

3. Which type of food can give the most energy?

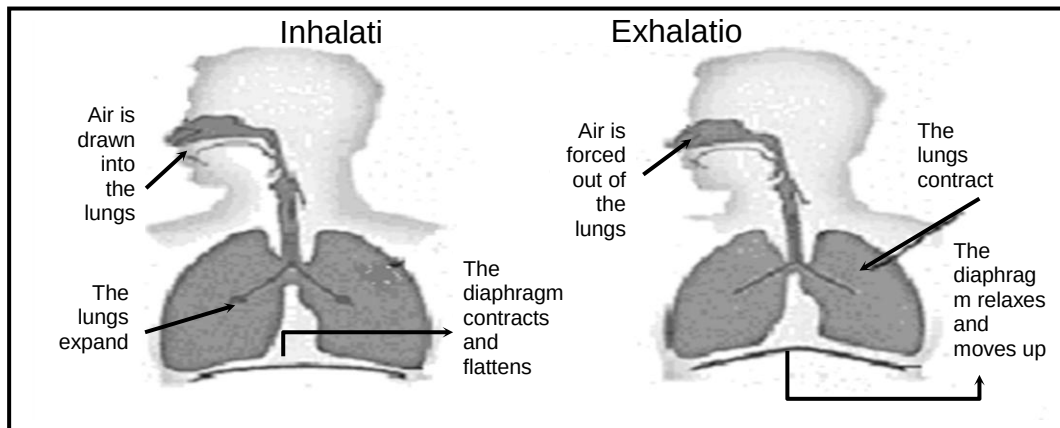
Gas exchange and breathing

Organisms must be able to take oxygen needed for respiration from the air and get rid of the poisonous waste product carbon dioxide to the air. Swapping or changing oxygen for carbon dioxide is called **gas exchange** (gaseous exchange).

Breathing or **external respiration** is the set of muscular movements that give the respiratory organ a constant supply of fresh air. It is the act of taking in oxygen and giving out carbon dioxide. This physical process is divided into two phases: inhalation and exhalation.

Inhalation is the breathing in process. You will notice that when you inhale, your chest and rib cage raises up and your diaphragm and abdomen moves in and contract. These actions cause air to rush in making your lungs expand and take in oxygen.

Exhalation is the breathing out process and takes place when the rib cage is lowered and the muscles in your diaphragm relaxes. The air is pushed out of the lungs. The exhaled air will contain more carbon dioxide and water, but less oxygen than the inhaled air.



A diagram showing the process of breathing

When you are resting, your breathing rate will be about 16 bpm (breaths per minute). During exercise the muscles work hard and need to release more energy by respiration. Greater volumes of air must therefore be breathed in and out by increasing the breathing rate.



Activity 2: Now test yourself by doing this activity.

In this activity you will need a watch. You will perform the suggested activity for 2 minutes and record your breathing rate after each activity by counting the number of times you will breathe in one minute. Remember that one inhalation and one exhalation count for one breathing process. Allow a two minute rest in between each activity.

1. Record your data on the graph.

Activity	Breathing Rate (breaths per minute)
Sitting (one minute)	
Standing and clapping	
Running	

2. Which activity produced the highest breathing rate?

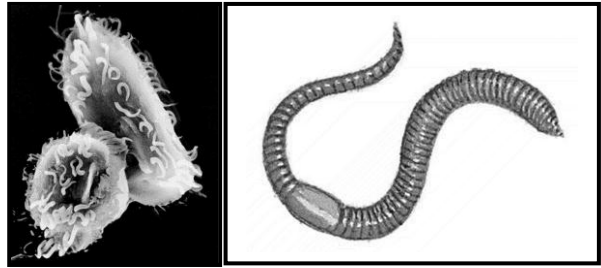
3. Name the activity that caused the highest depth of breathing.

4. Complete the following statement based from the data you collected:

The more _____ the work, the _____ the rate of breathing.

Function of the respiratory system

Different organisms have different ways of breath. Microscopic organisms are only made of one cell so gas exchange between the cell and the atmosphere is very easy. Gases involved in respiration simply move in and out of the cell membrane.

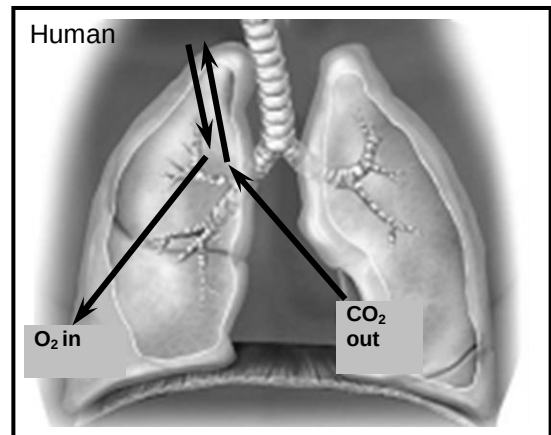
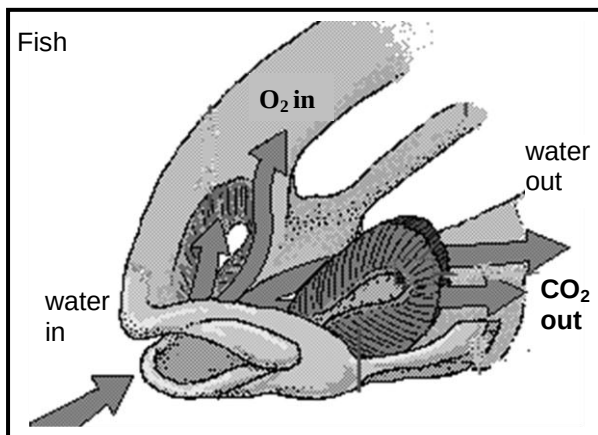


Very tiny organisms use their cell membranes to breathe while an earthworms use their moist skin

Bigger organisms are made of a lot of cells. The thick layers of cells would make it difficult for gases to reach the inner cells. Bigger organisms therefore need a more efficient system of delivering oxygen and removing carbon dioxide to and from the cells. A **respiratory system** functions to allow gas exchange to all parts of the body.



A leaf uses its stomata for breathing; an insect makes use of its spiracles on its abdomen.



Respiratory organs in fish and humans provide an efficient way of swapping oxygen for carbon dioxide. Fishes extract oxygen from water sucked through their gills. We, humans have 10 to 20 million thin tubes in our lungs with a total surface area of 1000 square metres for absorbing oxygen and removing carbon dioxide.

What is transpiration in plants?

Stomata are the breathing structures in the leaves of plants. They are tiny openings in the underside of leaves through which oxygen, carbon dioxide and water can pass. Stomata are not only helpful in the process of respiration but they are also important in the process of transpiration.

Transpiration is a plant process that involves the movement of water through the plant. The loss of water through the leaf stomata pulls water up through the plant from the roots. Transpiration is the way plants use water to carry nutrients through their structure. When additional water is unavailable to the roots, as in winter or drought, wilting and potential plant damage can occur.



Summary

You have come to the end of lesson 15. In this lesson you have learnt that:

- respiration is the chemical process by which cells breakdown energy rich food substances to get energy to perform living functions.
- most organisms including plants and animals respire by breaking down food using oxygen. This process produces carbon dioxide and water and a lot of energy.
- high levels of lactic acid in the muscles can cause the muscles to get tired.
- breathing is a physical process that living things perform to take in oxygen rich air (inhalation) and giving out carbon dioxide rich air (exhalation).
- hard physical activities can increase the breathing rate.
- the respiratory system helps organisms take in oxygen and give out carbon dioxide more efficiently.
- transpiration is the movement of water through the plant and the loss of water through the leaf stomata.

NOW DO PRACTICE EXERCISE 15 ON THE NEXT PAGE.



Practice Exercise 15

Part A. Multiple Choice Questions

Write the letter of the best answer in the box provided.

1. Which of the following organisms do not need oxygen when they respire?
 - a. Bats
 - b. Yeasts
 - c. Birds
 - d. Plants
2. Earthworms breathe by means of their
 - a. skin
 - b. gills
 - c. spiracles
 - d. cell membrane
3. From the following activities, which do you think will produce the least breathing rate when each is done at the same length of time?
 - a. sitting
 - b. jogging
 - b. jumping
 - d. walking
4. 5. Which of the following best describes the process of breathing?
 - a. Breathing breaks down food and releases energy.
 - b. Breathing enables organisms to grow and develop.
 - c. Breathing allows leaves to lose water through its stomata.
 - d. Breathing gives organisms the oxygen that they need and removes the carbon dioxide that is not needed in their body.

Part B. Short Answer Questions

Read carefully and write your answer on the space provided after each question.

6. Differentiate respiration from breathing.

7. Give two living processes that require or need energy from respiration.

8. Explain the function of the respiratory system in animals.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 4.

Answers to Activities

Activity 1

1. Respiration is the breakdown of food to release energy.
2. It is important because the energy produced is used by organisms to support its living functions such as movement, reproduction, growth and development, and to feel and respond.
3. Fat

Activity 2

1. Sitting will likely produce a normal breathing rate so answers close to 16 bpm or beats per minute is correct. Your breathing rates will increase depending on how fit you are.
2. Running
3. Running with the most air taken in per breath.
4. The harder the work, the higher the rate of breathing.

Lesson 16: The Lungs as Organs of Respiration



Welcome to Lesson 16 of Strand 2. In the last lesson you learnt about the process of respiration. In this lesson you will learn about the main organ in our body responsible for respiration. You breathe in and out anywhere from 15 to 25 times per minute without even thinking about it. You breathe so regularly that it is easy to take your lungs for granted. You can't even stop yourself from breathing if you try! In our previous lesson, you described the chemical process of respiration in the cells, and partly the physical process of respiration involving the gas exchange in the lungs. Your previous lesson showed you that your breathing rate goes up when you exercise.



Your Aims:

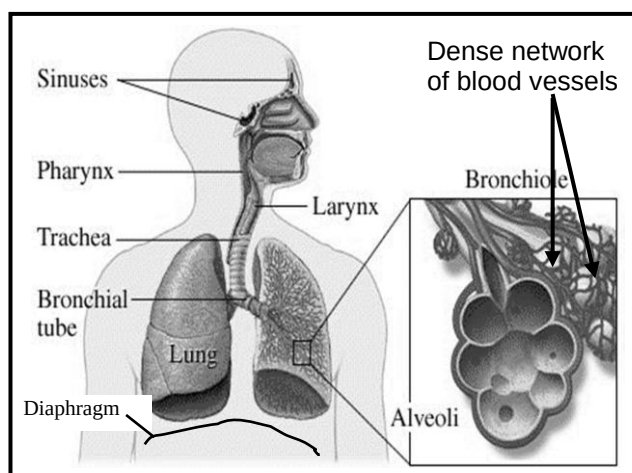
- take a close look at how your lungs work and how they keep your body's cells supplied with oxygen and get rid of the carbon dioxide waste
- identify the parts of the human gas exchange system
- describe the lungs as organs of breathing, and
- list the materials humans respire

The Human Respiratory System

The lungs are the major respiratory organs in humans. They are enclosed in the **thorax** or chest cavity. They communicate with the atmosphere through respiratory tract which includes the nose, nasal passage, pharynx, trachea, bronchus and bronchioles. Gas exchange takes place in the alveoli.

The air passages

The **nose** is an accessory organ for breathing. When air is drawn into the nose, it gets into the throat through the sinus or **nasal cavity**. The air passage has an inner lining filled with hair and mucous which help trap dust and bacteria from the air. The nose also warms the air before it reaches the lungs. You must also remember that the nose is a sense organ that is sensitive to chemicals in the air and give a sense of smell.



The human respiratory system

Pharynx is more commonly known as the throat. The mouth and nose open into the pharynx that's why it is possible to breathe using the mouth. It is not safe however to breathe with the mouth as air is not cleansed.

From the pharynx, air passes through the **larynx** or voice box. When breathing out, the **vocal cords** inside the voice box can be made to vibrate. The sound produced make up our speech.

Trachea or windpipe is the tube that carries air towards the lungs. The trachea divides into two **bronchi** (singular: bronchus) which enter the left and right lungs and further divide into smaller branches called **bronchioles**. The trachea and bronchi are lined with rings of cartilage to prevent them from collapsing during inhalation.

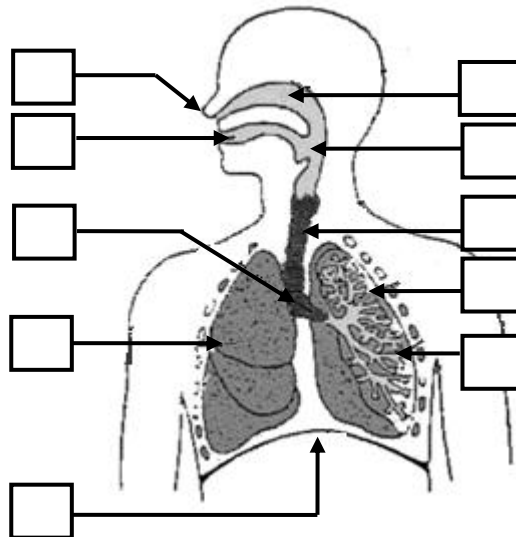
At the end of each bronchiole are the **alveoli** (singular: alveolus) or air sacs. It is in the alveoli where gas exchange between the air and the blood take place. The alveoli that make up the lungs have moist, thin, elastic walls with a dense network of blood vessels. Breathing is aided by the **diaphragm**, a sheet of muscles separating the thorax and the abdomen.



Activity: Now test yourself by doing this activity.

Match the parts of the human respiratory system to their appropriate boxes.

- A. Alveoli
- B. Bronchus
- C. Diaphragm
- D. Lung
- E. Mouth
- F. Nasal cavity
- G. Bronchiole
- H. Trachea
- I. Nose
- J. Pharynx



The human lung

Our two lungs are suspended on either side of the heart. The lungs are made up of tubes, the bronchi and bronchioles, and about 350 million alveoli or air sacs which provide the respiratory surface for gas exchange between the blood and the air. The surface of each alveolus or air sac is moist, thin and surrounded by very tiny blood vessels. All these features make the lungs effective in its function as the gas exchange organ.

Materials respired

Air component	Inhaled air (atmospheric air)	Exhaled air (air from the lungs)	Reason
Oxygen	21%	18%	Oxygen is taken in by the alveoli
Carbon dioxide	0.04%	3%	CO ₂ from the blood goes into the air in the alveoli
Nitrogen	78%	78%	Nitrogen is not used by the body
Water vapour	A trace	A lot	Water evaporates from the surface of the alveoli

Air is breathed in, gas exchange happens in the alveoli, and the air is breathed out again. The composition of the inspired (breathed-in) air is therefore different from the composition of the expired (breathed-out) air, as shown in the table.

**Summary**

You have come to the end of the lesson. In this lesson you have learnt that:

- the lungs are organs for respiration in humans. They are enclosed in the thorax or chest.
- the respiratory tract is the passage that allows gases to pass from the nose to the lungs and back. It includes the nose, nasal cavity, pharynx, trachea, bronchus and bronchioles.
- the trachea and bronchi are lined with rings of cartilage to prevent them from collapsing during inhalation.
- the inner wall of the respiratory tract contains hairs and mucus which help trap and filter dust and bacteria from the air that we breathe.
- air is cleansed and warmed before it reaches the lungs.
- Gas exchange takes place in the alveoli or air sacs.
- the surface of each alveolus or air sac is thin, moist, elastic and is surrounded by very tiny blood vessels. All these enable the lung to become an effective organ for gas exchange.
- breathing is aided by the diaphragm, a sheet of muscles separating the thorax and the abdomen.
- there is a difference in the composition of the air breathed in and the air breathed out. The air inhaled is more concentrated in oxygen while the air exhaled is more concentrated with carbon dioxide.

NOW DO PRACTICE EXERCISE 16 ON THE NEXT PAGE.



Practice Exercise 16

Part A. Paragraph Completion

Read the following paragraph and complete it by filling the missing words.

Air enters the _____ and gets into the nasal passages which are lined with hair and _____ that helps trap dust and bacteria laden in air. The air goes to the throat or _____, a passage common to both the mouth and the nose.

From the throat, air passes through the larynx or _____. When breathing out, the _____ inside the voice box can be made to vibrate. The sound produced make up our speech.

The pharynx leads to the trachea or _____. The trachea is the tube that carries air towards the lungs. The trachea divides into two _____. The trachea and bronchi are lined with rings of cartilage to prevent them from collapsing during inhalation. Each bronchus delivers air to the left and right lungs. Inside the lungs, the bronchi divide into smaller branches called _____.

At the end of each bronchiole are the _____ or air sacs. It is in the air sacs where gas exchange between the air and the blood take place.

The sheet of muscles separating the thorax and the abdomen that aid breathing is the _____.

Part B. Short Answer Questions

11. Explain why it is not good to breathe through the mouth.

12. Give another function of the nose besides being a breathing organ.

13. What makes the lung an effective organ for gas exchange?

14. Rearrange the following according to the order at which the air passes through the respiratory tract:

pharynx bronchus alveolus trachea nasal cavity bronchiole

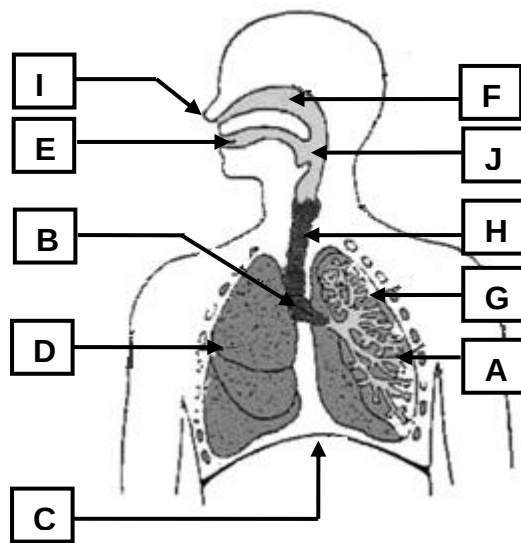
Nose → _____ → _____ → _____ → _____ → _____

15. Compare the air that we inhale and exhale according to the concentration of oxygen and carbon dioxide.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 4.

