PROTOTYPE

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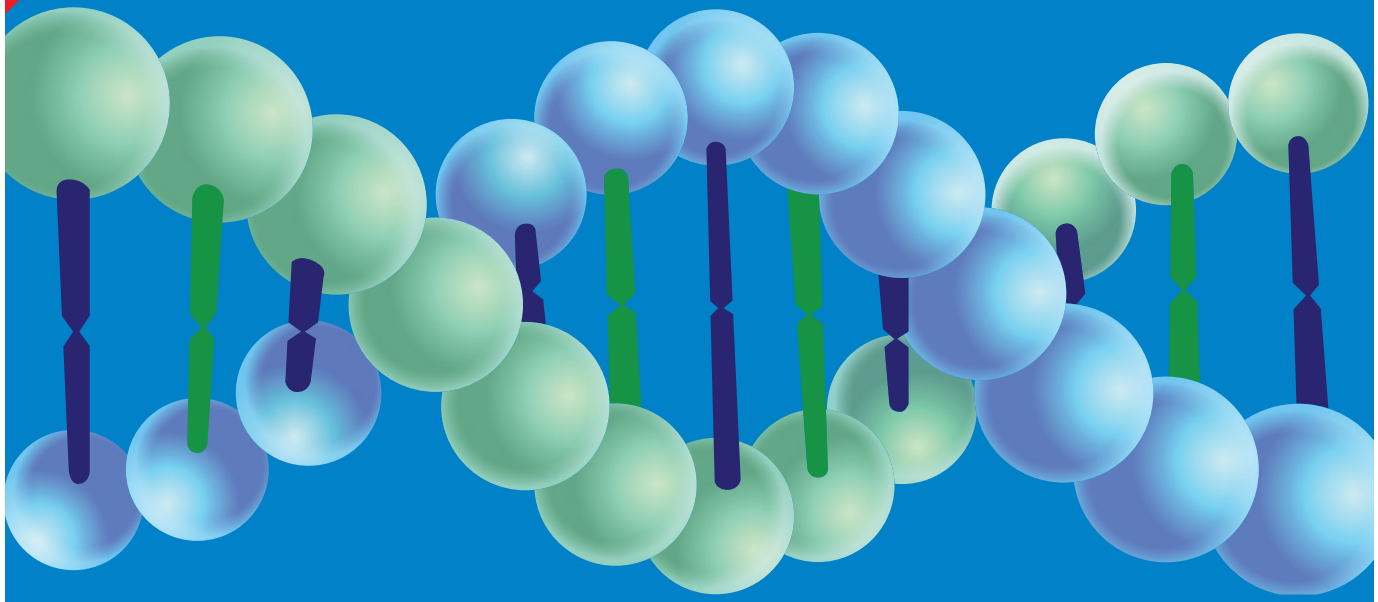

# BIOLOGY TEXTBOOK

## SENIOR ONE

LOWER SECONDARY CURRICULUM

PROTOTYPE

NCDC
NATIONAL CURRICULUM DEVELOPMENT CENTRE

# BIOLOGY TEXTBOOK

## SENIOR ONE

LOWER SECONDARY CURRICULUM


Published 2020

This material has been developed as a prototype for implementation of the revised Lower Secondary Curriculum and as a support for other textbook development interests.



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# Contents

# Preface

This Learner's Textbook has been written in line with the revised Biology syllabus. The knowledge and skills which have been incorporated are what is partly required to produce a learner who has the competences that are required in the 21st century.

This has been done by providing a range of activities which will be conducted both within and outside the classroom setting. The learner is expected to be able to work as an individual, in pairs and groups according to the nature of the activities.

The teacher as a facilitator will prepare what the learners are to learn and this Learner's Textbook is one of the materials which are to be used to support the teaching and learning process.

**Associate Professor Betty Ezati**
Chairperson, NCDC Governing Council

# Acknowledgements

National Curriculum Development Centre (NCDC) would like to express its appreciation to all those who worked tirelessly towards the production of the Learner's Textbook.

Our gratitude goes to the various institutions which provided staff who worked as a panel, the Subject Specialist who initiated the work and the Production Unit at NCDC which ensured that the work produced meets the required standards. Our thanks go to ***Enabel*** which provided technical support in textbook development.

The Centre is indebted to the learners and teachers who worked with the NCDC Specialist and consultants from Cambridge Education and Curriculum Foundation.

Last but not least, NCDC would like to acknowledge all those behind the scenes who formed part of the team that worked hard to finalise the work on this Learner's Book.

NCDC is committed to uphold the ethics and values of publishing. In developing this material, several sources have been referred to which we might not fully acknowledge.

We welcome any suggestions for improvement to continue making our service delivery better. Please get to us through P. O. Box 7002 Kampala or email us through admin@ncdc.go.ug.

**Grace K. Baguma**
Director, National Curriculum Development Centre

# CHAPTER 1

# INTRODUCTION TO BIOLOGY

| **Key Words** | By the end of this chapter, you should be able to learn: |
|---|---|
| • biology<br>• life processes<br>• zoology<br>• botany<br>• physiology | • that Biology is the science of living things.<br>• that Biology is applied in everyday life.<br>• the importance of life processes and how they are manifested differently in different organisms. |

## Introduction

An introduction to biology will enable you to appreciate that biology is the study of life, and application of the characteristics of living things will enable you identify living things from the non-living things.

The practical nature to biology will help you acquire skills such as inquiry, observation, making conclusions and informed decisions about life/living things. Therefore understanding Biology will enable you to develop concern for yourself, the environment and promote its conservation.

## Meaning of Biology

Do you remember the knowledge of science you studied in the Primary school? Some of the knowledge relates to living things while the other relates to non-living things.

### Activity 1.1: Sorting pictures of things into living and non-living

**Key question**

Is it possible to sort materials into living and non-living?

**What you need**

- pictures of different items

**What to do**

Look at the items in the picture below.

i) Draw lines to connect all the living things to the middle circle.
ii) Suggest any reasons why you chose those items.


Biology is a branch of science that deals with the study of living organisms.

**Activity 1.2: Identifying areas where knowledge of biology is applied**

**Key Question**

Name any occupation or job you know of that requires the knowledge of biology or deals with the wellbeing of living things?

**What you need**

i) pens/pencils
ii) notebook
**iii)** pictures of various occupations based on the knowledge of biology

**Zoology** is a branch of biology that deals with the study of animals.

**Botany** is a branch of biology that deals with the study of plants.

**Physiology** is a branch of biology that deals with the study of functions and processes of living organisms or their parts.

**What to Do**

1. In small groups, look at the pictures provided, discuss and write down what work you can do after studying biology to improve your life and for those in the community.
2. Present what you have discussed.
3. Group the pictures under the following branches of biology i.e. zoology, botany and physiology based on the definitions provided.

## Life Processes

In order to decide whether what we are observing is living or non-living, a set of characteristics called **life processes** are used. In the next section, you will find out the life processes.

Life processes are common to all living things. They feed (Nutrition), take in and use air (Respiration), produce and remove waste (Excretion), grow and develop (Growth), move (Movement), produce young ones (Reproduction) and respond to changes in their environment (Sensitivity). Each life process has particular functions that are important to living things for their survival.

### Activity 1.3: Identifying a life process

***Key question***

Can you tell a life process?

*Fig 1.1 (a): A water fall*

*Fig 1.1(b): A lion eating a zebra*

**What to do**

Observe the pictures in Figures 1.1(a) and (b) above.

i) Which of them is a life process and why?
ii) Which of them is not a life process and why?

### Activity 1.4: Finding out life processes and their importance

***Key question***

Can you tell a life process?

**What you need**

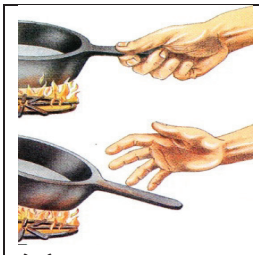
- pictures of living things involved in life processes

**What you do**

The pictures below show living things involved in life processes.

i) In pairs, study the pictures carefully.

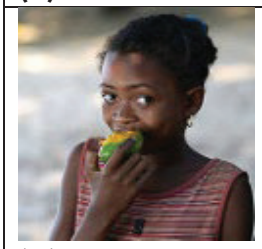
ii) Identify the life process shown in each picture and state its importance(s) to the living organism. Fill the answers in the table provided below the pictures.



**(a)**

**(b)**

**(c)**



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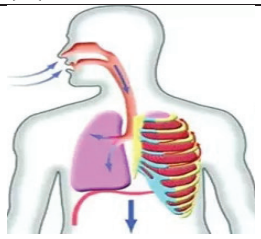

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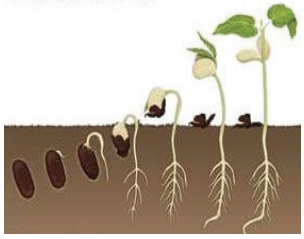


**(f)**

**(h)**

| Picture | Life process | Importance of the life process |
|---|---|---|
| (a) | | |
| (b) | | |
| (c) | | |
| (d) | | |
| (e) | | |
| (f) | | |
| (h) | | |

**Exercise 1.0: Characteristics of living organisms' word search**

**Instructions:** Search for and circle seven words that refer to life processes. The words may appear straight across, backward straight across, up-down, down-up, or diagonally.

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

For each word found, use it in a sentence or statement that makes scientific sense.

**2.0** Adam says plants take in carbon dioxide during the day and give out oxygen. Eve says plants take in oxygen throughout the day and at night. In your opinion, who would you agree with? Give reason(s) for your response.

## Differentiating Between Animals and Plants

From **Activity 1.3**, both plants and animals are living things and have common characteristics. However, some of the characteristics in plants and animals are carried out in different ways.

### Activity 1.5: Finding out the differences in characteristics of plants and animals

***Key question***

How do plants and animals differ in their life processes?

**What you need**

- A plant in a pot
- A small animal e.g. a rat in a cage or an ant in a glass container

**What you do**

In small groups, observe the life processes of the two organisms and record your observations. Write what you observe for the plant and animal. Describe how the organism will carry out the life process.

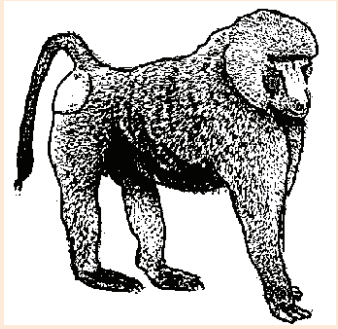
**Note:** in some cases it may be **difficult** or **impossible** to observe the processes. In that case use textbooks, the Internet to prepare your findings or consult a teacher for guidance.

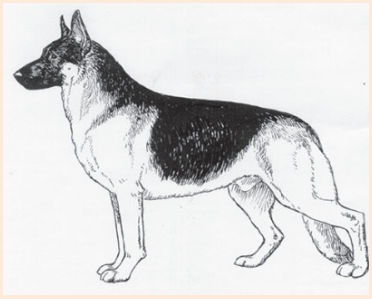
1. **Feeding**
   Plant_____
   Animal_____

2. **Movement**
   Plant_____
   Animal_____
3. **Sensitivity**
   Plant_____
   Animal_____
4. **Excretion**
   Plant_____
   Animal_____

**Activity of Integration**

You are a member of the Nature Club at your school. The club is developing an envorimental campaign for members of a community that lives next to a forest which is home to a troop of baboons. The baboons regularly destroy the crops in the community's gardens. The community members plan to get rid of the baboons permanently. The Nature Club has to raise awareness about repect for living things. You are given these 4 organisms and you are to elaborate a message showing their relation:





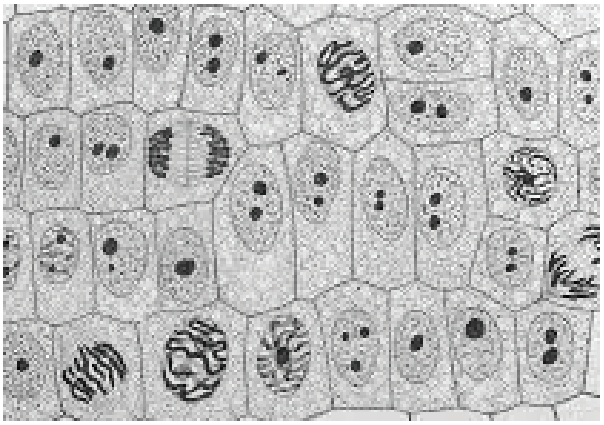

**Task:** Using your knowledge of life processes, draw a poster including all 4 organisms to show their relations.

## Chapter Summary

- Biology is a branch of science that deals with living organisms.
- Biology has several branches that can be applied in everyday life.
- All living organisms undergo/perform life processes that distinguish them from non-living things.
- There are seven life processes that enable all living organisms to survive.

# CHAPTER 2

# CELLS



| **Key Words** | By the end of this chapter, you should be able to learn: |
|---|---|
| • cell<br>• cytoplasm<br>• cell membrane<br>• nucleus<br>• gene<br>• cell wall<br>• vacuole<br>• chloroplasts<br>• tissue<br>• organ<br>• specialized cell | • what a cell is.<br>• identification of the parts of a typical animal cell and plant cell and their functions.<br>• explain the structure of specialized cells in terms of their functions in an organism.<br>• distinguish the levels of cellular organisation. |

# INTRODUCTION

***Have you ever wondered what organisms are made of?***

Imagine if a house was carefully dismantled. What would you see piled up as the smallest components that were joined to construct the house? You will notice that they were the bricks/blocks that were joined several times in different ways to form a house. Likewise, organisms are made up of tiny building blocks of life that are called **cells.** The cells are organized at different levels to perform specific functions. The knowledge you will acquire about cell structure and organization will enable you to explain how an organism interacts with its environment to sustain its life. This same knowledge has enabled scientists to make important medical and agricultural advances in science.

## Animal and Plant Cells

### Activity 2.1: Observing cells

Cells are too tiny to be seen by unaided eye. You can only observe cells using a microscope. A light microscope is an instrument used to observe things that are too small to be seen by an unaided eye. It makes them appear much larger and clearer.

### Activity 2.1a: Viewing an animal cell

**Key question**

What is found inside an animal cell?

**What you need**

i) prepared slides of an animal cell
ii) raw egg without a shell in a clear shallow container
iii) microscope
iv) notebook
v) pen /pencil

**What to do**

1. Observe the raw egg in a dish. Identify the different layers.
   i) How many layers are you able to distinguish?
   ii) What is the relative position of the layers you have seen?
   iii) Record the information from (i) and (ii) above in the table below. You will use it later in this activity.
2. Observe the prepared slide of an animal cell. (Ask the teacher to help you view the cell under a microscope).
3. Now compare the observation of the prepared slide with that of the raw egg.

| | **Raw egg** | **Animal cell** |
|---|---|---|
| Number of layers | | |
| Size of layers | | |
| Position of layers | | |

The central part of the animal cell is called the nucleus. The fluid part surrounding the nucleus is called the cytoplasm. The outer boundary surrounding the cytoplasm is the cell membrane.

4. Draw and label the parts of the animal cell you have viewed under the microscope.

## Functions of the Parts

***Cell membrane:*** This is a thin, outer layer surrounding the contents of the cell. It allows some substances to go in and some to come out of the cell.

***Cytoplasm*** is a mucus-like liquid in the cell. This is where some of the life processes take place.

***Nucleus*** is the "brain" of the cell. It controls all the chemical activities that take place in a cell. This is because of the presence of genes that carry instructions and information on how the activities should occur.

## 2.1b): Viewing a plant cell

All cells are similar but not identical. Although plant cells have several structures in common with animal cells, there are also some differences.

**Key question**
Do you know what is found inside a plant cell?

A gene is the basic unit that carries information which determines the characteristics passed from a parent to its offspring.

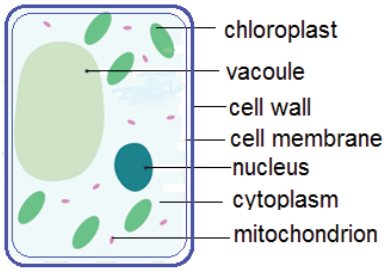
**What you need**

i) prepared slides of a plant cell
ii) microscope
iii) notebook
iv) pen /pencil

**What to do**

1. Observe the prepared slide of a plant cell. (Ask the teacher to help you view the cell under a microscope).
2. Draw only ONE plant cell you have viewed under the microscope and label its parts. The outer polygon-shaped layer is called the cell wall. The green round-shaped structures scattered in the cytoplasm are called chloroplasts.

   Some parts of the plant cell may not be seen easily. The diagram below shows the parts of a plant cell.



Plant cell

## Function of the Parts

The functions of the cell membrane, nucleus and cytoplasm are the same as those in the animal cell.

***Cell wall:*** This provides support to the plant cell. This is because it is made up of a tough material called cellulose.

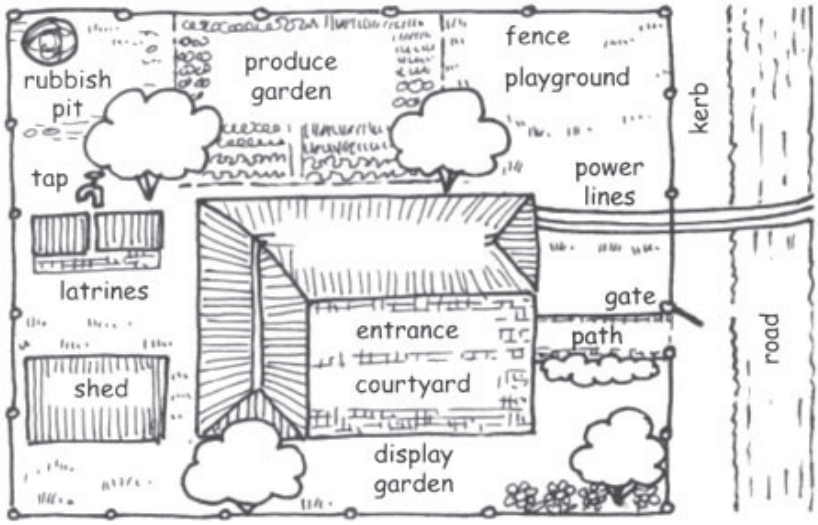
***Chloroplast:*** This is where plants make their own food through the process of photosynthesis. Chloroplasts are green in colour because they contain a substance known as chlorophyll which traps sunlight energy needed for photosynthesis.

***Vacuole:*** This is a storage area that may contain air, water, food and waste materials.

## Groups of Cells (Levels of Organisation)

People in a group can perform more complex tasks than one person alone. Consider what happens in a school system.

*Just like a body, a school carries out different activities. In order for a school to function properly, there have to be lots of different types of people performing different functions.*



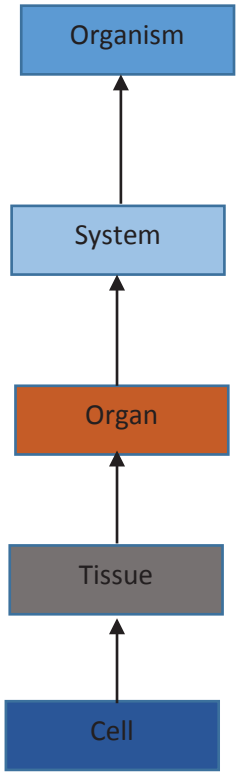

*List 8 different types of people and their roles that are needed for proper functioning of a school.*

Like people, similar cells in our bodies are organised into groups to make them work more effectively.

- *A group of **similar cells** performing a particular function is a **tissue** e.g. muscle tissue*

- *A group of **different tissues** form an **organ** to perform a particular function e.g. heart*
- *A group of **different organs** form an **organ System** to perform a particular function e.g. circulatory system*
- *A group of **different organ systems** form an **organism** e.g. a human*

Cell organisation at various levels carries out specific functions and key life processes in the body. This ensures efficient functioning of the body for the survival of the organism. For example, the reproductive cells (sperm and egg) fuse to develop into an organism that has tissues, organs and systems.

| Level of cell Organisation | Description | Example |
|---|---|---|
|  | *A group of **different organ systems** form an **organism.*** |  Human |
| | *A group of **different organs** form an **organ system** to perform a particular function e.g. circulatory system.* |  Circulatory system |
| | *A group of **different tissues** form an **organ** to perform a particular function.* |  The heart<br>  Muscle tissue |
| | *A group of **similar cells** performing a particular function is a **tissue*** |  |
| | *The basic unit of a living thing* | Muscle cells |

## Activity 2.2a: Identifying the tissues in your arm

a) What is the use of your arm?

Have you ever thought about what is below the skin of your arm?

**Key question**

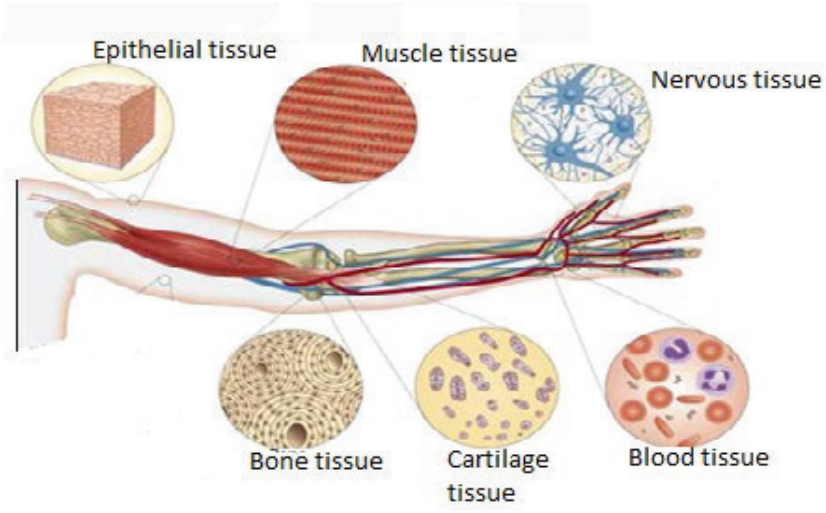
What is under the skin in your arm?