Answers to Activities

Activity 1



Lesson 17: Structure of Leaves



Welcome to Lesson 17 of Strand 2. In the last lesson you learnt about the organ for respiration in animals. In this lesson you will learn about the leaf of a plant which is responsible for respiration and another process called photosynthesis in plants. It is widely known that organisms need food to stay alive. But do organisms know their source of food? Did you know that a whole plant stays alive because of a leaf? Not just the plant, all other organisms depend on these leaves of a plant for survival. Therefore, this lesson teaches that all about leaves play an important role in the environment.



Your Aim:

- learn the typical structure of a leaf
- develop an understanding of how these structures support photosynthesis

Leaf Functions

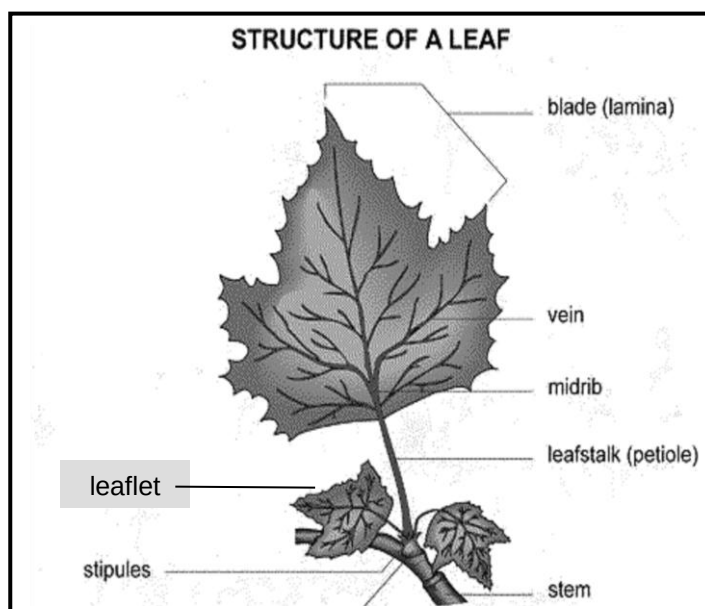
The important function of a leaf is to make food by the process called **photosynthesis**. The leaf also allows water to move out by **transpiration**. Finally, the leaf allows exchange of gases needed for **respiration** and photosynthesis.

The broad, flat shape of the leaf provides a large surface allowing a rapid exchange of gases and a lot of sunlight to fall on its exposed surface.

Leaf structure

The **leaf blade** is the green, broad, thin, flat and expanded part of the leaf. It is broad and flat to easily capture sunlight as well as to allow a rapid exchange of gases. It is thin to provide a short distance so that light and gases can easily get through. The thinness of the blade also allows rapid evaporation of water vapour.

The leaf is supported by a stronger network of **veins** that conducts food and water.



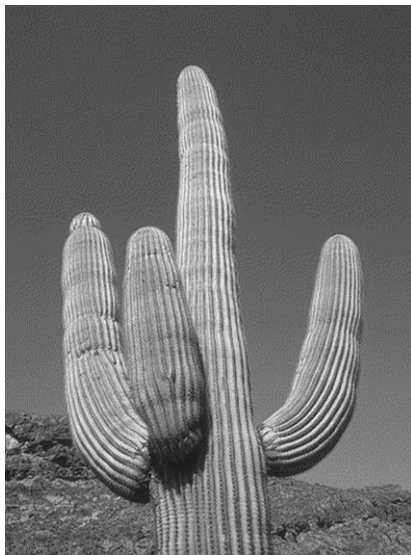
A diagram of a leaf

The water needed by the leaf runs and is transported from the roots to the stem, and through the petiole and midrib. Leaves are sometimes joined to the stem by a stalk or **petiole**.

A leaf is made of many layers that are put together between two layers of tough skin cells called the **epidermis**. The epidermis secretes a waxy substance that protects the leaf from insects, bacteria, and other pests, and also protects it from losing a lot

of water during a hot sunny day. Among the epidermal cells are stomata where gases enter and exit. The leaf can be able to close its stomata when the leaf doesn't need to take in any gases or when the plant wants to keep its water.

Most food production takes place in the inner cells. The leaf is generally green because of the green pigment called **chlorophyll**. The function of the chlorophyll is to trap the energy from the sun.



The stomata of most plants open during the day to release oxygen and even water while absorbing carbon dioxide. Most cacti open their stomata only at night to prevent water loss. Their rate of photosynthesis is low and they have a slower growth than most plants

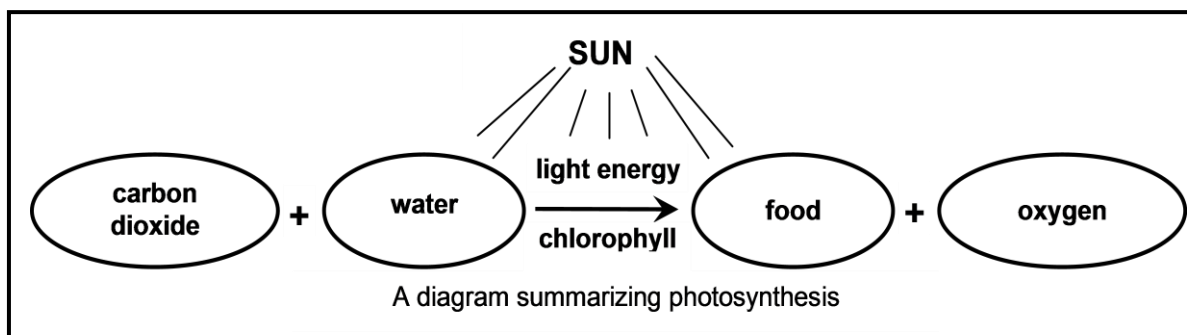
Food production in the leaves

Photosynthesis is the process by which plants make their own food.

To do this they need carbon dioxide obtained from the atmosphere, water and minerals from the soil and sunlight.

The energy from the sun, trapped by the green pigment called chlorophyll, is used by the plant to convert carbon dioxide and water into food and oxygen.

The food produced is carbohydrate. You have learned in the previous topic that this food is converted by plants through respiration into a form of energy that plants can use to support their living functions like growing and developing flowers, seeds and fruits.





Activity: **Now test yourself by doing this activity.**

Use the information about the process of food production in plants above and answer the following questions.

1. List the raw materials needed by plants to make their own food?

2. Where do these materials come from and explain how they get into plants?

3. Name the food produced by plants.

4. Briefly explain how this food is utilized by plants.

5. Predict what will happen to the level of carbon dioxide in the atmosphere if plants will be removed from our habitat.

Food produced from the leaves of plants can be stored. This stored food is called carbohydrate (car- bohy- drate)

Carbohydrate that is not used by the plant will be stored in its leaves, fruits and roots. Examples are potatoes, carrots, onions, beans, and of course many fruits. This becomes sources of food. Because the plant has done all the work storing the energy, animals are able to feed. This food is transferred to animals when they eat plants as energy.

The entire foundation of life comes from plants, and before that. Primary consumers are herbivorous animals that feed exclusively on the plants, and from there you enter the complex food web, with animals varyingly eating plants and animals, but none of this would be possible without the plants to take the energy from the sun.



Examples of different plant parts that store food manufactured from the leaves



Summary

You have come to the end of lesson 17. In this lesson you have learnt that:

- plants are producers. They can produce or manufacture their own food by the process of photosynthesis, using sunlight, carbon dioxide and water.
- a leaf is a very important structure in plants. It is where the process of photosynthesis occurs. A leaf also serves as an organ for gas exchange.
- the leaf is shaped and structured to easily capture light and allow gases to easily move in and out of the cells. It contains the green pigment chlorophyll that specializes to trap the energy from the sun. Its small openings called stomata functions for gas exchange.
- food manufactured in the leaves of plants comes in the form of carbohydrate. It is used by plants to keep itself alive. The food that it does not utilize is stored in the leaves, fruits roots and other organs specialized for storage. This stored food is transferred to animals when they eat plants.
- plants are the primary source of food on earth. The energy produced in their leaves may be stored and can be transferred to a series of animals by feeding.

NOW DO PRACTICE EXERCISE 17 ON THE NEXT PAGE.



Practice Exercise 17

Answer the following questions:

Read each question carefully and write your answer on the space provided.

1. Identify process taking place in the leaves of plants that enable them to make their own food.

2. Write a word equation to demonstrate the process of food production taking place in the leaves of plants.

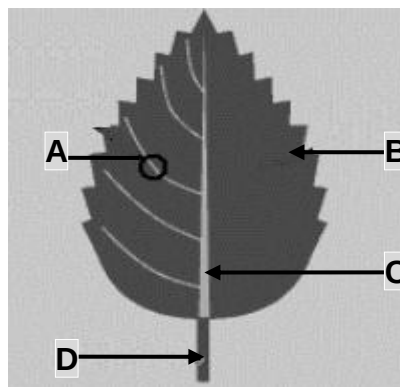
3. Name the parts labelled A, B, C and D

A – _____

B – _____

C – _____

D – _____



4. Using the diagram in number 3, indicate and label with arrowed lines (→) the movement of gases carbon dioxide and oxygen when the leaf photosynthesise.

5. List two characteristics of a leaf blade that enables it to perform photosynthesis efficiently.

6. The epidermis and the stomata are both found on the leaf surface. What is the difference between the two leaf structures in terms of their function?

7. Name three plant organs that are specialised in storing food produced from the leaves.

8. Explain why plants are called producers.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 4.

Answers to Activity

1. Carbon dioxide and water
2. Carbon dioxide comes from the atmosphere through the stomata in the leaves;
Water comes from the soil absorbed by the roots
3. Carbohydrates
4. It is burned by plants to produce energy to make the plant alive/ It is used in respiration to produce energy to support the plants' living functions.
5. The level of carbon dioxide will increase.

Lesson 18: Leaves as Organs for Gas Exchange



Welcome to Lesson 18 of Strand 2. In the last lesson you looked at the structure of plant leaves. In this lesson you will learn about leaves as organs for gas exchange in plants. It is important for the plant to acquire gases needed for both processes as well as to get rid of their waste.



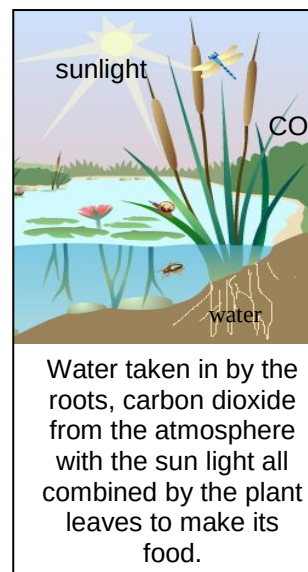
Your Aims:

- list materials respired
- describe leaves as organs of respiration and transpiration
- understand that exchange of gases takes place in leaves using the stomata through which the loss of water by transpiration also occurs
- state factors in the environment that can affect the speed of respiration

Respiration And Photosynthesis

Photosynthesis allows plants to make their own food using carbon dioxide and water, and release oxygen as a by-product. It can only take place during the day when there is sufficient light energy to support the process.

Internal respiration is the process where all plant cells use oxygen to burn food made by plants when they photosynthesize. This process is vital to keep all plant cells alive. **External respiration** occurs when a plant cell takes in the gas oxygen needed to burn the food. Unlike Internal respiration which involves all the plant organs, external respiration takes place mostly in leaves. The word respiration in this lesson will be used to refer to the process of external respiration in the leaves of plants. This involves the taking in of oxygen and the giving out of carbon dioxide by the leaves.



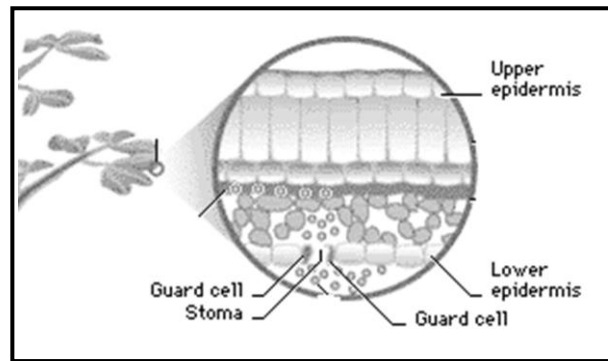
Internal respiration is an energy releasing process that occurs in all living plant cells.



External respiration is a gas exchange process taking place mostly in the leaves of plants.

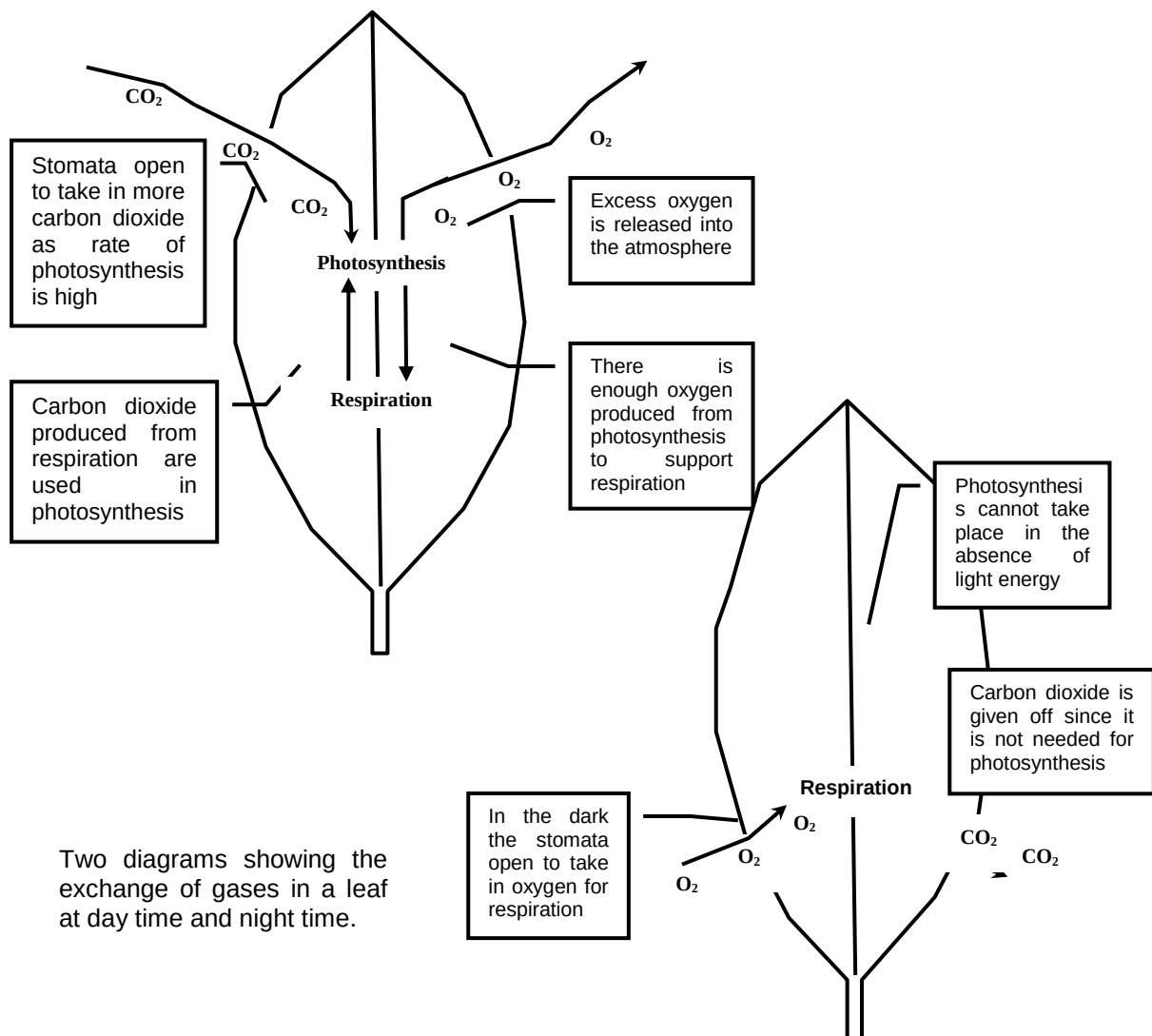
Gas exchange in the leaves

The **Stomata** (singular-**stoma**) are tiny pores or opening to the atmosphere, allowing gases such as carbon dioxide, oxygen and water vapour to pass in and out of the leaf. The stomata are often more numerous on the lower epidermis of the leaf. The guard cells on each side of the opening can swell or shrink and so open and close the stomata.



Section through the leaf blade

When there is sufficient light during the day, leaves also take in a lot of carbon dioxide and photosynthesize. The oxygen produced is not given off but is instead used to burn the food to release energy in respiration. Oxygen is only taken in at night, when plants do not photosynthesize.



Stomata and water loss

Transpiration is the process by which plants lose water as water vapour into the atmosphere. The greatest loss of water takes place through the stomata.

If the stomata open to allow carbon dioxide to get in, water vapour can escape through the pores. The importance of this is that as more water is lost through the openings, more water is drawn upwards from the roots transporting important minerals as well as cooling the entire plant.

Conditions affecting transpiration

Light, humidity, temperature and wind affect the amount of water lost by the leaves through respiration. When light intensity increases, the stomata open and allow rapid evaporation. Evaporation of water also increases with temperature and strong winds. The increase in humidity or amount of water vapour, however, decreases the rate of transpiration.

Wilting occurs if the amount of water lost from the leaves is greater than the amount of water absorbed in the roots.

Adaptations of plants to reduce water loss

The reason why most stomata are on the lower surface is to reduce water loss from the warming effects of the sun's heat. The waxy substance on the upper epidermis and the guard cells can also prevent water loss by transpiration. Leaves or cacti are spiny with sunken stomata to keep their water and withstand the very dry conditions in the desert.



The spiny leaves of a cactus help it to retain its water over long periods of drought.

**Summary**

You have come to the end of lesson 18. In this lesson you have learnt that:

- stomata are openings in the surface of a leaf through which oxygen, carbon dioxide, and water can pass.
- carbon dioxide enters the stomata during the day when there is plenty of light for the leaves to photosynthesize. A lot of oxygen is produced following this process.
- plants generally don't take in oxygen for respiration during the day because there is sufficient oxygen produced from photosynthesis. Carbon dioxide produced from respiration is also retained for photosynthesis.
- transpiration is the evaporation of water from the leaves.
- transpiration is high when the water vapours escape as stomata open to allow carbon dioxide gas to enter.
- when the stomata are closed, during the day, carbon dioxide will not be able to enter reducing the process of photosynthesis.

NOW DO PRACTICE EXERCISE 18 ON THE NEXT PAGE.