**What you need**

i) Notebook
ii) Pencil
iii) Pen

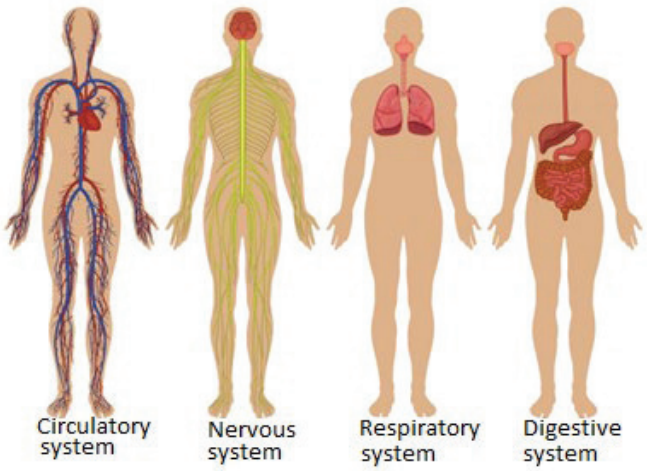
**What to do**

1. Make a sketch of your arm.
2. Try to name the parts of the arm.
3. Discuss with your neighbour the use of each part.
4. Compare your drawing with the figure below and suggest the importance of each tissue labelled.




## Exercise

1. Identify the organs in the systems shown in the figure and state the function of each.




**2.** Following is a list of some functions of systems in your body. Match the functions to the corresponding system.

| | |
|---|---|
| Transports materials around the body | Lymphatic system |
| Breaks down food substances for absorption | Circulatory system |
| Exchanges gases between the body and the surrounding | Urinary system |
| Produces gametes | Digestive system |
| Filters waste from the blood | Respiratory system |

| | |
|---|---|
| Defends the body against disease | Reproductive system |

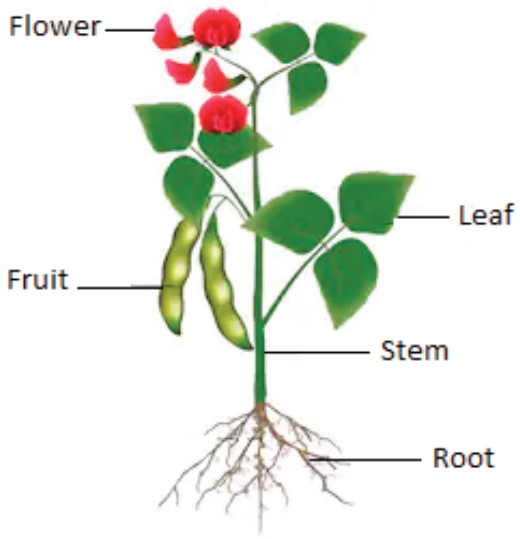
**Tissues, Organs and Systems in Plants**

A plant, like an animal is composed of tissues.

**Examples of plant tissues and their functions**

| Tissue | Function |
|---|---|
| Vascular tissues (forming vessels)<br>i) xylem | Transports water and minerals |
| ii) phloem | Transports food materials |

Since plants have tissues then they too have organs. Have a look at the picture below.




The organs in plants are: stem, leaf, root, flower and fruit.

i) Several leaves form a food making system for the plant.
ii) Flowers make up the reproductive system of a flowering plant.

iii) After fertilization, the flower changes into a fruit which is a food storage organ. The fruit bears seed that can grow into new plants.

iv) The stem is the organ consisting of vessels which transport water and mineral salts from the ground to the upper parts of the plant. The stem also transports food from the leaves to other parts of the plant.

*v)* The root is an organ for absorption of water and mineral salts from the soil into the plant. Some roots e.g. the carrot and sweet potato store food nutrients.

There are two systems in plants i.e. the **root** and **shoot** systems.

## Specialized Cells

Most of the cells in the body of an organism carryout general functions like respiration, growth and excretion. However, some cells are modified in structure to perform specific functions.

***What are such cells called?***

## Activity 2.2b: Relating the structure of specialised cells to their function

As earlier mentioned, some cells have special structures/features that enable them to carry out particular functions. In your body, a number of life processes take place, e.g. nutrition, reproduction and respiration.

For some of the life processes to be performed, specialised cells are required.

**Key questions**

1. What are the specialised cells in your body, and in a plant?
2. How are they adapted to their functions?

**What you need**

i) Notebook

ii) Pencil

iii) Four sets of cards:
   a. The first set is of pictures of five types of specialised cells
   b. The second set has the special features of each specialised cell
   c. The third set gives the functions of each specialised cell
   d. The fourth set has the names of each of the specialised cells

**Set one:** Specialised cells

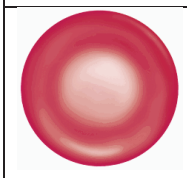
**Set two:** Feature/ structure of a specialised cell
- Has a tail
- Can change its shape
- Has a regular shape with many chloroplasts
- It is narrow and long providing a large surface area
- Flat biconcave shape and no nucleus

**Set three:** Functions of a particular specialised cell.
- To trap much sunlight to enable the cell carryout photosynthesis.
- To penetrate soil and absorb water and mineral salts.
- To provide a large surface area to absorb and carry oxygen from the lungs to respiring cells.
- To engulf foreign particles and destroy them in order to defend the body.
- To propel/swim to the egg cell and fertilise it.

**Set four:** Name of the cell
- Sperm cell
- Palisade cell
- Red blood cell
- Root hair cell
- White blood cell

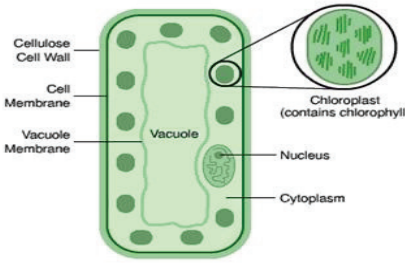
**What to do**

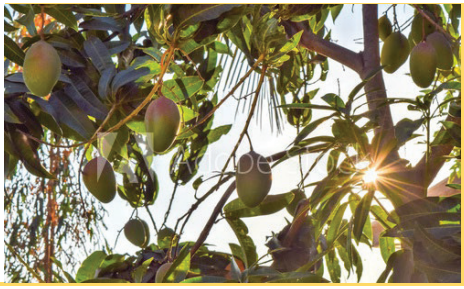
1. In pairs, study the cards carefully.
2. Observe each specialized cell, match it with the correct statement on the card of the specialised feature and the card with the particular function.
3. Select from the list of names, the one you think matches a particular specialised cell.
4. Record your work in the table below. Present your work to the rest of the class.

| Specialised cell | Adaptation | | Name |
|---|---|---|---|
| | Feature/Structure | Function | |
|  | | | |
|  | | | |
|  | | | |
|  | | | |
|  | | | |

## Activity of Integration

You have been asked to give a talk to the Primary seven class of your former school. The talk is about importance of plants to man. The Primary seven class already knows that plants make food but they do not know the details of the structures involved in the process. Your task is to write down (in not more than 100 words) how you would explain this in your talk using your knowledge of Biology. You can use the image below during your talk.



## Chapter Summary

- A cell is the basic unit where most life processes take place.
- All living organisms are made up of cells.
- Cells have different shapes, sizes and structures to carryout specialized functions.
- In multicellular organisms, cells combine to form tissues that join together to form organs which group to form organ/body systems.

# CHAPTER 3

# CLASSIFICATION

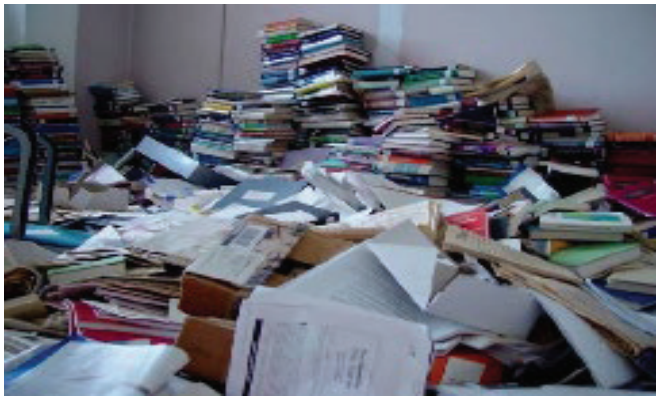
| **Key Words** | By the end of this chapter, you should be able to learn: |
|---|---|
| • taxonomy<br>• bi-nomial<br>• monera<br>• protoctista<br>• fungi<br>• bryophytes<br>• pteridophytes<br>• spermatophytes<br>• arthropods<br>• chordates<br>• viruses | • how living organisms are grouped and the reasons why.<br>• scientific names of living things that have two parts.<br>• identification of the characteristics and examples of organisms in kingdom monera, protoctista and fungi.<br>• the useful and harmful effects of bacteria, and fungi.<br>• identification of the characteristics and examples of organisms in the plant kingdom.<br>• identification of the characteristics and examples of organisms in the animal kingdom.<br>• how to describe viruses, give common examples, their mode of transmission, effect on infected plants or animals and their prevention. |

# INTRODUCTION

Have you ever imagined how many living things there are in the world? Indeed there is a greater variety of organisms in the world. How can we organize them so that they are easily recognizable? The first thing to do is to sort them into smaller and simpler groups. For example, if you were given a collection of books and asked to put them into two groups. How would you do it? What characteristics would you use? Biologists use the same practice of putting things into groups of related organisms. This is called **classification.**

## The Need to Group/Categorize Living Organisms

**Activity 3.1: Sorting books in a library**



**Key question**

How can you classify the books in the library?

**What you do**

Imagine you are in charge of a new library and government has delivered a number of different kinds of textbooks to your school. Someone is going to put the books on shelves in the school library, and she needs instructions on how to sort them. Write, in not more than 50 words, the instructions to be followed in sorting the books so that the library users can easily get access to the books they need.

**Drawing conclusions**

1) What characteristics did you look at in order to decide in what group to place a book?
2) Did any book fit into more than one group? Why or why not?
3) Do you think that scientists use classification when they are studying things? If so, how?
4) Why do you think scientists like to classify organisms?
5) Does classifying these organisms into certain groups help scientists study them?
6) How does classification help scientists study organisms?

## Levels of Classification

Classification is the act of putting together living organisms into groups based on their common/similar characteristics. Each group of similar organisms is called a taxon (taxa-plural). The branch of biology that deals with classification of organisms is called **taxonomy.**

**Activity 3.2: Finding out the seven levels of taxonomy of living things**

In this activity you are going to discover the different levels of organization of organisms by relating a day to day scenario to a biological concept of classification. The levels are determined by the unique characteristics of the organisms therefore at each level there are a number of organisms that differ.