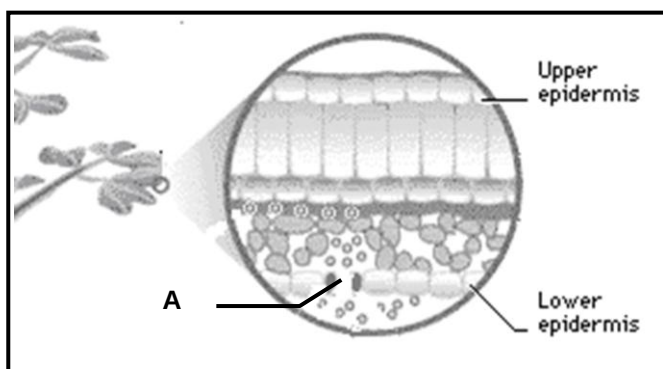
**Practice Exercise 18**

Read and complete the following sentences by filling in the missing words.

1. Photosynthesis is the production of food by green plants from _____ and _____.
2. When plants respire, they take in _____ to burn the food and release _____ to support their living functions. They give off _____ as a waste product.
3. The loss of water through the stomata of leaves is called _____.
4. The higher the temperature, the _____ water vapour evaporates from leaves.
5. During a bright, sunny day, plants don't take in the gas _____ because there is enough produced from the process of photosynthesis.

The diagram below is a section through a leaf blade. Use the diagram to answer question 6 to 8.

- 6-7. What is the name of the part labeled **A** and briefly describe its function.



8. Give a reason why structure **A** is often found in abundance at the lower section of the leaf rather than the upper section.

9. Name two conditions in the environment that can affect the speed of transpiration in plants.

10. Carbon dioxide is a greenhouse gas because it traps heat energy in the atmosphere and warms the air causing global warming.
 - a. Explain the role of plants in preventing global warming.

 - b. What can you do to help prevent global warming?

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 4.

REVIEW OF SUB STRAND 4: RESPIRATION AND BREATHING IN LIVING ORGANISMS (LUNGS AND LEAVES)

Revise all the Lessons in this Sub Strand and then do **ASSIGNMENT 3**.

Here are the main points to help you revise.

Lesson 15: Respiratory System

- Respiration is the chemical process by which cells breakdown energy rich food substances to get energy to perform living functions.
- Most organisms including plants and animals respire by breaking down food using oxygen. This process produces carbon dioxide and water and a lot of energy.
- High levels of lactic acid in the muscles can cause the muscles to get tired.
- Breathing is a physical process that living things perform to take in oxygen rich air (inhalation) and giving out carbon dioxide rich air (exhalation)
- Hard physical activities can increase the breathing rate.
- The respiratory system helps organisms take in oxygen and give out carbon dioxide more efficiently.
- Transpiration is the movement of water through the plant and the loss of water through the leaf stomata.

Lesson 16: The Lungs as Organs of Respiration

- The lungs are organs for respiration in humans. They are enclosed in the thorax or chest.
- The respiratory tract is the passage that allows gases to pass from the nose to the lungs and back. It includes the nose, nasal cavity, pharynx, trachea, bronchus and bronchioles.
- The trachea and bronchi are lined with rings of cartilage to prevent them from collapsing during inhalation.
- The inner wall of the respiratory tract contains hairs and mucus which help trap and filter dust and bacteria from the air that we breathe.
- Air is cleansed and warmed before it reaches the lungs.
- Gas exchange takes place in the alveoli or air sacs.
- The surface of each alveolus or air sac is thin, moist, elastic and is surrounded by very tiny blood vessels. All these enable the lung to become an effective organ for gas exchange.
- Breathing is aided by the diaphragm, a sheet of muscles separating the thorax and the abdomen.

Lesson 17: Structure of Leaves

- Plants are producers. They can produce or manufacture their own food by the process of photosynthesis, using sunlight, carbon dioxide and water.
- A leaf is a very important structure in plants. It is where the process of photosynthesis occurs. A leaf also serves as an organ for gas exchange.
- The leaf is shaped and structured to easily capture light and allow gases to easily move in and out of the cells. It contains the green pigment chlorophyll that specializes to trap the energy from the sun. Its small openings called stomata functions for gas exchange.
- Food manufactured in the leaves of plants comes in the form of carbohydrate. It is used by plants to keep itself alive. The food that it does not utilize is stored in the leaves, fruits roots and other organs specialized for storage. This stored food is transferred to animals when they eat plants.
- Plants are the primary source of food on earth. The energy produced in their leaves may be stored and can be transferred to a series of animals by feeding.

Lesson 18: Leaves as Organs for Gas Exchange

- Stomata are openings in the surface of a leaf through which oxygen, carbon dioxide, and water can pass.
- Carbon dioxide enters the stomata during the day when there is plenty of light for the leaves to photosynthesize. A lot of oxygen is produced following this process.
- Plants generally don't take in oxygen for respiration during the day because there is sufficient oxygen produced from photosynthesis. Carbon dioxide produced from respiration is also retained for photosynthesis.
- Transpiration is the evaporation of water from the leaves.
- Transpiration is high when the water vapours escape as stomata open to allow carbon dioxide gas to enter.
- When the stomata are closed, during the day, carbon dioxide will not be able to enter reducing the process of photosynthesis.

REVISE WELL AND THEN DO SUB STRAND TEST 1 IN YOUR ASSIGNMENT 3.
--

Answers to Practice Exercises 15-18

Practice Exercise 15

Part A. Multiple Choice Questions

1. **B** 2. **A** 3. **A** 4. **C** 5. **D**

Part B. Short Answer Questions

6. Respiration is the process by which cells breakdown energy rich food substances to get energy to perform living functions. Breathing is a process that living things perform to take in oxygen rich air and giving out carbon dioxide rich air.
 7. Any two of the following will be considered correct: movement, reproduction, growth, development, body temperature regulation, sensitivity and respiration
 8. The respiratory system enables organisms to take in oxygen and give out carbon dioxide more efficiently.
-

Practice Exercise 16

Paragraph completion

Air enters the **nose** and gets into the nasal passage which is lined with hair and **mucous** that helps trap dust and bacteria laden in air. The air goes to the throat or **pharynx**, a passage common to both the mouth and the nose.

From the throat, air passes through the larynx or **voice box**. When breathing out, the **vocal cord** inside the voice box can be made to vibrate. The sound produced make up our speech.

The pharynx leads to the trachea or **larynx**. The trachea is the tube that carries air towards the lungs. The trachea divides into two **bronchi**. The trachea and bronchi are lined with rings of cartilage to prevent them from collapsing during inhalation. Each bronchus delivers air to the left and right lungs. Inside the lungs, the bronchi divide into smaller branches called **bronchioles**.

At the end of each bronchiole are the **alveoli** or air sacs. It is in the air sacs where gas exchange between the air and the blood take place.

The sheet of muscles separating the thorax and the abdomen that aid breathing is the **diaphragm**.

Short Answer Questions

11. Bacteria and dust in the inhaled air will not be trapped and filtered.
12. It is also a sense organ for smelling.

13. The lungs are made up of moist, thin and elastic air sacs or alveoli. It also is surrounded by blood vessels. These characteristics make the lungs fit for gas exchange
 14. Nose → nasal cavity → pharynx → trachea → bronchus → bronchiole → alveolus
 15. The air inhaled is more concentrated in oxygen while the air exhaled is more concentrated with carbon dioxide.
-

Practice Exercise 17

Read each question carefully and write your answer on the space provided.

1. Photosynthesis
 2. Carbon dioxide + Water → Food (Carbohydrate) + Oxygen
 3. Name the parts labeled A, B, C and D
A – Vein
B – Leaf blade
C – Midrib
D – Petiole
 4. The arrow pointing to the leaf shows movement of carbon dioxide inside; the Arrow pointing away from the leaf shows the release of oxygen.
 5. It is broad and flat to easily capture sunlight and allow a rapid exchange of gases. It is thin to provide a short distance so light and gases can easily pass through.
 6. The epidermis protects the leaf from harmful organisms and from losing water. The stoma allows the entry and exit of gases.
 7. Leaves, fruits, roots
 8. Plants are called producers because they make their own food using sunlight, carbon dioxide and water.
-

Practice Exercise 18

1. carbon dioxide and water.
2. oxygen, energy carbon dioxide
3. transpiration.
4. more
5. oxygen

- 6-7. Stoma. It is an opening through which oxygen, carbon dioxide, and water can pass.
8. The reason why most stomata are on the lower surface is to reduce water loss from the warming effects of the sun's heat. / To reduce excessive loss of water
9. Light, humidity, temperature, wind (any two of these factors are correct)
10. a. Plants remove the carbon dioxide from the atmosphere when they photosynthesize.
- b. I can help by 1.) Planting more trees 2.) Not cutting down trees 3.) Not slashing down and burning vegetations.
(Any one of the three is correct)

SUB STRAND 5

PLANT AND ANIMAL NUTRITION

In this sub strand you will learn about:

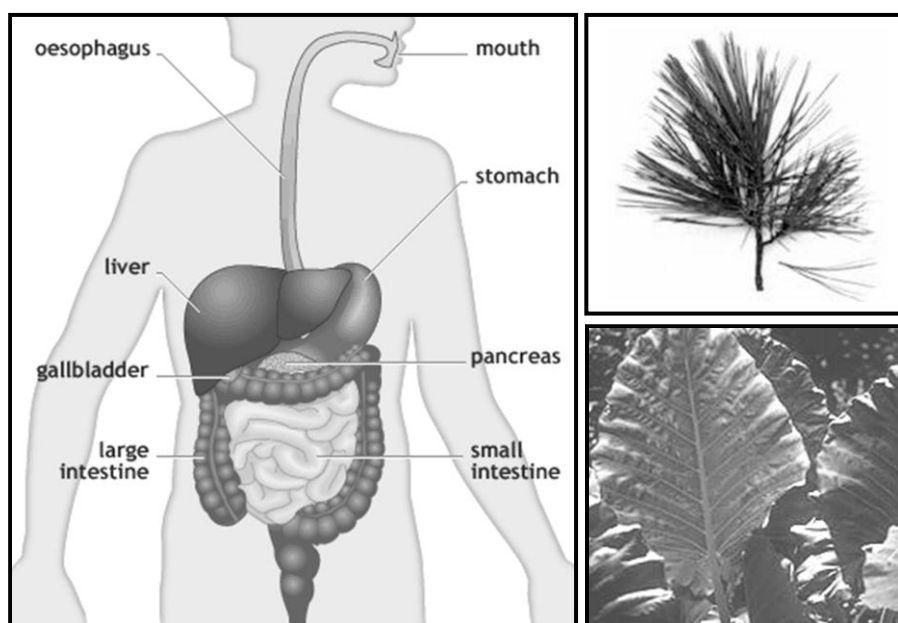
- **the alimentary canal**
- **transport system in plants**
- **leaves as manufacturers of food**

SUB STRAND 5: PLANT AND ANIMAL NUTRITION

Introduction

In order to live, all organisms need food molecules in their cells. The food molecules provide energy for growth and to function. Plants make their own food by photosynthesis. Animals feed on other living things because they cannot manufacture their own food.

The study of food, how they are obtained and used in the body of organisms is called nutrition. The food manufactured or obtained and utilised inside an organism are called nutrients. They are carried around the body of an organism and are used as building materials. They are built up together in the body of plants and animals to make new body parts. Nutrients may be used for growth, repair worn out tissues, and repair damaged cells. Nutrients that are not utilised are stored in special organs.



Humans like other animals need to feed in order to obtain nutrients.
Plants can manufacture their own food by photosynthesis.

The nutrients in food are not just building materials but also provide energy.

In this sub-strand you will have the opportunity to study:

- how humans digest or break down their food to obtain their nutrients.
- the function of the different parts of the human alimentary canal.
- how plants obtain and transport their nutrients.
- the process of food production or photosynthesis in plants.
- the structure of leaves as manufacturer of food.

In this Sub strand you will find the answers to these questions and all other questions relating to plant and animal nutrition.

Lesson 19: The Alimentary Canal



Welcome to Lesson 19 of Strand 2. In the last lesson you learnt about how plants and animals obtain their food. In this lesson we are going to look at how animals break down food into simpler forms. Through the use of an internal tube called the alimentary canal. This tube is composed of several organs that carry out different functions.



Your Aims:

- define digestion and absorption
- study the digestive system
- be familiar with the function of the different parts of the alimentary or digestive canal

Types Of Digestion

Digestion is the breakdown of food into simpler form so that they can be used by the body and takes place in two stages. **Mechanical digestion** occurs when large chunks of food are broken down into smaller pieces. This is achieved with the help of the chewing action by the teeth and when food is squeezed through the gut. **Chemical digestion** takes place when food is broken down by enzymes.

Digestion in the mouth

Digestion begins in the mouth. The teeth, tongue and jaws all help in the process of mechanical digestion. The saliva which mixes with the food in the mouth contains an enzyme or water type that chemically changes starch into simpler molecules. Saliva is released from the pairs of salivary glands in the lower jaw and behind the mouth cavity. It moistens the food so that it can be swallowed easily.

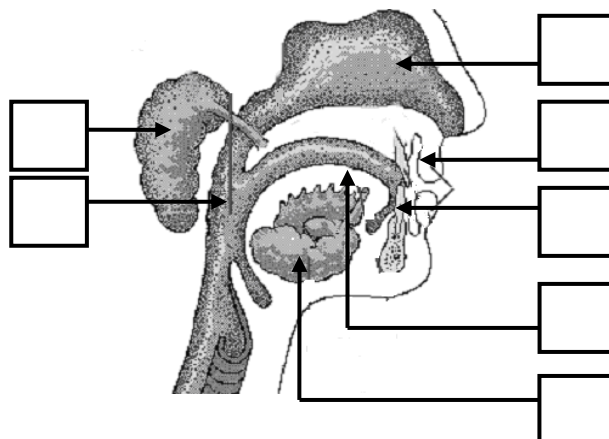
Chewing is important process since it reduces the food into smaller pieces. This increases the surface area of food and enables the enzyme to easily act on it.



Activity 1: Now test yourself by doing this activity.

- Use the words in the box below to label the parts of the mouth on the right.

- lips
- teeth
- salivary gland
- nasal cavity
- throat
- tongue



2. What stages or types of digestion take place in the mouth?

3. Briefly describe the role of the saliva?

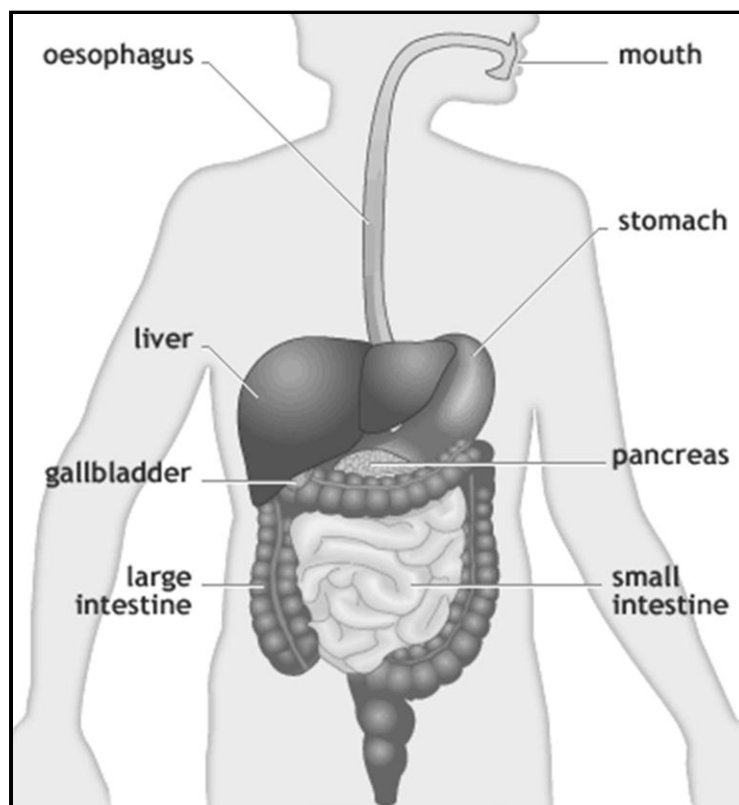
Movement of food in the oesophagus

After thorough chewing, the tongue pushes the food into the throat. The food is then squeezed down into a tube called **oesophagus** which leads to the stomach. The muscles of the oesophagus contracts and relaxes, in a process called **peristalsis**, pushing the food down to the stomach. To keep the food moving along, peristalsis continues to squeeze the food along the rest of the alimentary canal.

Digestion in the stomach

The **stomach** is a muscular pouch or bag that squeezes and churns the food. This squeezing and churning help break down food and mix it with **gastric juice** that contains an enzyme that chemically breaks down protein.

When the food is reduced to a milk-like fluid, it is slowly released into the next part of the alimentary canal – the small intestine.



The parts of the human digestive system

Digestion and absorption in the small intestine

The **small intestine** is quite long at about 7 metres in adult. The word 'small' refers to the diameter of the tube.

Final digestion occurs in the first part of the small intestine. Different chemicals and enzymes released from the small intestine, pancreas and liver to the first section of the small intestine complete the breakdown of carbohydrates, protein and fats.

The **liver**, large organ just in front of the stomach releases **bile**. Bile does not contain any enzyme but helps break down large fat droplets into smaller fat droplets. Bile is temporarily stored in the **gall bladder** before it is released into the small intestine.

Enzymes released from the pancreas and from the wall of the small intestine finally break down carbohydrates, fats and protein. The **pancreas** is a small, wrinkled organ behind the stomach.

The digested food products are then absorbed through millions of very small finger-like projections on the wall of the small intestine called **villi**.

The large intestine

The material that passes into the **large intestine** consists of water and food that cannot be digested by enzymes. Water is absorbed as the material passes through so the contents slowly become more solid.

This solid, undigested material called **faeces** is stored in the last part of the intestine called the **rectum**. The faeces are expelled through the terminal opening of the alimentary canal – the **anus**.



Activity 2: Now test yourself by doing this activity.

1. Besides digestion of food, what is the other function of the small intestine?

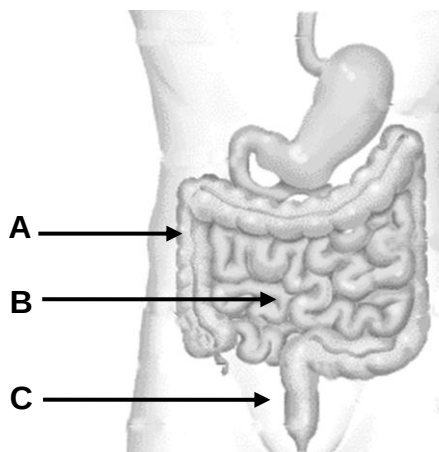
2. Name the parts labelled **A**, **B** and **C**.