**Key question**

How are organisms grouped scientifically?

**What you need**

i) Notebook
ii) Ruler
iii) Chart with a list of words (county, village, district, continent, world, parish, country)

**What to do**

1. Draw a large inverted isosceles triangle in your notebook and divide it horizontally into seven equal parts. The size of the triangle division represents a population size.
2. On one side of the triangle, write down the places (from the list of words provided) beginning with the biggest to the smallest in terms of population size matching with the divisions in the triangle.
3. On the other side of the triangle, starting from the top to bottom place the following terms which are the levels of organization in the following order; kingdom, phylum, class, order, family, genus and species.

*Of the terms you have written on the other side of the triangle, which one would contain the:*

*a. Largest number of organisms?*
*b. Smallest number of organisms?*
*c. What happens to the number of organisms in the levels as you move from kingdom to species? Explain your answer.*

**Species:** This is a group of organisms with similar characteristics that are able to breed freely among themselves and produce fertile offspring. This is a taxon/group with the fewest organisms.

**Genus:** This group consists of a number of similar or closely related species.

**Family:** This group is made up of closely related genera (genus-singular).

**Order:** This group is made up of closely related families.

**Class:** This group is made up of closely related orders.

**Phylum:** This group is made up of closely related classes.

**Kingdom:** This is the highest category into which organisms are classified. It consists of organisms belonging to closely related phyla (phylum-singular). This group contains the highest number of

organisms. There are five kingdoms of living organisms today: **Monera, Protoctista, Fungi, Plantae** and **Animalia.**

## The Two-Name Naming (Binomial) System of Living Organisms

An office/restaurant/bank in a town can easily be located using only two small groups of the address i.e. the name of the street and plot number. In the same way all species are named from the last two groups in the taxonomic levels i.e. the genus and the species.

In the two-name naming system every living organism has a unique two-part name that consists of two words from the genus name and species name. The first name is **Genus,** the second name is **species. Scientific** names of organisms are written in Latin, printed in *italics* or underlined separately when handwritten. The genus name always starts with a **capital** letter, and the species name is always written in **small** letters.

**Examples of scientific names**

| Organism | Genus | Species | Scientific name |
|---|---|---|---|
| Onion | *Allium* | *cepa* | *Allium cepa* |
| Man | *Homo* | *sapiens* | *Homo sapiens* |
| Housefly | *Musca* | *domestica* | *Musca domestica* |
| Butterfly | *Papilio* | *demodocus* | *Papilio demodocus* |
| Cockroach | *Periplaneta* | *americana* | *Periplaneta americana* |
| Lion | *Panthera* | *leo* | *Panthera leo* |
| Honey bee | *Apis* | *mellifera* | *Apis mellifera* |

The binomial system is important because of the following reasons:

(i) Clarification: each organism has a unique name that is specific to that organism and can be identified.
(ii) Universal: using same name everywhere to identify the specific organism.
(iii) Education: names are short and easier to remember and learn.
(iv) Classification: organisms are more easily categorized and the categories are easier to understand.

**Exercise**

| | |
|---|---|
| *alba,* white | *laminate,* edge or fringe |
| *borealis,* northern | *macro,* large |
| *lasio*, hairy | *ovi,* egg-shaped, oval |
| *auricula* ear-like | *phylla,* leaf |
| *coccinea,* scarlet | *rubra,* red |
| *dentaria,* pertaining to the teeth | *suber,* cork |

The list below shows the meanings of several Latin prefixes, suffixes, or words that are frequently used in species names.
Using the information about Latin word parts, match the scientific name on the left with the correct common name on the right. Draw lines to match them. Then write each pair of names on a separate sheet of paper.

1. *Auricularia auricula-judae*
2. *Betula borealis*
3. *Pachystachys lutea*
4. *Banksia coccinea*
5. *Dentaria laciniata*
6. *Magnolia macrophylla*
7. *Betula alba*

a. Scarlet banksia

b. Big leaf magnolia

c. European white birch

d. Golden shrimp plant

e. Jew's ear

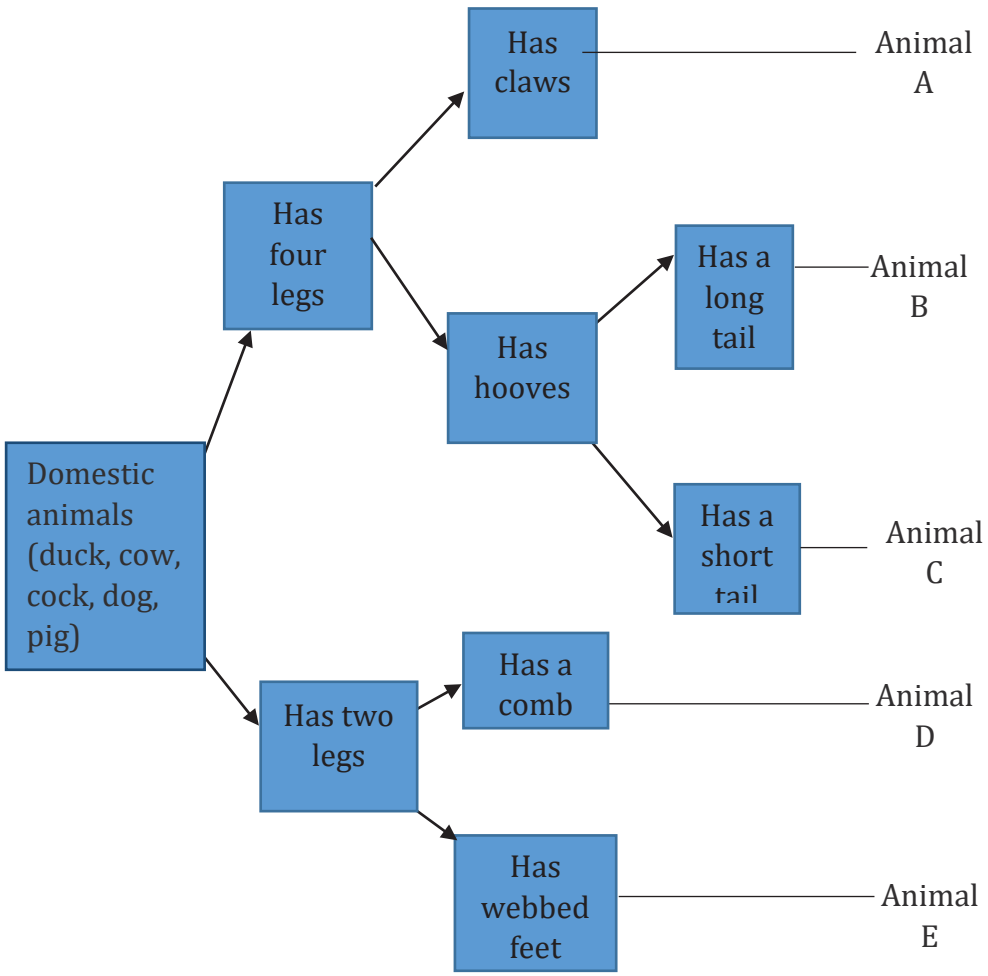
f. Cutleaf toothwort

g. Northern birch

## Using a Flow Chart for Biological Classification

The features/characteristics of organisms can be used to classify them using a flow chart. The chart usually begins with two distinct features that distinguish a group of organisms. Then other features/characteristics can be used to further separate the organisms until each individual in the group is identified independently. Take a look at the chart below and try to figure out the domestic animals based on their characteristics.

**Task:** Study the flow chart shown below and answer the questions that follow.



1. Which one of the domestic animals is a:
   i) duck
   ii) cow
   iii) cock
   iv) dog
   v) pig
2. Using the domestic animals in (1) above, create your own flow chart but with features/characteristics different from those given above.

# The Five Kingdoms of Living Organisms

## Kingdom Monera

This kingdom includes the simplest and smallest living organisms. The organisms are single-celled known as bacteria.

The bacteria have the following characteristics:

- They are unicellular (single celled) organisms
- The bacteria are grouped according to their shapes which can be rounded, coiled or rod-shaped.
- They have no true nucleus. Their genetic material is not enclosed by the nuclear membrane.

**Useful and Harmful aspects of Monera**

Some people may tend to fear bacteria, because they only imagine that bacteria cause harm. However biological studies show that bacteria can be both harmful and useful in nature.

Bacteria are harmful because:

1. They cause diseases e.g. tuberculosis and cholera in humans.
2. Action of bacteria on food makes it rot.

Bacteria are useful because:

1. They help in the process of decomposition by breaking up organic wastes.
2. They contribute to soil fertility by fixing nitrogen which is important for plant growth.
3. Some bacteria are used in treatment of sewage.
4. Some bacteria are used in industry e.g. in making of food like yoghurt.

## Kingdom Protoctista

This kingdom consists of single celled and simple multicellular organisms that possess a true nucleus unlike monera.

**Examples are:**

1. Amoeba: does not have a permanent shape. It moves by use of pseudopodia (pseudo- means false while podia – is to do with limb). It causes dysentery in man.

2. Paramecium: is oval shaped. It moves by use of hair-like structures called cilia. It feeds on other microorganisms e.g. bacteria.
3. Plasmodium causes malaria in humans.

## Kingdom Fungi

Kingdom fungi include mushrooms, yeast and moulds. Some fungi grow in wood and soil, and develop from tiny spores. Fungi have a nucleus and their cells have a cell wall made up of a substance known as **chitin**. They do not make their own food; instead feed on the decomposing organic matter of animals and plants.

You may already be aware that some types of fungi like mushrooms are grown and eaten while others like puff balls are poisonous. This informs you that fungi can be useful or harmful in nature.

### Useful Aspects of Fungi

1. Fungi keep soil fertile by recycling organic material through decomposition.
2. Some fungi are food for humans, for example, mushrooms.
3. Manufacture of medicine, for example, antibiotic Penicillin

Yeast is a type of fungus used in baking of bread and brewing of beer in industries.

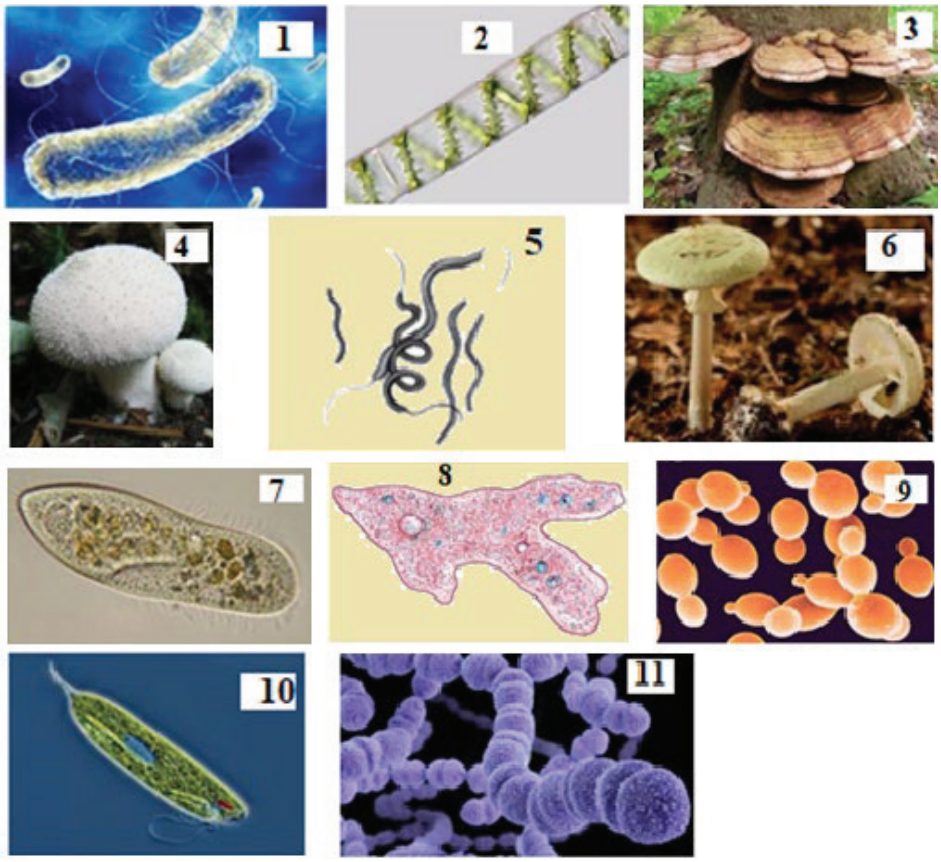
**Harmful Aspects of Fungi**

1. They cause diseases e.g. ringworm, candida, athletes' foot (in animals), potato blight and leaf rust in coffee.
2. Fungi like moulds when they grow on food they cause food spoilage.

**Activity 3.3: Sorting and identifying organisms in kingdom monera, protoctista and fungi**

**What you need**

1. Pictures or specimens (bracket fungus, amoeba, *bacillus*, spirogyra, puff ball, streptococcus, mushroom, paramecium, yeast, *spirilla*, euglena)



2. Group names (bacteria, fungi, protists)
3. Characteristics of different organisms (single celled, multicellular, nucleus is not surrounded by a membrane, nuclear membrane present, cell wall made up of chitin, feed on decomposing matter).

**What to Do**

1. Sort the organisms in the pictures according to their different groups using the common characteristics. Fill in the table below.

| Pictures | Group name | Characteristic(s) |
|---|---|---|
| | | |
| | | |
| | | |

2. Construct a flow chart for any four organisms based on the characteristics you have stated in the table above.

***Project work: Making Yoghurt***

*In groups of 4 to 6 make yoghurt at school. Use the Internet, cookbooks or ask your teacher to assist you:*

- *Determine the materials to use.*
- *Identify the conditions.*
- *Develop the procedure.*

*Write a report including the materials used, explaining the important steps followed and the description of the product. State the living organisms involved in the process. Mention the nutrients found in yogurt and their importance to man.*

*An example of the format of how a scientific report should be presented or written is given below:*

<table>
<tr><td colspan="2">Title: (This should accurately describe the experiment).<br><br>Your name:<br><br>Lab Partners: (Who helped you with the experiment? List their full names).<br><br>Date:<br><br>Class:</td></tr>
<tr><td colspan="2">Purpose: (It is either a single sentence or a paragraph summarizing why the experiment was performed or product was made).</td></tr>
<tr><td colspan="2">Hypothesis: (Predict the outcome(s) of the experiment, use the format “If…then…because”. E.g. “If we leave windows open at night then mosquitoes will enter the house because they are attracted by the scent from humans”).</td></tr>
<tr><td colspan="2">Materials: (What equipment and materials did you need for this lab assignment? Describe how any equipment was connected. List the name and amount of each item used.)</td></tr>
<tr><td colspan="2">Procedures: (What steps did you take to accomplish this lab assignment?)</td></tr>
<tr><td colspan="2">Data Recording: (Record the data that is required at each step of the lab: tables, charts, graphs, sketches, etc.)</td></tr>
<tr><td>Analysis: (Explain your data in words.)</td><td></td></tr>
<tr><td colspan="2">Discussion: (Discuss what happened in the lab. Give details on anything that went wrong).</td></tr>
<tr><td colspan="2">Conclusion: (What did you learn? What conclusions can you draw from the results of this lab assignment? Compare the results of the experiment with your hypothesis.)</td></tr>
</table>

## Kingdom Plantae

You have often used the word *plant* or *plants* in your conversations. Can you reflect on what organisms you have referred to as plants? You will notice that plants occur in different forms and sizes. Plants include trees, shrubs, ferns, mosses, and grasses. All plants are multi cellular. Their cells are surrounded by a **cellulose** cell wall and have a nucleus surrounded by a nuclear membrane. Their cells contain a green pigment known as chlorophyll that traps sunlight which the plant uses to make its own food (photosynthesis). Plants are grouped in divisions. A division is an equivalent of a phylum:

1. Non-vascular plants (Bryophytes)
2. Vascular plants (Pteridophytes and Spermatophytes)

**Vascular** refers to having vessels

## Bryophytes

This group includes mosses, liverworts and hornworts. They are small plants that commonly inhabit shady moist places. They bear stem and leaf-like structures but no roots. They have no vascular tissue and no flowers. Bryophytes break down rocks to form soil and they

prevent soil erosion. However, they weaken cement and verandas and walls if left to stay on them for long.

## Pteridophytes

This group includes ferns. They grow in damp shady places. They bear stems, leaves and roots. They have vascular tissues. They do not bear flowers.

## Spermatophytes

This is a group of plants that bear seeds hence seed-bearing plants. These include some trees, shrubs and herbs. They have a stem, leaves, roots and a well-developed vascular system.

Spermatophytes are divided into two groups:

1. Angiosperms (flowering plants)
2. Gymnosperms

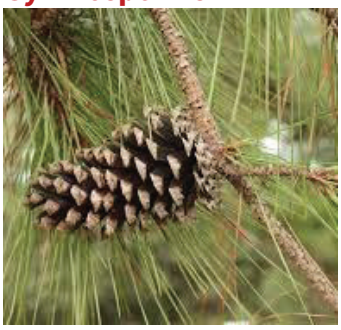
## Angiosperms

Flowering plants reproduce by seeds which are formed from flowers. The seeds are enclosed in an ovary. Flowering plants are divided into two: **monocotyledonous** and **dicotyledonous plants**.

**Monocotyledonous** plants are flowering plants which have only one cotyledon in their seeds. Most have long, narrow leaves with parallel leaf veins. Their flowers have dull coloured petals in multiples of three. Examples include grasses, maize, millet, sorghum.

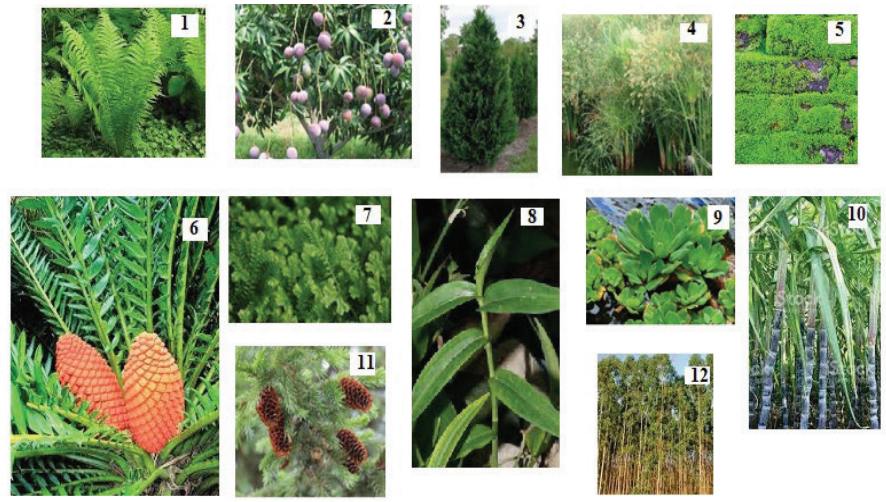
**Dicotyledonous** plants have two cotyledons in their seeds. Their leaves are usually broad and the leaf veins form a branching network. They have four or five brightly coloured petals on each flower. Examples include; beans, peas, groundnuts.

## Gymnosperms



This group of plants does not bear flowers. Their seeds are not enclosed in an ovary hence these plants are sometimes referred to as “naked seed” bearing plants. They produce seeds on structures called cones. Most have needle-like leaves. Examples include pine trees, cyads and cypress.

## Activity 3.4: Sorting and identifying organisms in kingdom plantae




### What you need

- Pictures or specimens (cycad, mango, papyrus, fern, water cabbage, cypress, eucalyptus, sugarcane, hornwort, clubmosses, wandering Jew)
    - Group names (angiosperms, pteridophytes, gymnosperms, bryophytes)
    - Characteristics of different organisms written on a chart (have roots, stems and leaves; seeds are in an ovary; have flowers; have vessels; have no flowers; have no vessels; have no roots; seeds are not in an ovary)

### What to Do

1. Sort the organisms in the pictures according to their different groups using the common characteristics.

Fill in the table below.

| Picture(s) | Group name | Characteristic(s) |
|---|---|---|
| | | |

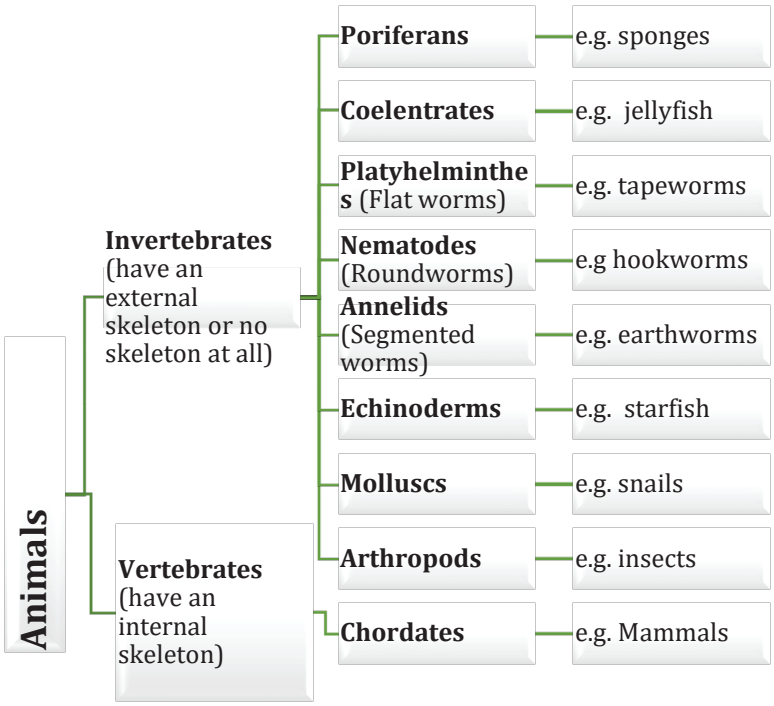
2. Construct a flow chart for any four organisms based on the

## Kingdom Animalia

We usually tend to limit the word 'animal' to a few particular organisms leaving out others. In this unit, you are going to learn what organisms are classified as animals.