A - _____

B - _____

C - _____

3. Give the function of the structure labelled **C**.





Summary

You have come to the end of lesson 19. In this lesson you have learnt that:

- digestion is the breakdown of food into simpler form.
- mechanical digestion occurs when large chunks of food are broken down into smaller pieces by the teeth and by peristalsis.
- chemical digestion takes place when complex food molecules are changed into simpler food molecules.
- chemical digestion is made possible by chemicals called enzymes.
- the alimentary canal is a tube that is composed of several organs that carry out digestion and absorption of food.
- the alimentary canal is composed of the mouth, oesophagus, stomach, small intestine, and large intestine.

NOW DO PRACTICE EXERCISE 19 ON THE NEXT PAGE.



Practice Exercise 19

Answer the following questions:

Part A. Multiple Choice. Circle the letter of the best answer.

- Where does the process of digestion begin in the human digestive system?
 - mouth
 - intestine
 - stomach
 - oesophagus
- Which of the following organ is NOT part of the human alimentary canal?
 - liver
 - stomach
 - intestine
 - oesophagus
- The villi in the small intestine specializes in the
 - physical digestion of food.
 - chemical digestion of food.
 - storage of undigested food.
 - absorption of digested food.
- Pick one that contributes to the chemical breakdown of food.
 - the grinding of food by the teeth.
 - the churning of food in the stomach.
 - the release of the enzymes in the small intestine.
 - the contraction of the muscles in the walls of the alimentary tract.

Part B. Short Answer Questions

Study the diagram of the human digestive system on the right and use it to answer the following questions.

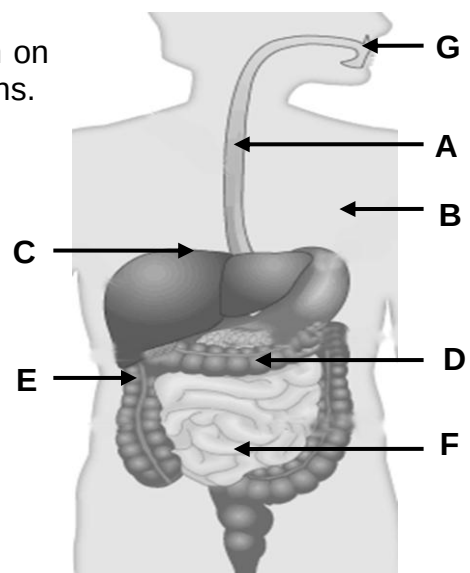
- Name the parts labelled **A** to **E**.

A - _____

B - _____

D - _____

E - _____



Refer to diagram on previous page.

2. Which letter represents the organ?

a. Where the saliva is released? _____

b. This stores the undigested food? _____

3. a. What chemical needed in digestion is released from the structure labelled C? _____

b. Where is this chemical temporarily stored? _____

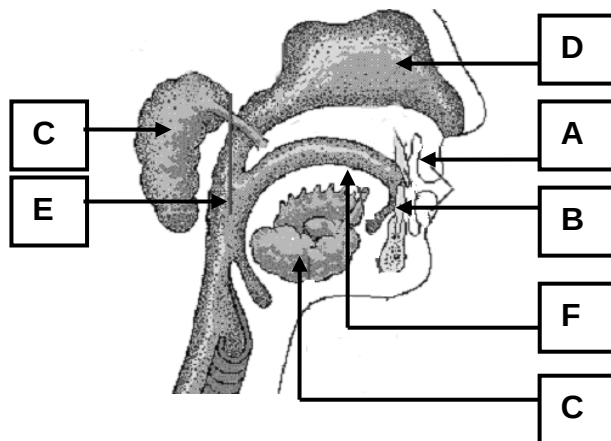
c. Briefly describe the function of this chemical.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 5.

Answers to Activities

Activity 1

1.



2. Mechanical and chemical digestion.

3. Saliva. It moistens the food so that it can be swallowed easily.

Activity 2

1. Absorption of digested food.

2. A - large intestine

B - small intestine

C - rectum

3. It temporarily stores the undigested food or faeces.

Lesson 20: Transport System in Plants



Welcome to Lesson 20 of Strand 2. In the last lesson you learnt about the alimentary canal in animals especially in the human beings. In this lesson you will learn about the transport system in plants. You know that plants spend most of their lives in one place, anchored in the soil. They make their own food in their leaves by taking in gases from the air, water from the ground and light from the sun. It is also important for plants to transport water from their roots to their leaves as well as transfer the food that they make



Your Aims:

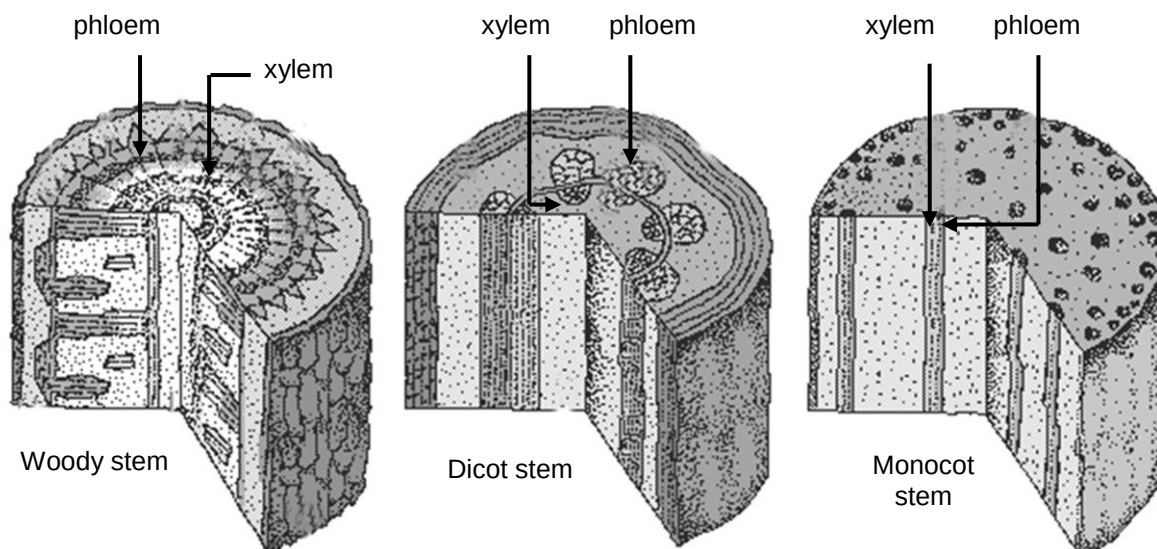
- study roots and stems as transport organs in plants
- describe how the roots and stems perform their role as transport organs
- list the materials transported from roots and stems and give their importance in plants

Transport System In Plants

A plant has roots, stems, branches, leaves and flowers. Inside the plant are bundles of **tubes** that carry water and food around to different parts of the plant. The tubes are made of two types of plant tissue called **xylem** and **phloem**. These tubes or vessels make up the transport or vascular system in plants.

The **xylem** vessel is a tube that is responsible for transporting water and dissolved mineral from roots to leaves. It consists of long dead cells that specialise in allowing water and dissolved nutrients to pass freely. The water is used as raw material for photosynthesis. The xylem also stores food and helps support the plant.

The **phloem** vessel is a tube that is made of living cells that are responsible for transporting food made from leaves to all plant parts. The food is used for plant growth or stored in roots or fruits.



Xylem and phloem vessels in stems



Activity 1: Now test yourself by doing this activity.

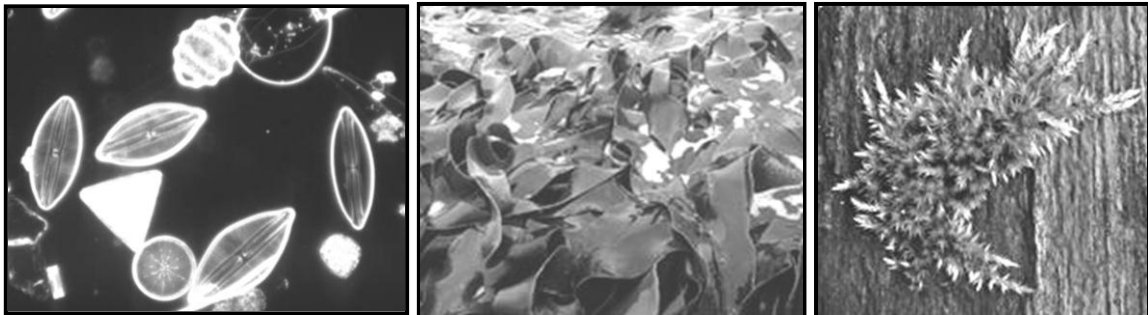
Read the following statements and fill in the blanks using the words in the box.

roots leaves stems fruits phloem xylem photosynthesis

1. The plant transport system is made up of _____ and _____ vessels found inside the roots, _____ and leaves.
2. Xylem transports _____ and mineral nutrients from the _____ to the leaves of plants. Water is used as a raw material to make food in leaves in a process called _____.
3. Phloem transports food from _____ to all plant parts. It may be used for plant growth in shoots or stored in roots or _____.

Vascular and non-vascular plants

Some primitive plants such as mosses and liverworts do not have proper or true roots and stems. They do not have a transport system. Instead, the water and food they need simply soak through them. They are called **non-vascular plants** because they do not have xylem and phloem vessels.



Simple microscopic plants (left), algae (middle) and mosses (right) do not have a transport or vascular system. Their cells directly absorb water and nutrients from their surroundings.

Plants that have xylem and phloem are called **vascular plants**. Vascular plants include almost every type of plant.



Vascular plants include woody trees and herbaceous shrubs.

Plant organs

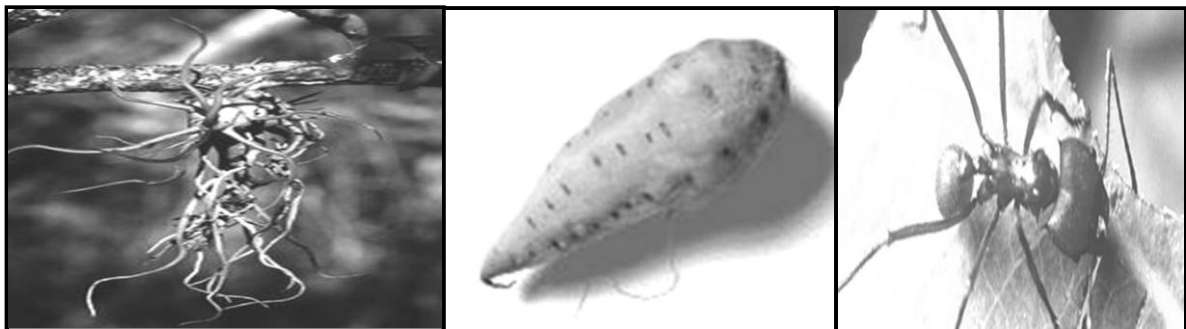
The body of a vascular plant is made of three general kinds of organs – the roots, stems and leaves. The roots and stems are composed of cells that specialise in transporting substances plants need in order to survive.

Roots

The function of **roots** is to anchor or hold the plant in the ground and to support the shoot. This is the reason why roots are generally found underground and grow downwards, or in the direction of gravity.

Roots also function to absorb water and mineral salts which are carried in special tubes or vessels to the shoot and leaves of the plant. Unlike stems, they have no leaves. The epidermis is covered with **root hairs**. The root hairs are small, thin and very numerous to increase the surface area of the roots so that they can absorb water and nutrients easily.

Inside, roots consist largely of xylem and phloem for transport of materials. Some roots however are adapted or modified to carry out special functions. For example, beetroots, carrots, and radishes can be able to store food. Many tropical trees have aerial prop roots that serve to hold the stem in an upright position. Epiphytes or aerial plants have roots modified for the rapid absorption of rainwater that flows over the bark of the host tree.



Some root functions may vary e.g. support, storage and anchorage, but they all have a common function that is to absorb nutrients needed for growth.

**Activity 2: Now test yourself by doing this activity.**

The roots serve to hold the plant in the ground using many of its parts. Now you will carefully look at roots.

Dig up a small plant and look at its roots. Dig all around the roots. Try not to break the small roots. Shake the dirt off from the roots. Wash the roots carefully so that a lot of dirt falls off from them. Look closely at the roots. You may use a hand lens.

1. Do you notice tiny parts which look like hairs along the roots? _____

2. Draw a simple diagram of a root showing these hair-like structures.



3. What are these hair-like structures called?

4. Why are these structures small, thin and very numerous?

Stems

Stems usually grow upwards above ground. They join the leaves and the flowers to the roots. They are the part of the plants that hold up the leaves and flowers. The leaves must be held up because they need to get sunlight to make food. Flowers need to be held up so they can easily be pollinated by wind or insects.

Stems have different external appearance and internal structure from roots, but they too consist of vascular bundles. The vascular bundles of xylem and phloem run the length of the stem, forming a continuous network with the vascular bundles in the leaves and the roots. The **epidermis** protects the stems and prevents water loss.

Within the plant kingdom there are many modifications of the basic stem, such as the thorns of hawthorns and acacia. Climbing stems, such as the tendrils of grapes allow them to grow up and attach to another plant or post.

Many plants like cactus have reduced leaves or no leaves at all, and their stems are green to perform the process of photosynthesis. Some stems creep along the surface of the ground and reproduce the plants through vegetative means; many grasses reproduce in this way.

Other stems are found underground and serve as food-storage organs, often allowing the plant to survive through the winter or drought season.



Some stems have specialised function like climbing, storing food, conserving water or protection. Despite these differences, they all share a common function that is to transport materials.



Summary

You have come to the end of lesson 20. In this lesson you have learnt that:

- the plant transport system functions to conduct materials that are important in plants.
- the transport tubes include the xylem and the phloem.
- xylem functions to transport water and minerals from roots to leaves.
- phloem transports food made from the leaves of plants to all plant organs.
- plants with xylem and phloem are called vascular plants. Plants without xylem and phloem are called non-vascular plants.

NOW DO PRACTICE EXERCISE 20 ON THE NEXT PAGE.



Practice Exercise 20

Answer the following questions:

Part A. Multiple Choice

Circle the letter of the correct answer.

1. Which one of the following may NOT be a modified root function?
 - A. Climbing
 - B. Support
 - C. Storage
 - D. Protection
2. Plants without xylem and phloem are called
 - A. epiphytes.
 - B. vascular plants.
 - C. incomplete plants.
 - D. non-vascular plants.
3. The phloem vessels conduct
 - A. food.
 - B. water.
 - C. gases.
 - D. minerals.
4. Which is NOT a reason why leaves or flowers must be held up by stems?
 - A. so they can easily get sunlight for food production.
 - B. so that water in xylem can easily conduct food upwards.
 - C. so that insects can easily brush off and pollinate flowers.
 - D. so that the wind can easily carry the pollen of wind pollinated flowers.
5. Pick one substance that is NOT carried in the plant transport system.
 - A. Food
 - B. Water
 - C. Oxygen
 - D. Mineral salts

Part B. Short Answers

The pictures below show a parasitic root, a root that specialises in storing food and an aerial root.



Parasitic roots
(‘pikus’)



Roots for storage
(‘kaukau’)



Aerial roots
(epiphyte or aerial plant)

1. All roots featured above may have different functions but they all perform a common process. What is this?

2. What are the transport tubes inside the roots of vascular plants?

3. Name two substances that are carried by the xylem inside the roots.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 5.

Answers to Activities**Activity 1**

The plant transport system is made up of xylem and phloem vessels found inside the roots, stems and leaves.

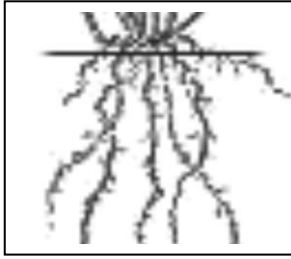
Xylem transports water and mineral nutrients from the roots to the leaves of plants. Water is used as a raw material to make food in leaves in a process called photosynthesis.

Phloem transports food from leaves to all plant parts. It may be used for plant growth in shoots or stored in roots or fruits.

Activity 2

1. Yes.

2.



3. Root hairs

4. The root hairs are small, thin and very numerous to increase the surface area of the roots so that they can absorb water and nutrients easily.

Lesson 21: Leaves as Manufacturers of Food



Welcome to Lesson 21 of Strand 2. In the last lesson you learnt about the transport system in plants. In this lesson you will learn more about how plants make their food using their leaves. Leaves use raw materials such as water and carbon dioxide to make food for the plants.



Your Aims:

- understand the function of leaves as manufacturers of food
- name the materials needed by the leaves to make food
- identify the materials produced from leaves when they make food
- study the features of a leaf that helps it perform its function

Leaves Make Food

Leaves are like food factories for plants. This food producing process called **photosynthesis** is done in leaves using **sunlight**, **carbon dioxide** from air, and **water**. Leaves are special organs that help plants collect light from the Sun. Sunlight is a form of energy and is changed to chemical energy inside the leaves.

The stem holds the leaves and spreads them out so that they can receive as much sunlight as possible.

The job of collecting sunlight is done by a chemical in leaves called **chlorophyll**. This chemical pigment is what makes most leaves look green. Many leaves turn yellow and red as their chlorophyll disappears when the season changes or when the leaf becomes old and dies.

Leaf structure

Besides chlorophyll that helps leaves collect sunlight, leaves also possess other features that allow them to easily photosynthesize.

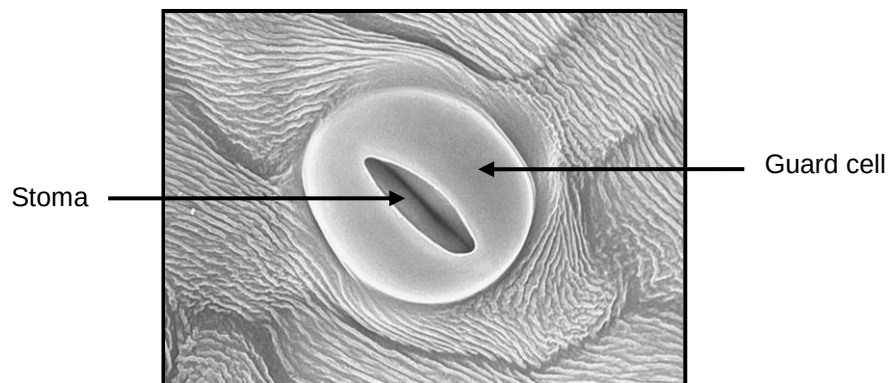
1. **Leaves are flat and wide.** They are flat and wide to catch as much sunlight as they can. They need the sunlight to make food.
2. **Leaves are thin.** The thinness of leaves allows the gas needed for photosynthesis to easily get in. It also makes it easy for the gas produced from the process to get out of the leaf.



Leaves are flat, wide and thin with a net-like pattern of veins.

3. **Leaves have veins.** When you look at a leaf you will notice that they have lines on them. These lines are called veins. These lines or transport tubes inside the leaves are composed of xylem and phloem vessels. The xylem transports water, and mineral salt, while phloem transports food from the leaf.
4. **Leaves have stomata.** Stomata (singular- **stoma**) are tiny pores on the surface of a leaf. They take in the gas carbon dioxide for photosynthesis and get rid of oxygen produced from the process.

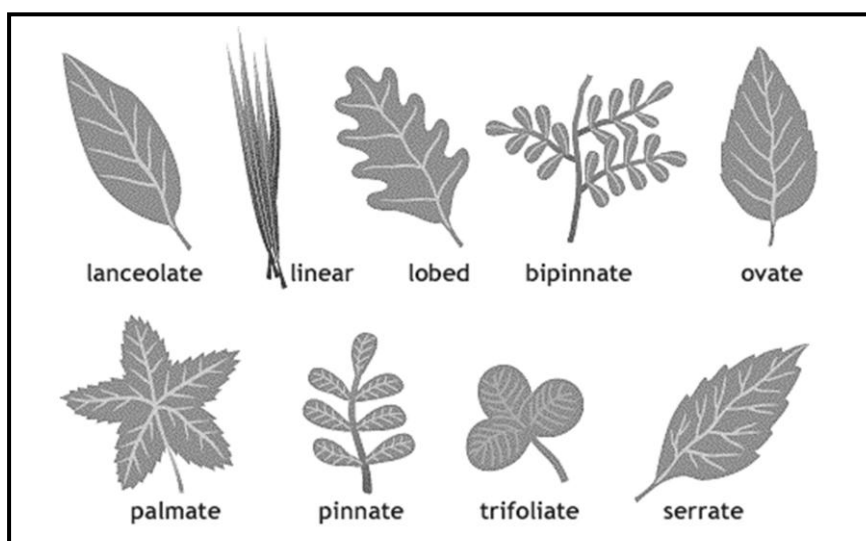
Stomata allow plants to lose water by evaporation by opening and closing the guard cells on either side of each stoma.



The surface of a leaf enlarged to show the stomata.

5. **Leaves have a waxy coating.** The rest of the leaf is covered with a waxy outer skin to prevent water loss. Plants control the amount of water they lose by opening and closing their stomata.

Leaves come in different shapes and form



Different leaf shapes and forms

Leaves come in different shapes and sizes. Most are broad and flat so they are exposed and can easily capture the light from the sun. The Leaf shape however can vary depending on the type of climate the plant grows. Conifers like pine trees have needle-like leaves with only a small surface area exposed because of the cold climate.

Plants in the desert have thick, fleshy leaves adapted to storing water. Cacti store water in their stems. Their leaves are reduced to spines as an adaptation to lose very little water as much as possible.

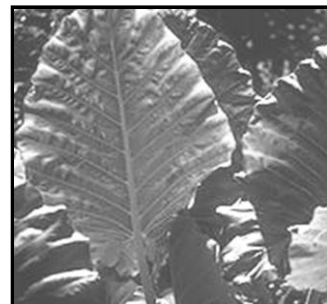
There is no need to store water in tropical rainforests as there is an abundance of water from the daily rainfall. The leaves of rainforest plants are wider to capture maximum sunlight especially when they are under the thick canopy of trees. They often have drip tips that are pointed to allow water to easily pass through.

The different shapes and arrangement of leaves are adaptations to different types of environment and are often used in identifying and grouping plants.



Activity: **Now test yourself by doing this activity.**

Below are pictures of different leaves labelled **A**, **B** and **C**. Study each and answer the following questions.

**A****B****C**

1. Which plant, **A**, **B**, or **C**, is more like be found in the
 - a. desert? _____
 - b. tropical rainforest? _____
 - c. cold northern regions? _____
2. Study the shape of the leaves in A and C and briefly explain why they have different shapes.

What happens to the food made by plants?

Food made by photosynthesis is temporarily stored in the leaves. They are then transported to the different plant organs to provide energy for **growth** of new cells. The development of new shoots, buds and fruits are an example. Food that is not used for plant growth is **stored** in stems, fruits or specialised roots.

The importance of leaves

Leaves are an important source of **food** for many animals. Humans use many different types of leaves in cooking and salads. Every time we eat fruits and '*kumu*' or leafy vegetables, we are taking in food the plant has made using the sun's energy. Leaves are also important as they provide **oxygen** for animals to breathe. Animals cannot survive without this gas needed for the process of respiration.

**Summary**

You have come to the end of lesson 21. In this lesson you have learnt that:

- plants use water, carbon dioxide and light from the sun to make their own food.
 - the food producing process that occurs in the leaves of plants is called photosynthesis.
 - the job of collecting sunlight needed for photosynthesis is done by the green pigment called chlorophyll in the leaves of plants. This pigment makes plant leaves appear green in colour.
 - leaves are shaped and structured for photosynthesis. They are flat and broad to catch a lot of light.
 - leaves are thin to allow carbon dioxide to easily get in.
 - leaves have veins that contain xylem and phloem vessels. Xylem transports water to the leaves while phloem conducts food to all parts of the plant.
 - leaves have tiny openings on their surface called stomata. The stomata are structures for gas exchange.
 - leaves have a waxy covering to prevent excessive water loss.
 - leaves are an important source of food and oxygen.
-

NOW DO PRACTICE EXERCISE 21 ON THE NEXT PAGE.
--



Practice Exercise 21

Answer the following questions:

Part A. Paragraph Completion.

Use the words in the box to fill in and complete the following paragraphs.

chlorophyll	phloem	roots	leaves	stems
oxygen	xylem	stomata	photosynthesis	water

Plants make their own food in a process called **a.**_____. This process needs sunlight, carbon dioxide and **b.**_____.

The food making process take place in the **c.**_____ of plants that specialises in collecting light from the sun. The job of collecting sunlight is done by the chemical in the leaves called **d.**_____. This chemical contains a green pigment that gives leaves their characteristic colour.

The leaves are generally thin, broad and flat. The **e.**_____ hold the leaves and spread them up so that they can capture as much sunlight as possible.

The leaves also have tiny openings called **f.**_____. These openings allow carbon dioxide needed for photosynthesis to get in and **g.**_____ produced from the process to get out.

h._____ function to absorb water needed for photosynthesis. Water is transported to the leaves of the plants via the **i.**_____ vessels. Food manufactured from the leaves is transported to all parts of the plants in the **j.**_____.

Part B. Short Answers

1. Explain what happens to food made by plants.

2. Give the two major importance of plant leaves on earth.

3. Leaves take in carbon dioxide from the air and use for photosynthesis. Predict what will happen to the concentration of carbon dioxide in the atmosphere if a lot of plants are cut down for firewood and logging.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 5.

Answers to Activity

1.
 - a. **B**
 - b. **C**
 - c. **A**
2. Leaf A is needle-like while leaf B is broad in shape. Needle-like leaves allow the plant to retain water from the colder regions of the Earth. Broad or wider leaves allow the plant to capture sunlight.
The different shapes and arrangement of leaves are adaptations to different types of environment.

REVIEW OF SUB STRAND 5: PLANT AND ANIMAL NUTRITION

Revise all the Lessons in this Sub Strand and then do **ASSIGNMENT 3**.

Lesson 19: The Alimentary Canal

- Digestion is the breakdown of food into simpler form.
- Mechanical digestion occurs when large chunks of food are broken down into smaller pieces by the teeth and by peristalsis.
- Chemical digestion takes place when complex food molecules are changed into simpler food molecules.
- Chemical digestion is made possible by chemicals called enzymes.
- The alimentary canal is a tube that is composed of several organs that carry out digestion and absorption of food.
- The alimentary canal is composed of the mouth, oesophagus, stomach, small intestine, and large intestine.

Lesson 20: Transport System in Plants

- The plant transport system functions to conduct materials that are important in plants.
- The transport tubes include the xylem and the phloem.
- Xylem functions to transport water and minerals from roots to leaves.
- Phloem transports food made from the leaves of plants to all plant organs.
- Plants with xylem and phloem are called vascular plants. Plants without xylem and phloem are called non-vascular plants.

Lesson 21: Leaves as Manufacturers of Food

- Plants use water, carbon dioxide and light from the sun to make their own food.
- The food producing process that occurs in the leaves of plants is called photosynthesis.
- The job of collecting sunlight needed for photosynthesis is done by the green pigment called chlorophyll in the leaves of plants. This pigment makes plant leaves appear green in colour.
- Leaves are shaped and structured for photosynthesis. They are flat and broad to catch a lot of light.
- Leaves are thin to allow carbon dioxide to easily get in.
- Leaves have veins that contain xylem and phloem vessels. Xylem transports water to the leaves while phloem conducts food to all parts of the plant.
- Leaves are an important source of food and oxygen.

REVISE WELL AND THEN DO SUB STRAND TEST 2 IN YOUR ASSIGNMENT 3.
--

Answers to Practice Exercises 19- 21

Practice Exercise 19

Part A. Multiple Choice.

1. **A** 2. **C** 3. **B** 4. **D** 5. **C**

Part B. Short Answer Questions

1. A - oesophagus
 B - stomach
 D - small intestine
 E - large intestine
 - 2 a. G
 b. F
 3. a. Bile
 b. Gall bladder
 c. It helps break down large fat droplets into smaller fat droplets.
 4. Protein
-

Practice Exercise 20

Part A . Multiple Choice

1. **D** 2. **D** 3. **A** 4. **B** 5. **C**

Part B. Short Answers

1. Absorption
2. Xylem and phloem
3. Water and mineral salts

Practice Exercise 21**Paragraph completion.**

- a. photosynthesis
- b. water
- c. leaves
- d. chlorophyll
- e. stems
- f. stomata
- g. oxygen
- h. Roots
- i. xylem
- j. phloem.

Short Answers

1. Food made by plants is used for growth or it may be stored.
2. Plant leaves are an important source of food for many animals.
Plant leaves provide oxygen for respiration.
3. The concentration of carbon dioxide will increase.

SUB STRAND 6

BALANCE OF NATURE IN LIVING ORGANISMS

In this sub strand you will learn about:

- **the process of natural selection in plants and animals**
- **the natural cycles**
- **the importance of decomposition**
- **the food webs**

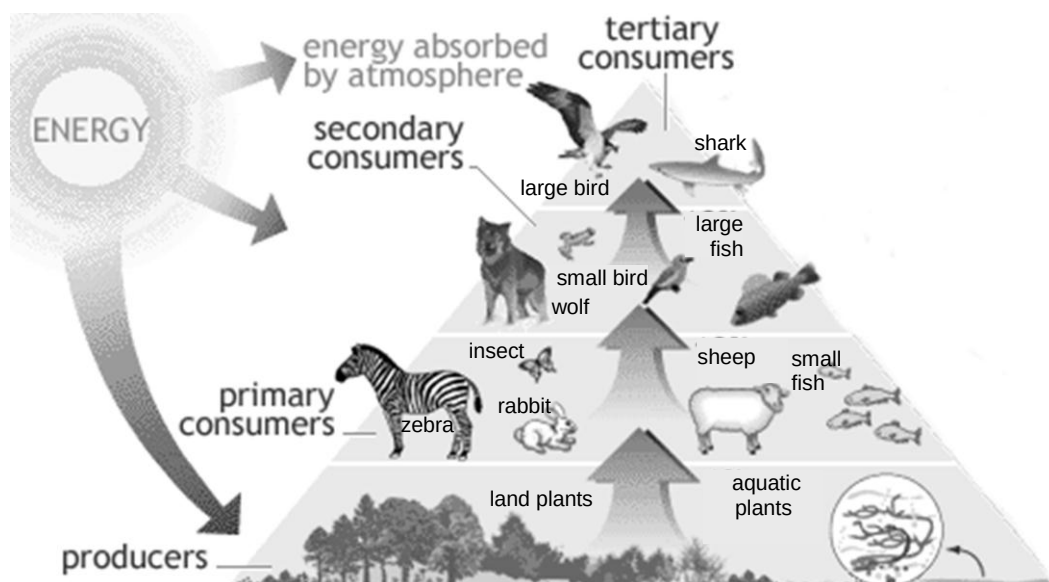
SUB STRAND 6: BALANCE OF NATURE IN LIVING ORGANISMS

Introduction

Each organism plays a vital role in the environment. These different roles and life processes in organisms play an important part in maintaining balance in nature.

In this sub strand you will study how living things cope and interact with each other and their environment. You will understand the natural cycles or the paths followed by any life-essential substance as they move through the living and the non-living part of the environment.

This sub strand will also explain to you the importance of the process of decomposition as well as the energy flow in food chains and food webs.



An example of a food web drawn as a pyramid

In this sub-strand you will have the opportunity to study:

- adaptation, variation and natural selection
- why plants and animals develop variations in their shapes, colour, height and other features.
- the three different types of natural cycles: oxygen, carbon and nitrogen cycles.
- the importance of natural cycles in the environment.
- decomposition and understand its importance in the environment.
- the feeding relationships in food chains and food webs .

In this Sub strand you will find the answers to these questions and all other questions relating to the balance of nature in living organisms.

Lesson 22: The Process of Natural Selection in Plants and Animals



Welcome to Lesson 22 of Strand 2. In the last lesson you learnt about how the leaves make food for the plant. In this lesson you will learn about the process of natural selection in living things. The environment may provide plants and animals' requirements in order to survive but nature also brings harsh or difficult conditions to disturb the balance and challenges for living organisms. You will study in this lesson that if an environment changes, an organism may have to change or adapt to suit the new conditions in order to continue living.



You Aims:

- define adaptation, variation and natural selection
- understand why plants and animals develop variations in their shapes, colour, height and other features

Environmental Factors That May Affect An Organism

Plants and animals are affected by some factors in the environment. For example, plants are affected by light, water, carbon dioxide, nutrients in the soil, soil type, temperature, wind and humidity. Animals are affected by oxygen, water, predators, breeding partner, temperature, and availability of food to name a few.

Organisms that are better suited to their environment are likely to survive while those that are not better suited will not survive.

Adaptation

Adaptation refers to the way living things has changed to make them more suitable for their way of life. This may be observed in the special characteristics of organisms that help them to survive. It can be shown in the **structure**, **function** or **behaviour** of organisms.

Structural adaptation is best observed in the shape, form and appearance of organisms. It includes physical attributes such as height, weight, body or organ size, colour and body covering.

Functional or physiological adaptation refers to how an organ becomes better suited to work or do its job. This type of adaptation is not easily observed as it involves the internal functions of organs.



Barn owl

The long talons or claws and powerful beak of an owl are its structural adaptations. One of its physiological adaptations is its long and flexible neck that allows its head to rotate 270 degrees. It behaves differently from most birds because of its nocturnal habits. This means that it is highly active and often hunts at night

Behavioural adaptation is shown in the way organisms behave. It may include their habits, ways, food preference, movements, feeding, mating and breeding patterns, and the manner organisms raise their young.



Activity 1: Now test yourself by doing this activity.

1. Below are examples of adaptations in selected organisms. Classify the following adaptations into: structural, functional or behavioural adaptation.

- a. A monarch butterfly (right) has a bitter taste that helps it deter insectivorous animals. The viceroy butterfly (left) doesn't have a bitter taste but imitates the colour of a monarch to fool insectivores.



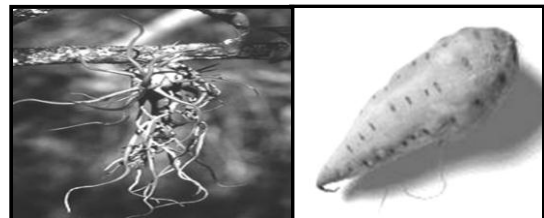
Type of adaptation _____

- b. A male ostrich performs a dance ritual to attract a female ostrich to mate or breed.



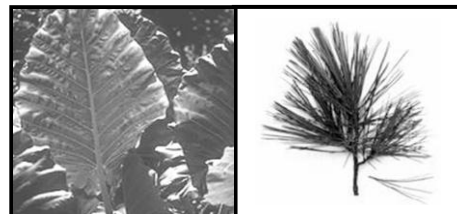
Type of adaptation _____

- c. The prop roots of mangrove (left) support the tree from violent wave action or water current. The sweet potato or kaukau (right) root stores food.



Type of adaptation _____

- d. Taro leaves (left) are flat and very large to capture sunlight under the forest canopy while leaves of pine trees (right) are small and needle-like to withstand a dry, colder climate.



Type of adaptation _____

- e. One "wood pecker" finch lacks a true wood-pecker's powerful beak but uses small sticks to probe for insects in tree holes in a manner similar to a woodpecker finch.



Type of adaptation _____

2. Why is it important for an organism to adapt?

Variation

For adaptation or change to occur, there must be some variety or differences in a group of organisms to start with. **Variations** are the differences in characteristics that can be observed in organisms of the same group.



Variations in the beaks of finches

Variation can be observed in the 14 different groups of birds. The differences are observed in the structure of their beaks. The differences in their beaks show the different types of food available in their environments. Fruits, cactus, insects and seeds. If there is a shortage of fruit after a big drought for example, not all finches will be affected. The fruit-eating finches will die of starvation but those that rely on cactus and insects will survive. This is the importance of variation. It increases the chances of survival if some major changes occur in the environment.

For an adaptation or change to occur, a living thing must be able to inherit its parent's characteristics and it must also live in an environment in which it is under pressure to survive.

If an animal inherits a favourable characteristic from its parents so that it can camouflage, run faster, or grow taller, it can cope with its environment better. Such variations can make a difference to its chances of survival.

**Activity 2: Now test yourself by doing this activity.**

Read the descriptions of some variations in the three species of hawks below and answer the following questions.