Animals are multicellular organisms. Their cells have no cell walls or chloroplasts therefore they cannot make their own food. Most animals ingest solid food and digest it internally.

The animal kingdom can be divided into 9 main groups (Phyla); eight of these groups are animals without a backbone **(Invertebrates)** and the other group comprises animals that have a backbone **(Vertebrates)**.




## Arthropods

This is the largest phylum in the animal kingdom. They live on land, in water and in air.

They have an exoskeleton that protects their bodies and prevents them from losing excessive water. Their bodies are segmented with pairs of jointed appendages (legs and antennae). The segmented body eases movement.

Arthropods consist of four classes:

- myriapods
- crustaceans
- arachnids
- insects

## Myriapods

Examples

*centipede*

*millipede*

They have an elongated body with several segments. They have one pair of antennae. They have several legs and simple eyes.

Millipedes coil when faced with danger.

Centipedes have one pair of legs on each body segment. They have a poison claw used to kill its prey.

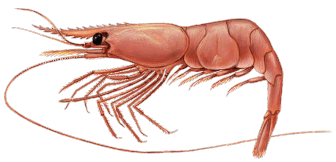
Millipedes have two pairs of legs on each body segment.
They contribute to soil fertility by barrowing in soil to aerate the soil and add humus.

## Crustaceans

Examples

*crab*

*crayfish*



*prawn*

They live in water or in damp places. They have two main body divisions i.e. fused head/thorax and abdomen. They have two pairs of antennae and two compound eyes. They have five pairs of jointed legs and in some species the front pair is modified into claws or pincers.

### Arachnids

Examples


*spider*


*tick*


*scorpion*

They have two body parts i.e. fused head/thorax and abdomen. They all have four pairs of legs. They do not have antennae or wings. They have simple eyes and breathe by book lungs. Most arachnids are predators and live on land. The tick is a parasite and transmits disease in farm animals e.g. cattle.

### Insects

Examples


*grasshopper*


*cockroach*


*butterfly*


*housefly*

Insects form the largest group in phylum Arthropoda. They can be found anywhere.

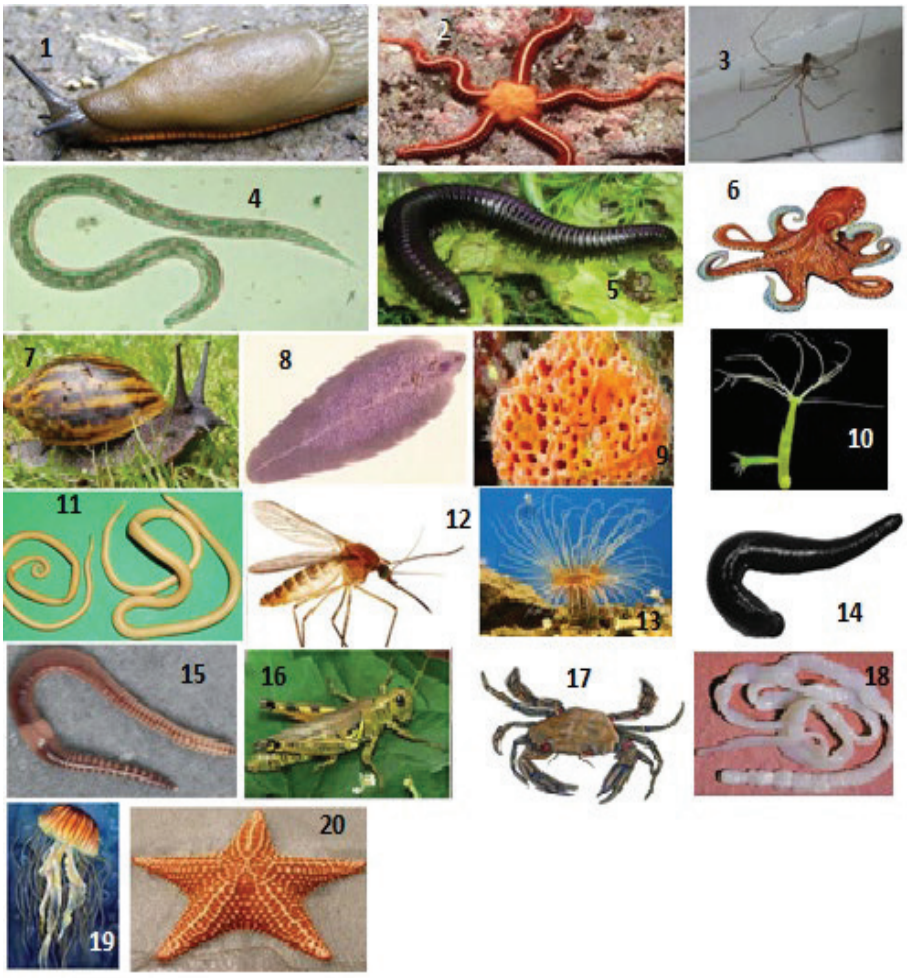
The insect's body is divided into three distinct body parts, namely; head, thorax and abdomen. They have three pairs of jointed legs on the thorax. They have a pair of compound eyes except the soldier termites. Most adults have one or two pairs of wings. Some insects are harmful or useful or both harmful and useful to other organisms.

**Activity 3.5: Classifying invertebrates**

**What you need**

Pictures or preserved specimens of the following: hook worm, tape worm, octopus, slug, jelly fish, sponge, mosquito, spider, starfish,

earth worm, sea anemone, crab, hydra, millipede, *ascaris*, snail, leech, liver fluke, brittle star, and locust.




**What to Do**

Construct a flow chart for any six organisms in the pictures using their observable characteristics.

## Chordates

Members of this group are also referred to as vertebrates (have a backbone). They all have an endoskeleton (inner skeleton) comprising a skull, backbone. limb bones and ribs. Thev have a dorsal nerve cord (spinal cord). Most vertebrates, apart from fish, have four

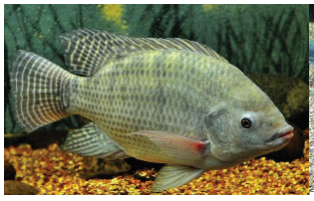
limbs which they use for locomotion. In birds and bats, the front limbs develop into wings for flying. A fish's limbs are its fins, which vary in number. Snakes have no limbs.

Chordates comprise five classes:

i) Fish (Pisces)
ii) Amphibians
iii) Reptiles
iv) Birds (aves)
v) Mammals

## Class Pisces (fish)

Examples


*tilapia*

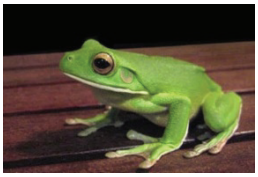

*catfish*

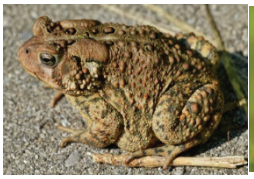

*shark*

Fish live in water. Their bodies are covered with scales for protection and they have fins and tails for movement and stability in water. Fish are ectotherms. Fish use gills for gas exchange. Fish is food for many other animals.

## Class Amphibia (amphibians)

Examples


*frog*


*toad*


*salamander*

For the first part of the life of amphibians they live in water and use gills for gas exchange. When they become adults they develop lungs and are able to live on land and return to water to mate and lay eggs. They are also able to exchange gases through their soft moist skins. There are no scales on the skin. Amphibians are ectotherms.

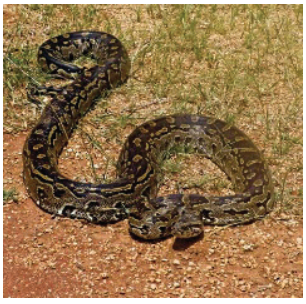
An ectotherm is an organism whose body temperature changes with the temperature of the external environment.

## Class Reptilia (reptiles)

Examples

*lizard*

*crocodile*



*python*

*tortoise*

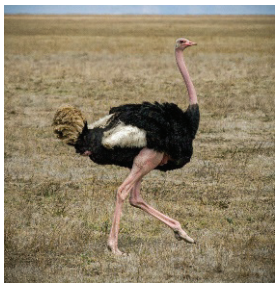
Most reptiles live on land. They have tough dry scales on their bodies which prevent loss of water and are for protection. They use lungs for gas exchange. Like fish and amphibians, reptiles are ectotherms. Reptiles reproduce by laying eggs that have soft shells.

## Class Aves (Birds)

Examples

*crane*

*cock*



*ostrich*

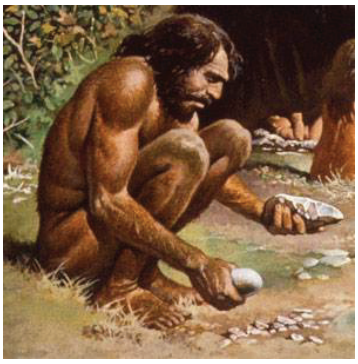
*stork*

Birds are endothermic animals that live on land. They have feathers, beaks and scales on their legs. They reproduce by laying eggs with hard shells. Their fore limbs are modified into wings. Most birds are able to fly because of their powerful wings and light, strong bones.

An endotherm is an organism whose body temperature stays fairly the same (constant)

## Class Mammalia (mammals)

Examples



*man*

*cow*

*kangaroo*

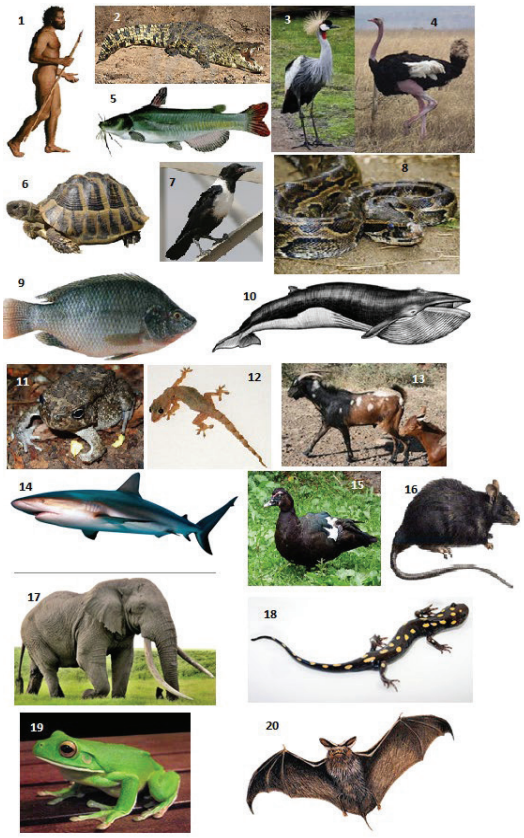
*gorilla*

Mammals are animals with hair or fur on their bodies. Like birds, mammals are endotherms. Most live on land except a few like the whale and dolphin. Mammals use lungs for gas exchange. Female mammals give birth to live young and feed the young on their own milk produced by mammary glands.