Osprey



Red-tailed hawk



Harrier

The **osprey hawk** is dark brown and white, its head is white with a dark brown mask-like cheek patch. The osprey feeds only on fish, and is often called fish hawk or fish eagle. When seeking food, it hovers over a body of water and dives beneath the surface to capture fish in its talons or sharp claws.

The plumage of **red-tailed hawk** varies but all adults have a characteristic reddish-brown tail. It hunts by gliding over open countryside searching for rodents, insects, birds, and snakes.

An adult male **harrier** is pale grey above, with black wing-tips, and white dotted sparsely with reddish-brown below. It flies low to the ground hunting for mice, frogs, fish, and snakes. It also occasionally eats other birds, leaving its natural habitat to raid nests in trees.

1. In what aspects are the three species of hawks described above different?

2. Which hawk will be severely affected if a lot of fish die after an oil spill?

3. What is the importance of variation?

Natural selection

In their natural environment, plants and animals compete with others in order to survive. There might not be enough water and nutrients in the soil for plants, or there might not be enough space or light for them to use. Food might not be enough for animals, or they may have many predators or other animals that eat them.

A plant that cannot grow fast and tall will not be able to compete for light for photosynthesis and will not grow well.

A deer that cannot run very fast is more likely to be food for predators. If there are lots of predators, only the fastest deer will survive long enough to reproduce and give birth to young deer. Those young deer are likely to inherit the ability to run fast. The deer that cannot run very fast are likely to die before they have a chance to breed, so their favourable characteristic will not be inherited. Over time, more and more of the deer population will be made up of fast runners. Slowly, over many generations, the deer population will change to become sleeker and faster.

The environment naturally selected the faster running deer. This is what is meant by natural selection. As a result of this process over many generations, populations of living things change. And they change so that they fit in better with their environment. They are better adapted.



Summary

You have come to the end of the lesson. In this lesson you have learnt that:

- adaptation refers to the way a living thing has changed to make it more suitable for its way of life.
- adaptation may be observed in an organism's structure, function or behaviour.
- structural adaptation is best observed in an organisms shape, form and appearance.
- functional or physiological adaptation refers to how an organ becomes better suited to work or do its job.
- behavioural adaptation is shown in the way an organism behaves.
- variations are the differences that can be observed in the characteristics of a group of living things.
- natural selection is a process caused by variation amongst organisms that brings about adaptation in organisms.

NOW DO PRACTICE EXERCISE 22 ON THE NEXT PAGE.



Practice Exercise 22

Answer the following questions:

Part A. True or False.

Write T if the statement is true and F if it is false.

Statement	T or F
1. In the process of natural selection organisms that have better characteristics are likely to reproduce and survive.	
2. Variation among a group of organisms decreases their chances of survival.	
3. The sharp talons and strong beaks of predatory birds are their functional or physiological adaptation..	
4. The variations in the beaks of the finches in the Galapagos are caused by the different types of food available in the island.	
5. Adaptations may be observed in the structure, function or behaviour of organisms.	

Part B. Short Answers

1. Define the following terms:
Adaptation

Variation:

2. Read the following passage that describes some characteristics of cassowaries.

Cassowaries are flightless birds that can stand 1.2 to 1.6 metres tall. Their inner toes bear long, straight, knife-like nails, which are deadly weapons of defence. Like other birds, they bear no teeth. They have a crop close to their throat which is a chamber that stores food and a gizzard just above their liver which breaks down food. Unlike their relatives the emus and ostrich, cassowaries are birds of the forest rather than of open plains. Unlike the other birds, the male cassowaries incubate the eggs.

From the descriptions above, identify the structural, physiological and behavioural adaptations of cassowaries that help them survive.

Structural adaptation

Physiological adaptation

Behavioural adaptation

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 6.

Answers to Activities

Activity 1

1.
 - a. structural
 - b. behavioural
 - c. functional
 - d. structural
 - e. behavioural
2. Animals need to adapt to their environment in order to survive.

Activity 2

1. They are different in the colour of their feathers, their manner of flying when they hunt and the type of food that they eat.
2. The osprey.
3. Variation can increase the chances of survival in a group of organisms when a major change and pressure occurs in the environment.

Lesson 23: The Natural Cycles



Welcome to Lesson 23 of Strand 2. In the last lesson you learnt about the process of natural selection in plants and animals. In this lesson you will learn about the natural cycles that maintain life and balance on earth. There are different kinds of recycling processes taking place around us. For example, you may have heard about the water cycle or the continual flow of the earth's water from the surface of the earth to the atmosphere and back to the surface of the earth again.

The natural cycle, also known as the nutrient cycle, refers to the path followed by any life-essential substance as it moves through the living (biological) and the non-living (physical) part of the environment. Natural cycles such as carbon, oxygen and nitrogen are important because of the limited supply of resources.



Your Aims:

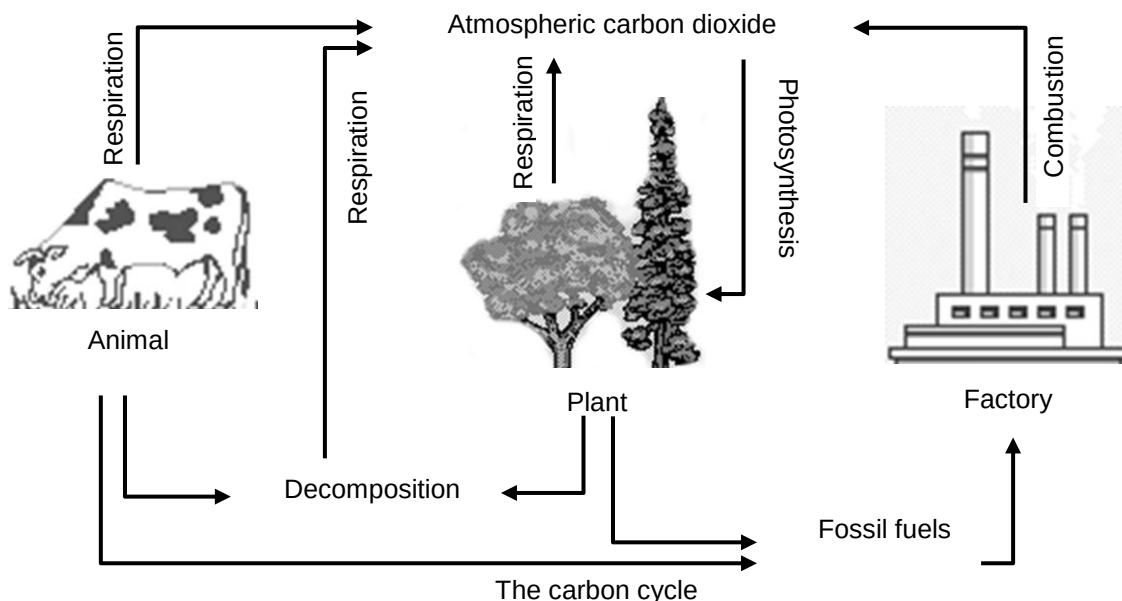
- name and identify the three different types of natural cycles
- understand how the cycle works
- state the importance of natural cycles in the environment

The Carbon Cycle

One important natural cycle is the carbon cycle. Carbon is found in all living things and is needed to make sugar and starch, which are both **carbohydrates**. Green plants can make sugar and starch using carbon dioxide from air. This process is known as **photosynthesis**. Plants can also make proteins and oils from sugars using special chemicals called enzymes.

Green plants are known as producers because they can make their own food. Carbon compounds are passed along the food chain. This occurs by the process of **feeding** when herbivores eat green plants and when carnivores eat herbivores.

Both plants and animals must be able to obtain energy from food. This is made possible by the process called **respiration** which happens in all living cells. Carbon dioxide is a waste substance produced by respiration and is released into the air.



Respiration is similar to **burning** or combustion of fuels such as wood, coal, petroleum and natural gas. Burning or combustion releases carbon dioxide into the air. This carbon dioxide in the air can be used by green plants to produce more carbohydrates.

The organic matter of dead animals and plants is used by **saprophytes**. Saprophytes are bacteria and fungi that feed on dead and decaying matter. These very small living things decompose the plant and animal remains and turn the carbon compounds into carbon dioxide. This process called **decay** or decomposition also adds carbon dioxide into the atmosphere.

The continual flow or movement of carbon in the form of carbon dioxide taken up by plants from the atmosphere and returned to the atmosphere by respiration, combustion, and decay is called **carbon cycle**.



Activity 1: Now test yourself by doing this activity.

Answer the following questions about the carbon cycle.

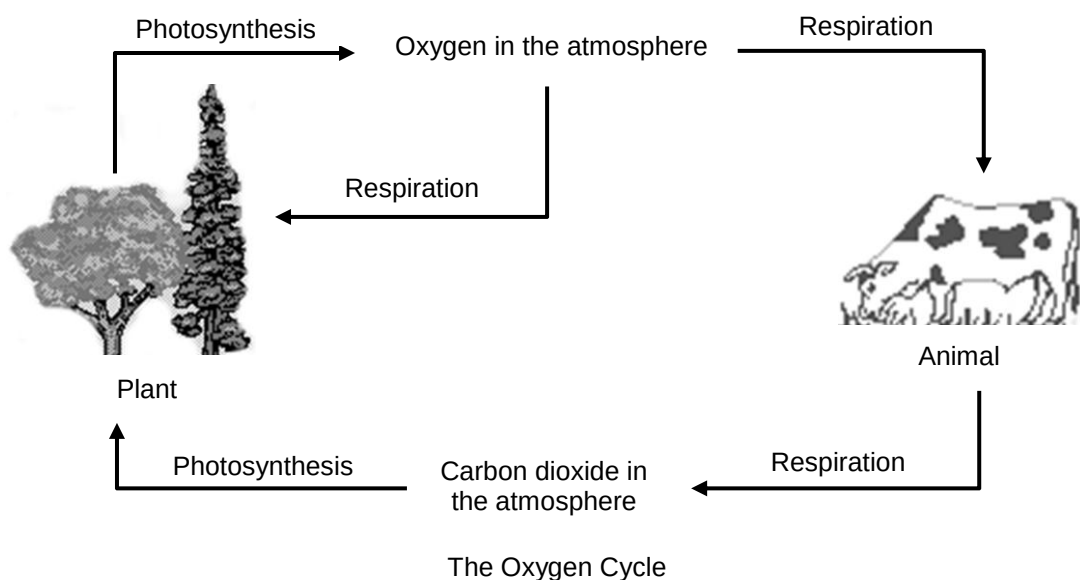
- In what form of carbon compound(s) is present in
 - plants? _____
 - the atmosphere? _____
- What process removes carbon from the atmosphere?

- How is carbon transferred from one organism to another in a food chain?

4. Briefly explain how respiration is similar to burning or combustion?
-
-
5. Predict what will happen to the concentration or level of carbon dioxide in the atmosphere if the number of plants on earth is greatly reduced by deforestation.
-
-

The oxygen cycle

The oxygen gas (O_2) is a product of **photosynthesis**. This gas is used by animals in **respiration**. The animals give out carbon dioxide (CO_2) when they respire. The carbon dioxide produced can be used by plants in photosynthesis. Just like carbon dioxide, oxygen gas can be recycled. Look at the simple diagram below.



Activity 2: Now test yourself by doing this activity.

Complete the following sentences.

Animals use _____ when they _____. They give off _____ which plants use to make their _____.

Plants give off oxygen in the process of _____ and take in oxygen in a process called _____.

The Nitrogen cycle

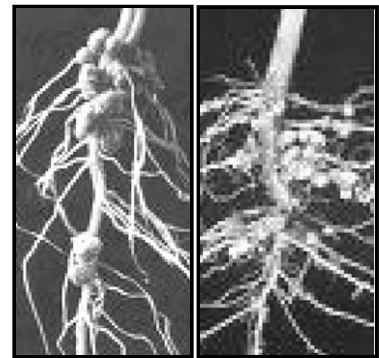
The nitrogen cycle describes how nitrogen moves through the living and the non-living part of the environment. Nitrogen is found in all plants and animals in a form of a compound called **protein**.

When organisms die their protein made tissues are decomposed by organisms that cause decay, like **fungi** and **bacteria**. Two of the products from the decomposition are **ammonia** and **nitrates**. Both contain nitrogen.

Ammonia escapes to the air and produces the character smell where decay is taking place. Nitrates are washed deep into the soil where they can be absorbed by growing plants and used to build up new proteins. In this way nitrogen is continuously going round and round in a cycle.

Nitrifying bacteria in the soil can use ammonia from decaying organisms as a source of energy. In the process of getting energy from ammonia, the bacteria produce nitrates that make the soil more fertile.

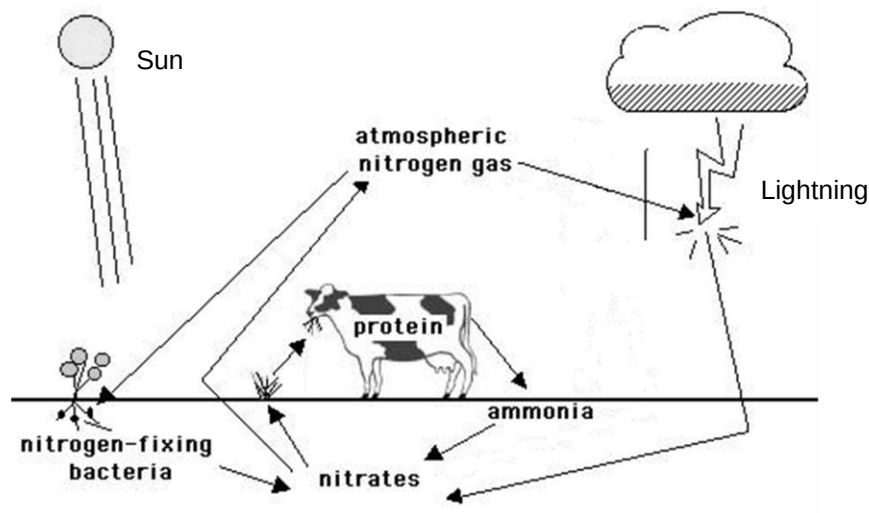
Another group of bacteria, the **nitrogen-fixing bacteria**, can absorb nitrogen as a gas from the air spaces in the soil. They use nitrogen gas and build it into compounds of nitrogen that plants can use. Some nitrogen-fixing bacteria can live freely in the soil while others live in the roots of legume plants where they cause swelling called root nodules. Examples of legume plants are beans and peanuts.



Root nodules

Lightning adds several million tonnes of nitrates to the earth's surface each year.

Denitrifying bacteria in the soil convert nitrates into free nitrogen and return the gas into the atmosphere. The diagram below outlines the nitrogen cycle.



The nitrogen cycle



Summary

You have come to the end of lesson 23. In this lesson you have learnt that:

- nutrient cycle is a process in which substances such as oxygen, carbon and nitrogen are used and then returned to their original source so that they can be used again. This is important because there is only a limited supply of resources.
- the continual flow or movement of carbon in the form of carbon dioxide taken up by plants from the atmosphere and returned to the atmosphere by respiration, combustion, and decay is called carbon cycle.
- oxygen cycle is driven by two important life processes – photosynthesis and respiration.
- the nitrogen cycle describes how nitrogen moves through the living and the non-living part of the environment. Nitrogen is found in all plants and animals in a form of a compound called protein.

NOW DO PRACTICE EXERCISE 23 ON THE NEXT PAGE.



Practice Exercise 23

Answer the following questions:

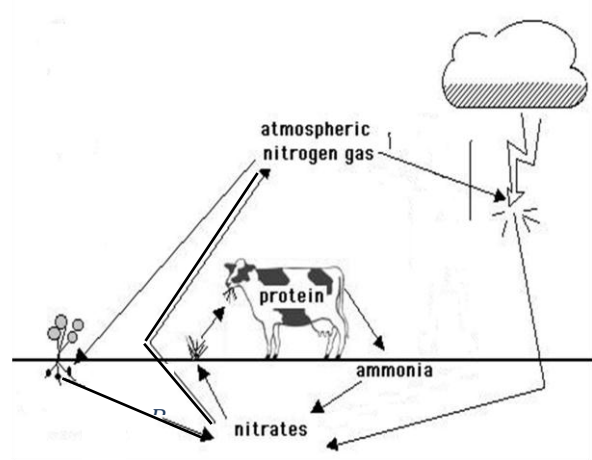
Part A. Multiple Choice

Circle the letter of the best answer.

1. Plants and animals need oxygen for
 - A. decay.
 - B. respiration.
 - C. combustion.
 - D. photosynthesis.
2. When plants make their own food by photosynthesis, they release
 - A. water.
 - B. carbon.
 - C. oxygen.
 - D. nitrogen.
3. The swellings or root nodules in legumes contain
 - A. nitrifying bacteria.
 - B. denitrifying bacteria.
 - C. nitrogen-fixing bacteria.
 - D. bacteria that cause decay.
4. In what form of compound is carbon present in plants and animals?
 - A. fats
 - B. protein
 - C. vitamin
 - D. carbohydrate.
5. Just like combustion or burning, respiration releases the atmospheric
 - A. gas.
 - B. oxygen.
 - C. nitrogen.
 - D. carbon dioxide.

Part B. Short Answer

Study the diagram of the nitrogen cycle on the right and answer the following questions.



- In what form of compound is protein present in animals?

- Name the two bacteria involved the processes labelled **A** and **B**.
A - _____
B - _____
- Explain where and how animals get their protein.

- By what process do proteins in the body of plants and animals return to the soil?

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 6.

Answers to Activities**Activity 1**

- starch/ sugar/ oil/ protein
 - carbon dioxide
- Photosynthesis
- By the process of feeding.
- Just like combustion or burning, respiration releases carbon dioxide into the atmosphere.
- The carbon dioxide concentration or level will increase.

Activity 2

Animals use **oxygen** when they **respire**. They give off **carbon dioxide** which plants use to make their **food**.

Plants give off oxygen in the process of **photosynthesis** and take in oxygen in a process called **respiration**.

Lesson 24: The Importance of Decomposition



Welcome to Lesson 24 of Strand 2. In the last lesson you learnt about the nutrient cycle and how important substances are reused over and over again without running out. In this lesson you will learn more about decomposition. Plants and animals reproduce and always increase in number. If they are to survive forever, the Earth would soon be too full. Instead, all living things die eventually, but the surface of the Earth is not over-crowded with the dead bodies of plants and animals. This is because a special group of living organisms feeds on dead plants and animals.



Your Aims:

- define decomposers
- name some decomposers and
- understand the important role they play in the environment

Decay And Decomposition

Decay or decomposition is the breakdown of dead plants and animals and their wastes. This process is the reason why the Earth is not littered with dead plants, excretes or wastes, and animal corpses.

Nutrients produced from this breakdown process are recycled. They are absorbed by plants and are passed on to animals along a food chain.



If there is no decomposition, the grounds will be metres deep in dead leaf litter.

Decomposers

Decomposers are very small organisms or microbes such as fungi and bacteria that feed on the remains of dead plants and animals making them rot or decompose. Decomposers are important because they get rid of dead plants and animals as well as plant and animal wastes.

Bacteria

Bacteria are very tiny organisms they can only be seen with the help of a special device called a microscope. Some bacteria are harmful and cause diseases in people. Other bacteria are helpful in many different ways, both to people and as part of nature.

Soil bacteria are especially helpful because they help to rot down, or decompose, old bits of living things such as dead leaves and animal droppings. The bacteria feed on this decaying matter and in the process; help to return nutrients to the soil so that new life can grow.



Bacteria

Saprophytes are bacteria that live on dead plants and animals and help them decompose into their constituent elements, making them available as food for plants.

Fungi

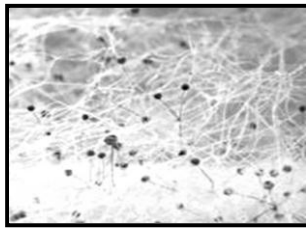
There are thousands of different types of fungi, and they can look very different from each other. A single fungi is called a fungus.

Many fungi are single-celled organisms. That means they have only one cell each, and each are so tiny that they are too small to see except through a microscope.

Some fungi like the bread mould are also small. Other fungi like the mushrooms that grow on waste or dead remains of organisms are rather large and can be seen by the naked eye.

Most fungi obtain their food by absorbing nutrients, or food chemicals, from rotting plant and animal matter such as dead wood and fallen leaves. That is why you will often find toadstools growing on dead, rotten tree trunks, and mould fungi growing on old food that has started to go off. Soil contains lots of rotting leaves and other bits of dead plant and animals, so lots of fungi like to live there. In fact, any handful of healthy soil will have lots of tiny fungi living in it.

Below are pictures of some fungi.



Bread mould



Mushrooms

Conditions needed for decomposition

Decomposition is fast when it is warm, dark, and moist, and there is plenty of air. The fungi and bacteria release chemicals called **enzymes** that speed up the chemical breakdown of dead organisms. Enzymes work faster when it is warm.

Bacteria and fungi grow faster when water is available and it also helps in the external digestion and absorption of their food. This is the reason why decomposition is fast in moist areas.

Most decomposers respire aerobically so they need a good supply of oxygen.

The role of decomposers in a food chain

A single line of feeding relationships is called a **food chain**.



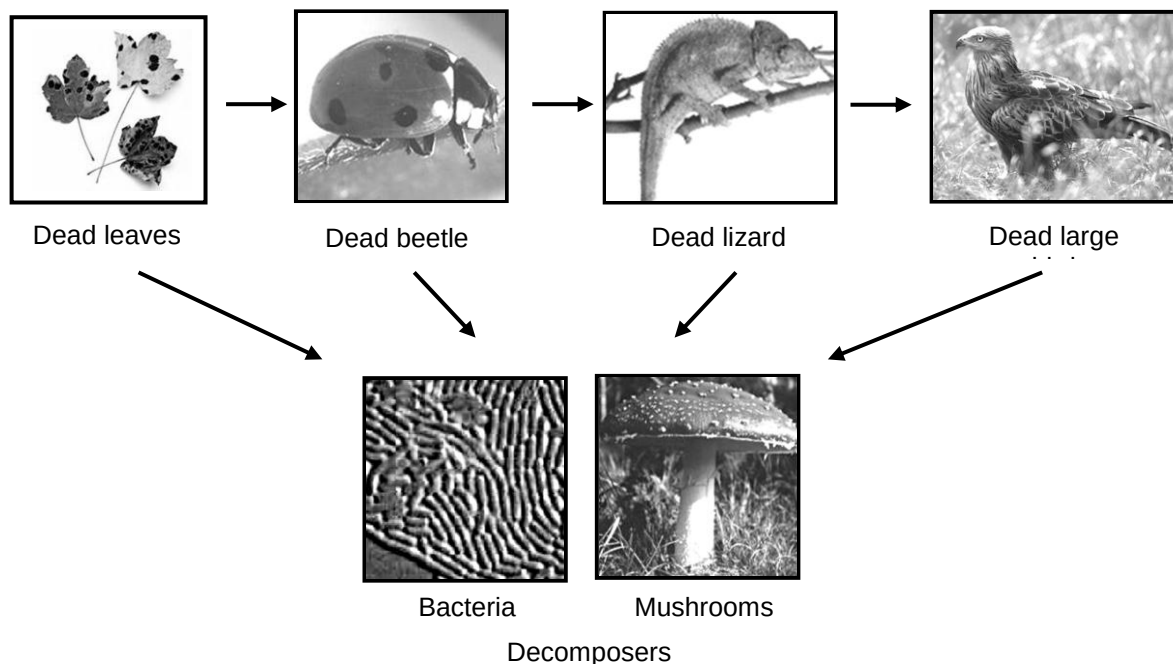
Leaves

Beetle

Lizard

Large bird

All food chains end up with decomposers. When an organism dies, the decomposers return to the environment the materials that made up the organism.



Materials that decompose are called **biodegradable** materials. Biodegradable materials do not only include dead plants and animals or their wastes but also include things made from them such as paper, cardboard cartons, cotton wool and leather.



Summary

You have come to the end of lesson 24. In this lesson you have learnt that:

- decay or decomposition is the breakdown of dead plants and animals and their wastes.
- decomposers are very small organisms or microbes such as fungi and bacteria that feed on the remains of dead plants and animals making them rot or decompose.
- bacteria are very tiny organisms that feed on decaying matter and, in the process, help to return nutrients to the soil so that new life can grow.
- some fungi like the mushrooms grow on waste or dead remains of organisms. They obtain their food by absorbing nutrients, or food chemicals, from rotting plant and animal matter such as dead wood and fallen leaves.
- decomposition is fast when it is warm, dark, and moist, and there is plenty of air.
- the fungi and bacteria release chemicals called enzymes that speed up the chemical breakdown of dead organisms.
- materials that decompose are called biodegradable materials.

NOW DO PRACTICE EXERCISE 24 ON THE NEXT PAGE.



Practice Exercise 24

Short Answers

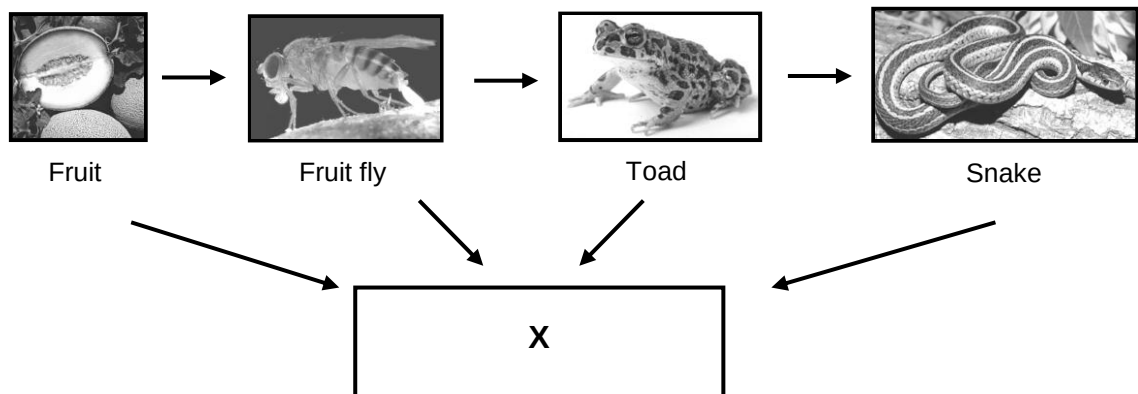
1. Describe the role of decomposers to the environment?

2. What do you think will happen if all decomposers disappear from Earth?

3. Name the two groups of decomposers.

4. Give the four environmental conditions that may speed up the process of decay.

5. The diagram below shows a single line of feeding relationship. Study it and answer the following questions.



- a. What is the term used to refer to this single line of feeding relationships?

- b. All feeding relationships end with a group of organisms represented inside the box marked **X**. Identify this group of organisms.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 6.

Lesson 25: The Food Webs



Welcome to Lesson 25 of Strand 2. The last lesson of strand 2. In the last lesson you learnt about the importance of decomposers and their role in the environment. In this lesson you will learn about the food webs. What was the last food you ate? Does it include bread, kaukau, banana or some local fruit and vegetable? Or perhaps chicken, egg or fish. If your food were obtained from plants alone, you might be a vegetarian or herbivore, eating just plants and their parts. If you ate animal parts especially meat, then you are probably a carnivore. By finding out what other organism eat, we can study food chains and food webs in our environment.



Your Aims:

- differentiate between food chains and food webs
- understand and describe the feeding relationships in food webs

Food Chain

Food chain is whereby one organism feeds on the other organism and that organism feeds on the other and so on.

A possum feeds on fruits and leaves of a eucalyptus tree. Unexpectedly a tree snake attacks, injects its venom and slowly feeds by swallowing the paralysed possum. This is a simple food chain with three links: fruit tree to possum to tree snake. A **food chain** is a single line of feeding relationships.

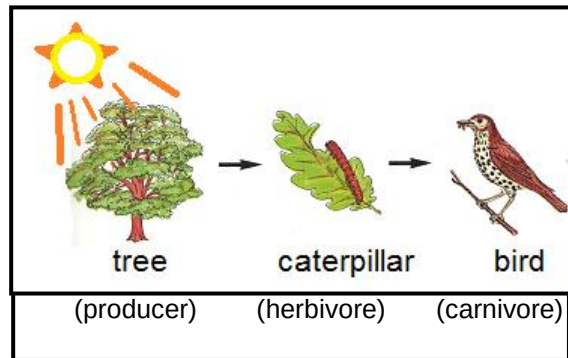
The possum eats fruits and leaves to obtain nutrients for growth and, as well as energy. The snake eats the possum for the same reason, to obtain nutrients and energy. In this way we can imagine that nutrients and energy passes along a food chain from one link to the next.



A food chain. The direction of the arrow indicates 'eaten by' and also shows the direction of energy flow.

Plants to animals

Food chains begin with the **Sun**. The Sun gives energy to plants. The plants obtain their energy by trapping sunlight in their leaves. Plants then make their own food in the process known as **photosynthesis** and are therefore called **producers**. The next link in a food chain is usually a plant-eating animal, or **herbivore**. After this comes the **carnivores** or animals that eat other animals.



Animals are **consumers**. They gain their food and energy by eating plants or other animals. The herbivore is the first consumer in the food chain and may be called the **first order** or **primary consumer**. The second animal in the food chain may be referred to as the **second order** or **secondary consumer**. There may also be higher level consumers in the food chain, usually occupied by the **top carnivores**.

How long are food chains?

Food chains can include plants and animals of all sizes, and the chains can have more than three links. For example, leaves are eaten by a possum, the possum is eaten by the snake and the snake is killed and consumed by the hawk. This is a four-link chain:

seeds → possum → snake → hawk.

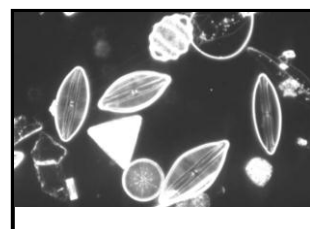
Food chains are often longest in the sea. They can have six or seven links. The chains start with the microscopic plants floating in **plankton**, which are eaten by tiny animals. These are consumed by small fish, which are eaten by slightly bigger fish and so on.



Activity 1: Now test yourself by doing this activity.

Below is an example of a feeding relationship from a salt water environment. Study it and answer the following questions.

Mussels completely bury themselves under the sand and feed by filtering out small food particles like plant planktons drifting in the water. To filter-feed and breathe, they use two special tubes called siphons which project out of the sand. Crabs patrolling the shallow waters often find a tasty mussel by nipping off the end of the siphons. Mackerel swim in huge schools near the surface of the water, feeding on crabs.



Plankton



Mussel



Crab



Mackerel

1. Use the descriptions above to construct a food chain.

2. Which organism in the food chain above is

the producer? _____

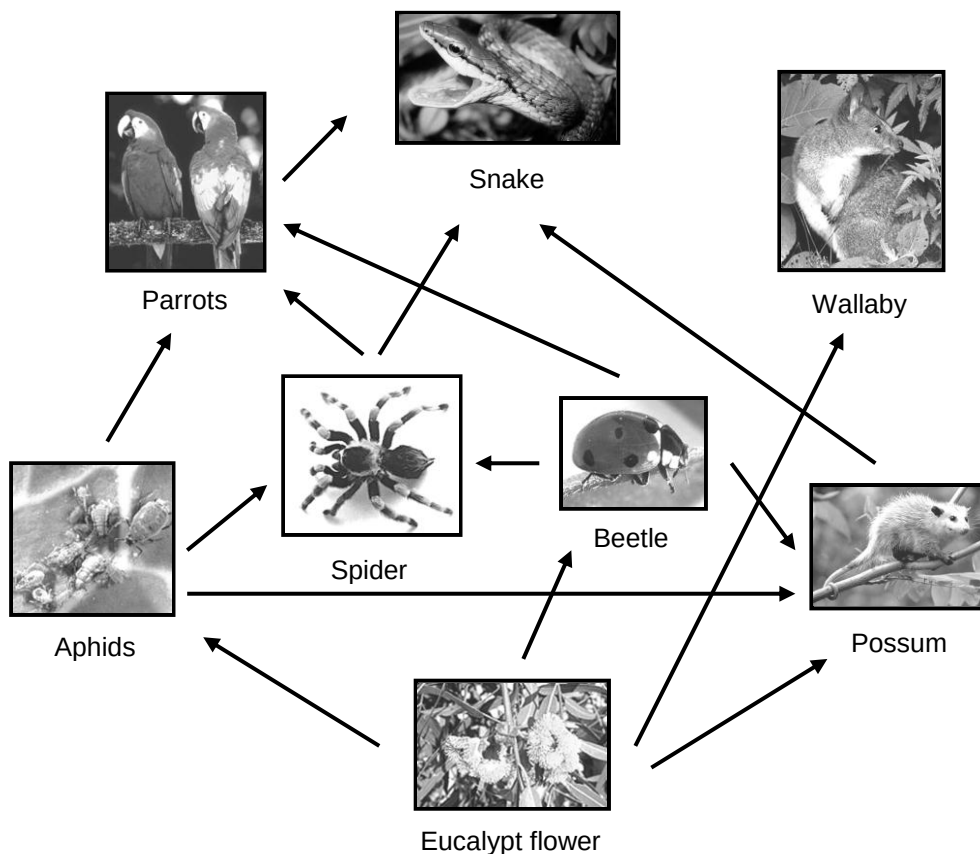
the first order consumer? _____

a top carnivore? _____

3. What does the direction of the arrow in the food chain indicate?

Food web

Naturally few animals eat just one kind of food. Most organisms eat different kinds of food so the food chains are connected. Many food chains connected together make a **food web**.



An example of a food web

**Activity 2: Now test yourself by doing this activity.**

Draw a food web from the following aquatic food chains.

Algae on rock → snail → large fish

Water plant → small fish → crab → large fish → man

Algae on rock → small fish → large fish → shark

Water plant → turtle → man

Water plant → small fish → man

Small fish → algae

Crab → man

Draw your food web on the space given below.

Changes in food webs

Changes often occur in food webs as the populations of different plants and animals increase, decrease or move to another place. Some plants and animals might be in the pond only at certain times of the year. For example, tadpoles might be a good source of food for fishes. Once they become frogs they will no longer be a suitable source of food for fish.

There may be a shortage of plant algae available when populations of herbivores increase. This shortage of food supply can lead to competition and consequent decrease in population of herbivores that are weak and cannot compete.



Summary

You have come to the end of the lesson. In this lesson you have learnt that:

- a food chain is a single line of feeding relationships.
- nutrients and energy pass along a food chain from one organism to the next. Energy flow is indicated by the arrows.
- the sun is the primary source of energy in a food chain.
- a food web is made up of many food chains connected together.
- changes often occur in food webs as the populations of different plants and animals increase, decrease or move to another place.

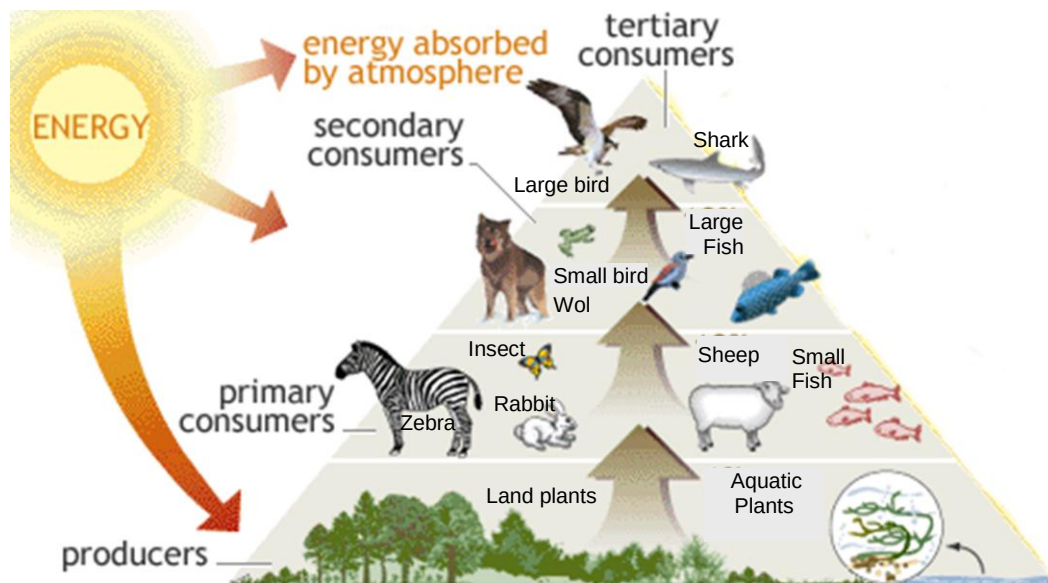
NOW DO PRACTICE EXERCISE 25 ON THE NEXT PAGE.