### Activity 3.6: Classifying chordates

**What you need**

Pictures of goat, rat, bat, elephant, human, whale, tortoise, python, gecko, crocodile, crested crane, crow, duck, ostrich, tilapia, shark, catfish, toad, frog, salamander




**What to Do**

Construct a flow chart for any six organisms in the pictures using their observable characteristics.

## Viruses

Viruses though not living things exist in nature. Viruses are not classified under any of the five kingdoms. A virus is a very small microscopic biological particle that infects cells. Like other living cells, a virus has genetic materials and multiplies inside living cells. Viruses can infect and cause deadly diseases to humans, plants and other organisms, for example, AIDS, Hepatitis B and Ebola in man, Cassava Mosaic in cassava plants.

**HIV** (Human Immunodeficiency Virus) is what causes **AIDS** (Acquired Immune Deficiency Syndrome) disease. The virus weakens the immune system of the infected person making it easy to catch diseases e.g. TB (tuberculosis). The virus is transmitted through: having unprotected sex with an infected person, infected injections, blood transfusion from an infected person and from an infected mother to her child during pregnancy or birth.

Today, there is no scientifically known cure for AIDS but there are drugs that can make an infected person's immunity stronger allowing him/her to live a longer and productive life. The most effective way to prevent the spread of HIV and AIDS is abstinence from sex more especially among people who are not in a permanent adult relationship. Hepatitis B and Ebola are transmitted through body contact with fluids from infected persons e.g. kissing. You need to understand that viral diseases are difficult to treat or have no treatment at all. Hepatitis B can be prevented by vaccination; however, Ebola and HIV have no vaccine.

The cassava mosaic virus affects the tubers of the plant resulting in low crop yields. This virus causes the cassava mosaic virus disease. It can be recognized on the cassava leaves which have spots ranging from light green to yellow. The disease is transmitted from plant to plant by the whitefly.

This disease cannot be cured but it can be avoided. The cassava mosaic virus disease can be prevented by the use of cuttings which have not been attacked by the virus. Farmers are particularly encouraged to plant varieties which are resistant to the disease.

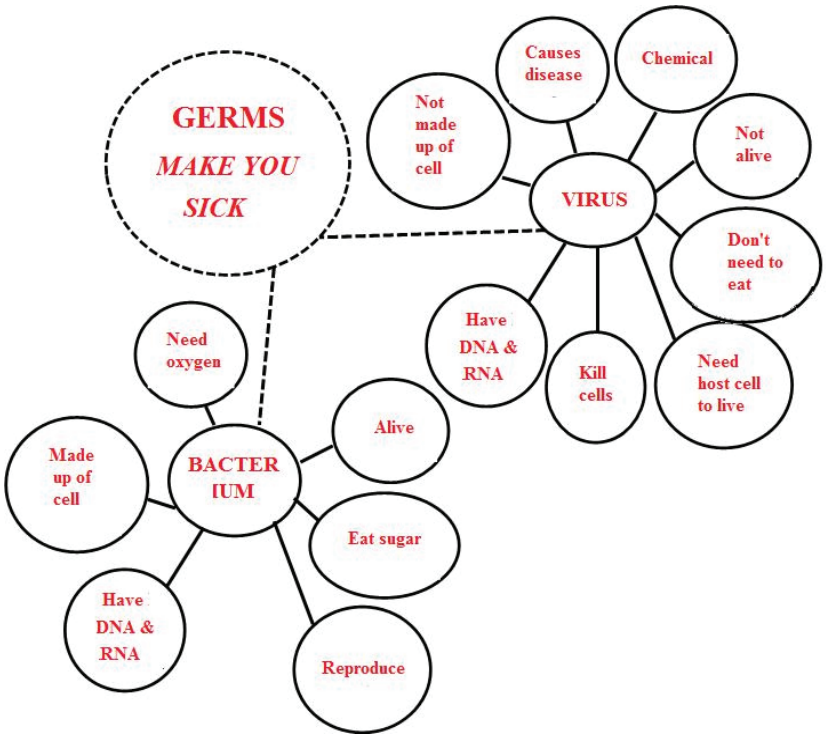
**Activity 3.7: Comparing the characteristics of a virus and bacterium**

**What you need**

i) Chart comparing viruses to bacteria
ii) Pen/pencil

iii) Biology textbooks
iv) Notebook
v) Internet

**Study the chart provided, and answer the questions that follow.**




1. Compare viruses and bacteria using the information in the chart.
2. Read, discuss and write down short notes on common diseases caused by bacteria and viruses in humans, plants and other animals.

## Chapter Summary

- Classification involves naming and grouping of living organisms according to characteristics.
- There are seven main levels/groups of classification. The largest group being the kingdom and the smallest is species.

- Living organisms are grouped in five kingdoms namely: bacteria, protists, fungi, plants and animals.
- The scientific name of an organism has two parts i.e. the genus name and the species name.

# CHAPTER 4

# INSECTS

| **Key Words** | By the end of this chapter, you should be able to learn: |
|---|---|
| • dichotomous key<br>• dorsal view<br>• pest<br>• methods of control | • description of the antennae, eyes, mouth parts, wings and legs of a housefly, cockroach, mosquito, termite, bee, and butterfly.<br>• to use the observable characteristics of the different insects to construct a dichotomous key to identify each.<br>• the beneficial and harmful aspects of a housefly, cockroach, mosquito, bee and butterfly.<br>• identification of the different methods of controlling the harmful stages of a housefly, cockroach, mosquito and butterfly. |

## Introduction

Insects have for a long time been known as pollinators, honey producers, vectors, food and for beauty. Insect populations and their variety can tell us how important they are to the environment. Their physical features and behaviour give an idea of the role they play in the lives of man, plants and other living organisms.
The insects that we interact with regularly are the housefly, cockroach, mosquito, worker bee, and butterfly and soldier termite. *Do you remember which phylum and class these insects belong to?*

## External Features of an Insect

All insects have a head, thorax and abdomen. These parts bear other structures that enable the insect to function normally and live well in its environment.

### Activity 4.1: Observing and drawing the back (dorsal) view of a cockroach

**What you need**

i) Freshly killed adult cockroach
ii) Notebook
iii) Pencil

**What to do**

Place (on a white background) the cockroach on its legs with the head away from you (dorsal view). Pull all the wings upwards and outwards. (Do not pluck them off).

**Dorsal view** refers to the back of or upper side of an organism.

Draw the structure of the whole cockroach.

Label the following parts: hind wing, leg, thorax, head, fore wing, abdomen, compound eye and antennae.

**Caution**

After completing the activity, **WASH** your hands thoroughly with **CLEAN WATER** and **SOAP**

*Why should you do this?*

## The Head of an Insect

The head of an insect bears antennae, mouth parts suited to the type of food the insect feeds on and may or may not have eyes. If the insect has eyes they are either simple or compound.

### Activity 4.2: Identifying the features on the head of an insect

**What you need**

i) Hand lens
ii) Freshly killed adult cockroach, housefly, mosquito, worker bee, butterfly and termite
iii) Notebook

**What to do**

Using a hand lens, observe the features of the antennae, eyes and mouth parts of the insects provided. Describe the features in the table below.

| **Insect** | **Description** | | | | | |
|---|---|---|---|---|---|---|
| | **Antennae** | | **Eyes** | | **Mouth parts** | |
| **Cockroach** | *number* | | *number* | | *number* | |
| | *length and shape* | | *type* | | *type* | |
| | *texture* | | | | *shape* | |
| **Housefly** | *number* | | *number* | | *number* | |
| | *length and shape* | | *type* | | *type* | |
| | *texture* | | | | *shape* | |
| **Mosquito** | *number* | | *number* | | *number* | |
| | *length and shape* | | *type* | | *type* | |
| | *texture* | | | | *shape* | |
| **Worker bee** | *number* | | *number* | | *number* | |
| | *length and shape* | | *type* | | *type* | |
| | *texture* | | | | *shape* | |
| **Butterfly** | *number* | | *number* | | *number* | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | *length and shape* | | *type* | | *type* | |
| | *texture* | | | | *shape* | |
| **Termite** | *number* | | *number* | | *number* | |
| | *length and shape* | | *type* | | *type* | |
| | *texture* | | | | *shape* | |

**Caution**

After completing the activity, **WASH** your hands thoroughly with **CLEAN WATER** and **SOAP**.

1. (a) What is the function of antennae to an insect?
   (b) Among the insects provided, which do you think has antennae that are specifically adapted to its way of life? Give reasons for your answer.
2. Did all the insects have eyes? If no, which insect did not have eyes? Suggest a reason for your answer.
3. Based on your observations, select the insects which have the following types of mouth parts and give a reason for your answer.
   a. Biting-chewing mouth parts

      Reason

   b. Piercing-sucking mouth parts

      Reason

   c. Siphoning mouth parts

      Reason

   d. Sponging mouth parts

      Reason

## The Thorax of an Insect

The thorax of an insect bears its legs and may or may not have wings.

### Activity 4.3: Identifying the features on the thorax of an insect

**What you need**

i) Hand lens
ii) Freshly killed adult cockroach, housefly, mosquito, worker bee, butterfly and termite
iii) Notebook

**What to do**

Using a hand lens observe the features of the thorax of the insects provided. Describe the features in the table below.

| **Insect** | **Description** | | | |
|---|---|---|---|---|
| | **Wings** | | **Legs** | |
| **Cockroach** | *number* | | *number* | |
| | *texture* | | *texture* | |
| | | | | |
| **Housefly** | *number* | | *number* | |
| | *texture* | | *texture* | |
| | | | | |
| **Mosquito** | *number* | | *number* | |
| | *texture* | | *texture* | |
| | | | | |
| **Worker bee** | *number* | | *number* | |
| | *texture* | | *texture* | |
| | | | | |
| **Butterfly** | *number* | | *number* | |
| | *texture* | | *texture* | |
| | | | | |
| **Termite** | *number* | | *number* | |
| | *texture* | | *texture* | |
| | | | | |

1. What are the legs and wings in insects used for?
2. Did all the insects have wings? If no, which one(s) did not have and why?

3. Was there an insect(s) with more than one pair of wings? If yes, which one(s) was it? Suggest the functions of the wings observed.
4. (a) Which insects have special features on their legs?
   (b) What are those features and what are they used for?

**Caution**

After completing the activity, **WASH** your hands thoroughly with **CLEAN WATER** and **SOAP**.

## Dichotomous Keys

**A dichotomous key** is a tool that can be used to identify organisms in the natural world. Dichotomous originates from the Greek meaning "cut in two". Each step of the key provides two choices until there are no more choices to be made and you have identified the organism.