Practice Exercise 25

Read the information below and answer the questions that follow:

An interconnecting food chain or food web is often drawn as a pyramid as shown below. Study the diagram and the accompanying paragraphs to answer the questions.



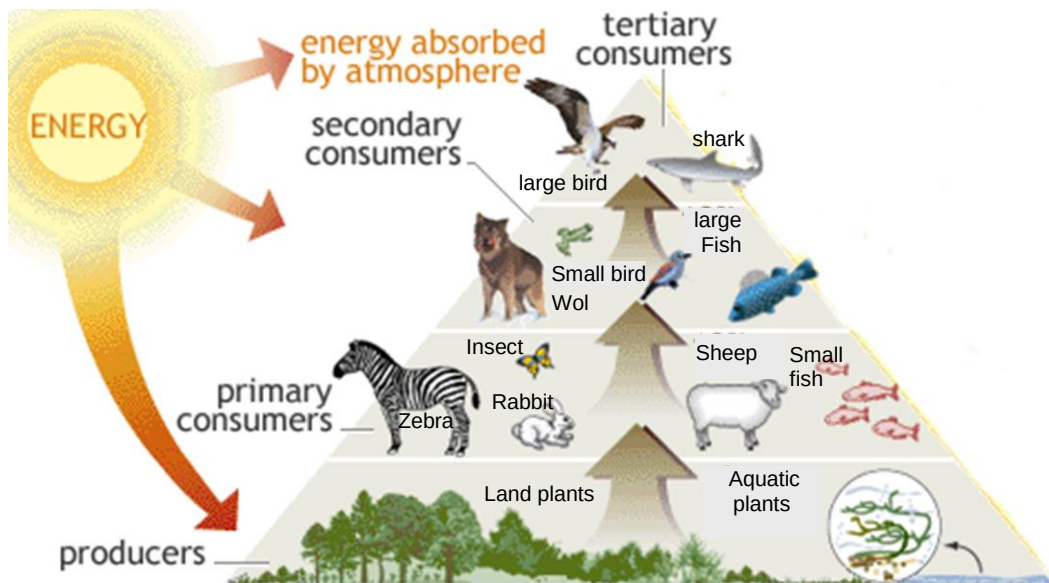
The Sun provides the Earth with a huge amount of energy in the form of light and heat. Plants are producers. They capture the energy from the Sun and turn it into sugar in a process called photosynthesis. Only about 1 per cent of the energy created by the Sun is passed into the food chain by the producers. Once the producers have turned this energy into sugar, some more energy will be lost before it is passed on to the next level in the food chain. This is because the plants will use up some energy to fuel their own life processes.

The animals that eat the plants are primary consumers. They also use up some energy on their own life processes, and some is lost through heat and waste. Primary consumers are then eaten by secondary consumers. Only 10 per cent of the energy that is provided by the plants will be passed on by the primary consumers to the secondary consumers. The secondary consumers are then eaten by tertiary consumers. Again, much energy is lost. It is used up by the secondary consumers' life processes or lost through heat or waste.

1. What is an interconnecting food chain called? _____
2. Name the primary source of energy in all food chains? _____
3. Plants are producers.
By what process do they manufacture their own food? _____

4. Name two primary consumers in the diagram above.

_____;

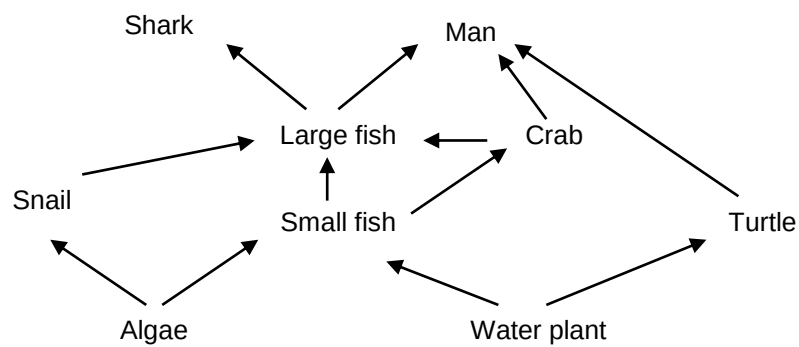


5. Explain what will happen to the population of plant algae if the small fishes' population increases?
- _____
- _____
6. Energy is lost at each step in the food chain. Give three ways in which energy is lost in consumers?
- _____
- _____
7. Identify the two top carnivores in the food web above.
- _____
- _____

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 6.

Answers to Activities**Activity 1**

1. **Plankton** → **mussel** → **crab** → **mackerel**
2. The producer - **plankton**
The first order consumer - **mussel**
A top carnivore - **mackerel**
3. The direction of the arrow indicates 'eaten by' and also shows the direction of energy flow.

Activity 2

REVIEW OF SUB STRAND 6: BALANCE OF NATURE IN LIVING ORGANISMS

Revise all the Lessons in this Sub Strand and then do **ASSIGNMENT 3**.
Here are the main points to help you revise.

Lesson 22: The Process of Natural Selection in Plants and Animals

- Adaptation refers to the way a living thing has changed to make it more suitable for its way of life.
- Adaptation may be observed in an organism's structure, function or behaviour.
- Structural adaptation is best observed in an organisms shape, form and appearance.
- Functional or physiological adaptation refers to how an organ becomes better suited to work or do its job.
- Behavioural adaptation is shown in the way an organism behaves.
- Variations are the differences that can be observed in the characteristics of a group of living things.
- Natural selection is a process caused by variation amongst organisms that brings about adaptation in organisms.

Lesson 23: The Natural Cycles

- Nutrient cycle is a process in which substances such as oxygen, carbon and nitrogen are used and then returned to their original source so that they can be used again. This is important because there is only a limited supply of resources.
- The continual flow or movement of carbon in the form of carbon dioxide taken up by plants from the atmosphere and returned to the atmosphere by respiration, combustion, and decay is called carbon cycle.
- Oxygen cycle is driven by two important life processes – photosynthesis and respiration.
- The nitrogen cycle describes how nitrogen moves through the living and the non-living part of the environment. Nitrogen is found in all plants and animals in a form of a compound called protein.

Lesson 24: The Importance of Decomposition

- Decay or decomposition is the breakdown of dead plants and animals and their wastes.
- Decomposers are very small organisms or microbes such as fungi and bacteria that feed on the remains of dead plants and animals making them rot or decompose.
- Bacteria are very tiny organisms that feed on decaying matter and, in the process, help to return nutrients to the soil so that new life can grow.
- Some fungi like the mushrooms grow on waste or dead remains of organisms. They obtain their food by absorbing nutrients, or food chemicals, from rotting plant and animal matter such as dead wood and fallen leaves.
- Decomposition is fast when it is warm, dark, and moist, and there is plenty of air.
- The fungi and bacteria release chemicals called enzymes that speed up the chemical breakdown of dead organisms.
- Materials that decompose are called biodegradable materials.

Lesson 25: The Food Webs

- A food chain is a single line of feeding relationships.
- Nutrients and energy pass along a food chain from one organism to the next. Energy flow is indicated by the arrows.
- The sun is the primary source of energy in a food chain.
- A food web is made up of many food chains connected together.
- Changes often occur in food webs as the populations of different plants and animals increase, decrease or move to another place.

REVISE WELL AND THEN DO SUB STRAND TESTS 3 & 4 IN YOUR ASSIGNMENT 3.

Answers to Practice Exercises 22- 25

Practice Exercise 22

True or False

1. **T** 2. **F** 3. **F** 4. **T** 5. **T**

Short Answers

1. Adaptation: **The special characteristics of living things that help them survive./ It is the way living things has changed to make them more suitable for their way of life.**
- Variation: **Variations are the differences that can be observed in the characteristics of a group of living things.**
2. Structural adaptation - **tall/ long, straight, knife-like nails**
- Physiological adaptation - **crop that stores food/ gizzard that breaks down food**
- Behavioural adaptation - **live in the forest/ the male incubates the eggs**
-

Practice Exercise 23

Multiple Choice.

1. **B** 2. **C** 3. **C** 4. **D** 5. **D**

Short Answer

1. Protein
2. A - nitrogen-fixing bacteria B - denitrifying bacteria
3. Animals get their protein from plants by feeding or eating them.
4. By decomposition or decay
-

Practice Exercise 24

Short Answers

1. They help breakdown dead plants and animals.
2. Dead plants and animals or their remains will pile up and soon the Earth will be covered with them.
3. Bacteria and fungi
4. Decay or decomposition is fast when it is warm, dark and moist, and when there is plenty of air.

5. a. Food chain
 - b. Decomposers (accept fungi and bacteria)
-

Practice Exercise 25

Short answers

1. Food web
2. The sun
3. Photosynthesis
4. zebra, insect, rabbit, sheep, small fish (any two of the following)
5. Their population will decrease as more small fishes will feed on them.
6. It is lost when used in the consumers' life processes or lost through heat or waste.
7. shark, large bird

GLOSSARY

Adaptation	Refers to the way living things has changed to make it suitable for its way of life.
Algae	Simple aquatic plants that do not have roots, stems and leaves.
Amphibians	Actually means able to live both on land and in water. They are vertebrates that have moist skin.
Arachnid	A scientific term to refer to invertebrates like spiders, scorpions, ticks, and mites.
Asexual	There is only one parent need to produce an offspring.
Bacteria	Tiny organisms that feed on decaying matter and, in the process, help to return nutrients to the soil so that new life can grow.
Behavioural adaptation	Shown in the way organisms behave. It may include their habits, ways, food preference, movements, feeding, mating and breeding patterns, and the manner organisms raise their young.
Breathing	Also called external respiration is the set of muscular movements that give the respiratory organ a constant supply of fresh air. It is the act of taking in oxygen and giving out carbon dioxide.
Binary Fission	reproduction characterized by division of the body into two or more parts, each of which develops into a complete individual.
Birds	Warm blooded vertebrates that have feathers that covers and protects as well as keeps them warm and dry.
Camouflage	protective colouring on the body of animals that helps them to blend into their environment in order to avoid being seen by predators or prey.
Carbon Cycle	The continual flow or movement of carbon in the form of carbon dioxide taken up by plants from the atmosphere and returned to the atmosphere by respiration, combustion, and decay.
Cell membrane	Forms a tiny covering to the cell. It controls what enters and leaves the cell.
Cells	Basic unit structure of all living things.
Coelenterates	Also called cnidarians are soft-bodied animals with tentacles around their mouth. They include hydra, jellyfish, corals and anemone.
Conifers	Mostly evergreen trees that have narrow, needle-like leaves.
Co-ordinator	Interprets the stimuli and determines the response.
Crustaceans	Invertebrates with a hard external skeleton made of shell to protect their soft body.
Decay or Decomposition	Breakdown of dead plants and animals and their wastes.

Decomposers	Very small organisms or microbes such as fungi and bacteria that feed on the remains of dead plants and animals making them rot or decompose.
Digestion	The breakdown of food into simpler form so that they can be used by the body.
Echinoderms	Spiny-skinned invertebrates that include starfish, brittle stars, sea urchins, sand dollars, and sea cucumbers.
Effectors	Are organs that respond.
Embryo	The early stage of an animal or plant after fertilization.
Excretion	The elimination of waste from the organism.
Exhalation	Also called expiration is the breathing out process and takes place when the rib cage is lowered and the muscles in your diaphragm relaxes.
Exoskeleton	The hard material formed outside of the body and functions for support and protection.
Flowering plants	Have well developed roots, stems and leaves. They have green pigment chlorophyll in their leaves and can make their own food.
Food chain	Single line of feeding relationships.
Food web	Interconnecting food chain.
Fronds	A large leaf divided into many thin sections that is found on many flowerless plants, especially ferns and palms
Functional adaptation	Also called physiological adaptation. It refers to how an organ becomes better suited to work or do its job. This type of adaptation is not easily observed as it involves the internal functions of organs.
Growth	Simply the increase in size brought about by the development of new cells and tissues.
Hair	Refers to the slender, thread-like covering of mammals that functions to protect, insulate and provide extra sensitivity to movement.
Inhalation	Also called inspiration is the breathing in process. You will notice that when you inhale, your chest and rib cage raises up and your diaphragm and abdomen moves in and contract.
Insulation	The act of covering or surrounding something to prevent or reduce the passage of heat, electricity, or sound
Invertebrates	Animals without backbone or vertebral column.
Lungs	The major respiratory organs in humans. They are enclosed in the thorax or chest cavity.
Mammals'	Warm-blooded animals with constant body temperature.

Marsupials	Pouched mammals are born very early and develop in their mother's pouch.
Molluscs	Soft-bodied animals that usually have shells outside their body.
Monotremes	Egg laying mammals are hatched from leathery- shelled eggs.
Natural selection	A process caused by variation amongst organisms that brings about adaptation in organisms.
Nutrient cycle	A process in which substances such as oxygen, carbon and nitrogen are used and then returned to their original source so that they can be used again.
Nutrition	The process that involves the taking in of nutrients by organisms and assimilating these in their cells for growth and to replace old or injured tissues.
Nitrogen cycle	Describes how nitrogen moves through the living and the non-living part of the environment.
Offspring	A person's child or children, or the young of an animal or plant.
Organ	Tissues combine together.
Parasite	a plant or animal that lives on or in another, usually larger, host organism in a way that harms or is of no advantage to the host
Pharynx	More commonly known as the throat.
Phloem	A tube that transports food made from the leaves of plants to all plant organs.
Photosynthesis	Allows plants to make their own food using carbon dioxide and water, and release oxygen as a by-product. It can only take place during the day when there is sufficient light energy to support the process.
Predator	A carnivorous animal that hunts, kills, and eats other animals in order to survive, or any other organism that behaves in a similar manner
Placental	Mammals that develop in their mother's womb before being born alive.
Receptor	The sense organ that receives the stimulus.
Respiration	The process that provides energy for organisms. Respiration produces carbon dioxide and energy.
Reproduction	A process that occurs when living things make more of their own kind.
Reptiles	Cold blooded vertebrates with dry scaly skin.
Rhizoids	Outgrowth on mosses, liverworts, and the reproductive cells of ferns that absorbs nourishment in much the same way as a root.

Sensitivity	The ability of an organism to respond to a stimulus
Sponges	Also called poriferans are animals with pores around their body.
Stimulus	Refers to any factor or changes in the environment that can cause an organism to respond.
Structural adaptation	The physical attributes that is best observed in the shape, form and appearance of organisms. It includes height, weight, body or organ size, colour and body covering.
Stomata	The breathing structures in the leaves of plants. They are tiny openings in the underside of leaves through which oxygen, carbon dioxide and water can pass.
System	Two or more organs performing the same task.
Trachea	Also called windpipe is the tube that carries air towards the lungs.
Transpiration	A plant process that involves the movement of water through the plant. The loss of water through the leaf stomata pulls water up through the plant from the roots.
Tropism	Refers to the growth response.
Variations	The differences in characteristics that can be observed in organisms of the same group.
Xylem	A tube in plants that functions to transport water and minerals from roots to leaves.

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PC NO.	FODE PROVINCIAL CENTRE	ADDRESS	PHONE/FAX	CUG PHONE (COORDINATOR)	CUG PHONE (SENIOR CLERK)
1	ALOTAU	P. O. Box 822, Alotau	6411343/6419195	72228130	72229051
2	BUKA	P. O. Box 154, Buka	9739838	72228108	72229073
3	CENTRAL	C/- FODE HQ	3419228	72228110	72229050
4	DARU	P. O. Box 68, Daru	6459033	72228146	72229047
5	GOROKA	P. O. Box 990, Goroka	5322085/5322321	72228116	72229054
6	HELA	P. O. Box 63, Tari	73197115	72228141	72229083
7	JIWAKA	c/- FODE Hagen		72228143	72229085
8	KAVIENG	P. O. Box 284, Kavieng	9842183	72228136	72229069
9	KEREMA	P. O. Box 86, Kerema	6481303	72228124	72229049
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22	WEWAK	P. O. Box 583, Wewak	4562231/4561114	72228122	72229062

FODE SUBJECTS AND COURSE PROGRAMMES

GRADE LEVELS	SUBJECTS/COURSES
Grades 7 and 8	1. English
	2. Mathematics
	3. Personal Development
	4. Social Science
	5. Science
	6. Making a Living
Grades 9 and 10	1. English
	2. Mathematics
	3. Personal Development
	4. Science
	5. Social Science
	6. Business Studies
	7. Design and Technology- Computing
Grades 11 and 12	1. English – Applied English/Language & Literature
	2. Mathematics - Mathematics A / Mathematics B
	3. Science – Biology/Chemistry/Physics
	4. Social Science – History/Geography/Economics
	5. Personal Development
	6. Business Studies
	7. Information & Communication Technology

REMEMBER:

- For Grades 7 and 8, you are required to do all six (6) subjects.
- For Grades 9 and 10, you must complete five (5) subjects and one (1) optional to be certified. Business Studies and Design & Technology – Computing are optional.
- For Grades 11 and 12, you are required to complete seven (7) out of thirteen (13) subjects to be certified.

Your Provincial Coordinator or Supervisor will give you more information regarding each subject and course.

Notes: You must seek advice from your Provincial Coordinator regarding the recommended courses in each stream. Options should be discussed carefully before choosing the stream when enrolling into Grade 11. FODE will certify for the successful completion of seven subjects in Grade 12.

GRADES 11 & 12 COURSE PROGRAMMES			
No	Science	Humanities	Business
1	Applied English	Language & Literature	Language & Literature/Applied English
2	Mathematics A/B	Mathematics A/B	Mathematics A/B
3	Personal Development	Personal Development	Personal Development
4	Biology	Biology/Physics/Chemistry	Biology/Physics/Chemistry
5	Chemistry/ Physics	Geography	Economics/Geography/History
6	Geography/History/Economics	History / Economics	Business Studies
7	ICT	ICT	ICT

CERTIFICATE IN MATRICULATION STUDIES		
No	Compulsory Courses	Optional Courses
1	English 1	Science Stream: Biology, Chemistry and Physics
2	English 2	Social Science Stream: Geography, Intro to Economics and Asia and the Modern World
3	Mathematics 1	
4	Mathematics 2	
5	History of Science & Technology	

REMEMBER:

You must successfully complete 8 courses: 5 compulsory and 3 optional.