**Activity 4.4 Constructing a dichotomous key for shoes**

**What you need**

Note books/paper, pens/pencils

Shoes

**What to do**

1. As a whole class, seat in a circle and take off one of your shoes.
2. Gather the shoes in a pile in the middle of the circle, line them up so that everyone can see the shoes.
3. Come up with a way to divide the shoes into two groups of approximately even numbers.
4. Record the features/characteristics you have used to divide the shoes into the two groups. For example
   a. Shoes .....
   b. Shoes .....
5. Push one pile of shoes (e.g. pile b) aside for a moment.

6. Continue dividing the pile of shoes (pile a) into two distinct piles until you can't divide them any further. Record the features you have used each time you divide the pile into two.
7. Repeat the process using the other pile of shoes (pile b).
8. Compile and write the sets of features for the sorted piles as one piece of work to form your dichotomous key for shoes

   **Note.** Dichotomous keys may differ depending on the choice of features used during the making of the key.

**Task**

Use your knowledge from making flow charts to construct a dichotomous key for any four of the insects provided using the characteristics/features identified in activities 4.2 and 4.3 above

## More about Insects

| Insect | General information |
|---|---|
| **Cockroach** | Cockroaches live in damp but warm places and are generally found in kitchens and cupboards. They are nocturnal animals hiding in holes and crevices during the day and coming out at night. They feed on plant and animal material. |
| **Housefly** | Houseflies live in warm places and are generally found everywhere around the homes. Houseflies breed in manure and decomposing material. They are seen flying around during the day and hiding away at night. They feed on anything whether plant or animal material and your food left uncovered. |
| **Mosquito** | Mosquitoes live in dark and cool places. The eggs, larvae and pupa are found in ponds, slow flowing water or in |

| Insect | General information |
|---|---|
| | stagnant water in tins and broken bottles. They are nocturnal animals hiding in dark places during the day and coming out at dusk. |
| **Honey bee** | Honey bees live in various types of hives. Bees are commonly seen flying around during the day from one flower to another and at water points. When the sun goes down, they retire to their hives. They feed on nectar from virtually every flower available. |
| **Butterfly** | Butterflies live in various areas. Butterflies are commonly seen flying around during the day from one flower to another and at water points. When the sun goes down, they also hide in trees. They feed on nectar from virtually every flower available. |
| **Termite** | Termites live in damp but warm termite mounds. They are easily seen when the mound is broken. They feed on fresh and dry plant material. |

## The Beneficial and Harmful Aspects of Insects

Insects have an important role they play for the existence of the rest of the organisms. This role may be positive/beneficial or it might be negative/harmful to the organism.

**Activity 4.5: Finding out the helpful and harmful aspects of insects**

**What you need**

i) markers
ii) charts/manila paper

**Fact**

Did you know that Uganda hosts about 33% of the total of all Afro tropical species with over 1,235 species of butterfly having been recorded in Uganda?

**What to do**

In groups of 3 to 4, for each of the insects in the table below, discuss the following:

i) How the insect is helpful to other organisms/the surroundings.
ii) How the insect is harmful to other organisms/the surroundings.

Fill in the table below with your discussion points. Write your information on the chart/manila paper and present to the rest of the class.

| Insect | How it is helpful | How it is harmful |
|---|---|---|
| **Cockroach** | | |
| **Housefly** | | |
| **Mosquito** | | |
| **Honey bee** | | |
| **Butterfly** | | |
| **Termite** | | |

**Note:** Put into consideration the different stages of the lifecycles of these insects.

## Methods of control

From **Activity 4.3**, you found out that some of the insects are pests. There are a number of ways we can control pests.

**A pest** is an insect or any other organism that attacks crops, food or livestock.

**Activity 4.6: Finding out the methods of control of the harmful stages of insects**

**What you need**

i) markers
ii) charts/manila paper

**What to do**

In groups of 3 to 4, brainstorm:

i) the harmful (pest) stage in the life cycle of a cockroach, housefly, mosquito, butterfly and termite.
ii) the methods that are used to control the cockroach, housefly, mosquito, butterfly and termite in your environment.

For each insect, write down your discussion in form of a report include information on:

a) the harmful/pest stage of the insect.
b) control methods that are harmful to the environment and those that are not harmful to the environment.

Present to the rest of the class.

**Activity 4.7: To create an insect trap**

**What you need**

i) markers
ii) charts/manila paper
iii) locally available materials

**What to do**

In groups of 3 to 4, for any one of the insects you have studied, that is, a pest, design and make a trap using locally available materials.
Present your trap to the rest of the class explaining how it works.

### *Activity of Integration*


The following is an extract from a media brief on control of the Fall Armyworm in Uganda by the Minister for Agriculture, Animal Industry and Fisheries. Read the extract and answer the questions that follow.

*As a result of the climate change and climate variability, Uganda is experiencing an outbreak of new pests and diseases such as the coffee twig borer, banana bacterial wilt, cassava brown streak disease, tomato leaf miner, maize lethal necrosis and now the Fall Armyworm. This will negatively impact the nation's food and nutrition security and wealth creation efforts.*

*In the second season of 2016, the Ministry of Agriculture received reports of a severe outbreak of "caterpillars" on maize plants in the districts of Kasese, Kayunga and Bukedea. A visit made to these districts found that almost 40% of the maize crops in the fields visited were attacked by an unknown pest. The National Agricultural Research Organization (NARO) has confirmed identity of the pest as a moth commonly known as the Fall Army Worm. The fall army worm is native to tropical and subtropical regions of the Americas. How it arrived in Africa is not clear. There is suspicion, however, that the pest could have been introduced as a result of increase in trade (imports) of Agricultural commodities across continents and the pest's migratory nature of 2000km per annum could have facilitated its entry into Uganda.*

*First observed in Nigeria in January 2016, the pest is now reported in several other countries including Togo, Ghana, Zambia, Zimbabwe,*

*South Africa, Malawi, Mozambique, Namibia and Kenya. In Uganda to date, the pest has been confirmed in over 54 districts.*

*The pest is known to feed on more than 80* ***plant species****, including* ***cereals (maize, millet, sorghum, sugarcane, rice and wheat), legumes (****cowpea, groundnuts and soybean), cotton and* ***many pasture grasses*** *(Rhodes grass, Kikuyu grass, Lucerne and other pasture grasses).*

*The destructive stage of the pest is the caterpillar. The caterpillar feeds aggressively on most parts of the plant including the leaves, stems of maize, sorghum, rice, Kikuyu grass, Napia grass and sugarcane crops. This feeding damage results in a reduction in both yield and grain quality.*

*The adult moths move in large swarms at night with each female laying up to 2000 eggs and the emerging caterpillars are aggressive feeders with the potential to destroy a hectare within 72 hours in its later stages. The moths are strong flyers, when the wind conditions are right; they are capable of covering over 2000 km per year.*

**Tasks:**

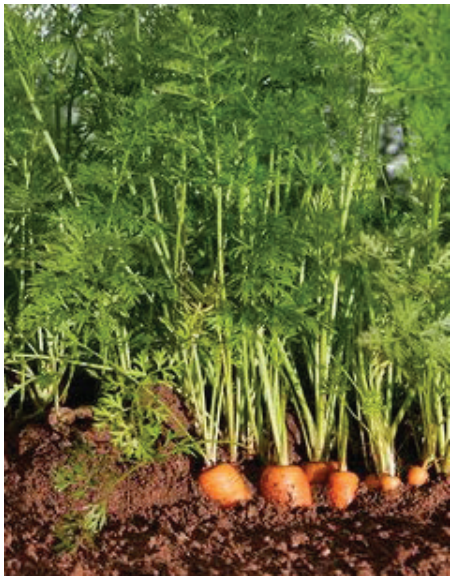
1. Suggest, giving reasons, whether the fall armyworm is an insect or not.
2. Apart from man, write down four other organisms that are affected by the destruction of crops due to the fall armyworm. Give a reason for your answer.
3. Write down four explanations why the fall armyworm is a hard/difficult pest to control.

## Chapter summary

- All insects have the same number of legs and body parts.
- The external characteristics of insects can be used to classify them and determine their mode of life.
- Most insects are beneficial and/or harmful to themselves, to other organisms or to the environment.

# CHAPTER 5

# FLOWERING PLANTS



| **Key Words** | By the end of this chapter, you should be able to learn: |
|---|---|
| • adaptation<br>• shoot system<br>• monocotyledonous<br>• dicotyledonous<br>• leaf venation | • how to describe and outline the functions of the different observable external parts (root, stem, node, leaf, internode, bud, flower and fruit) of a typical flowering plant.<br>• how roots, stems and leaves are adapted to their function.<br>• classification of leaves. |

## Introduction

Different parts of plants carryout different functions to enable plants survive in their environment. Plants obtain water and mineral salts from the soil through their roots and use sunlight to manufacture their food in the leaves. The manufactured food can be stored in fruits and seeds that are formed from flowers.

Flowering plants are made up of a ***root system*** and a ***shoot system***. The ***root system*** absorbs water and mineral nutrients from the soil. The ***shoot system*** is composed of the stem, leaves, and flowers. The leaves specialize in making food while flowers are specialized in sexual reproduction. Both the root system and shoot system work together to enable flowering plants to survive mainly on land. The two systems are connected by vascular tissue (vessels) that run from the root through the shoot.

**Parts of a Flowering Plant**

*Have you ever noticed any differences between plants?*
*Do **Activities 5.1** and **5.2** given below and find out how much you really know about the flowering plant.*

**Activity 5.1: Identifying and comparing parts of a flowering plant**

In this activity, you will explore the monocotyledonous and dicotyledonous plants and appreciate that the two plants have similar structures of different forms.

**What you need**

i) a dicotyledonous plant e.g. a bean plant
ii) a monocotyledonous plant e.g. maize plant
iii) notebook
**iv)** pen/pencil

**What to do**

1. In your groups observe the plants provided carefully; draw and label the parts of the plant.

2. Compare the features of the plants and complete the table below using the structural features.

| Features | Dicotyledonous plant | Monocotyledonous plant |
|---|---|---|
| 1. Type of root system | | |
| 2. Leaf venation | | |
| 3. Leaf shape | | |
| 4. Leaf attachment to stem | | |
| 5. Flower appearance | | |

**Activity 5.2: Identifying plant parts that are used as food by human beings**

In this activity, you will explore parts of plants that are used as food in your community.

**What you need**

i) cabbage, water melon, bamboo shoot, sugar cane, irish potato, pumpkin, carrot, spinach, onion, lettuce, tomato, groundnuts, cassava, sweet potato, maize, yam, garlic
ii) notebook
**iii)** pen/pencil

**What to do**

i) Choose a partner to work with.
ii) Study each plant part provided carefully.
iii) For each of the plant parts used as food in your community, state whether they are fruits, leaves, stems or roots.
iv) Fill the information in the table below.

| Plant part | Food |
|---|---|
| Fruit | |
| Leaf | |
| Stem | |
| Root | |

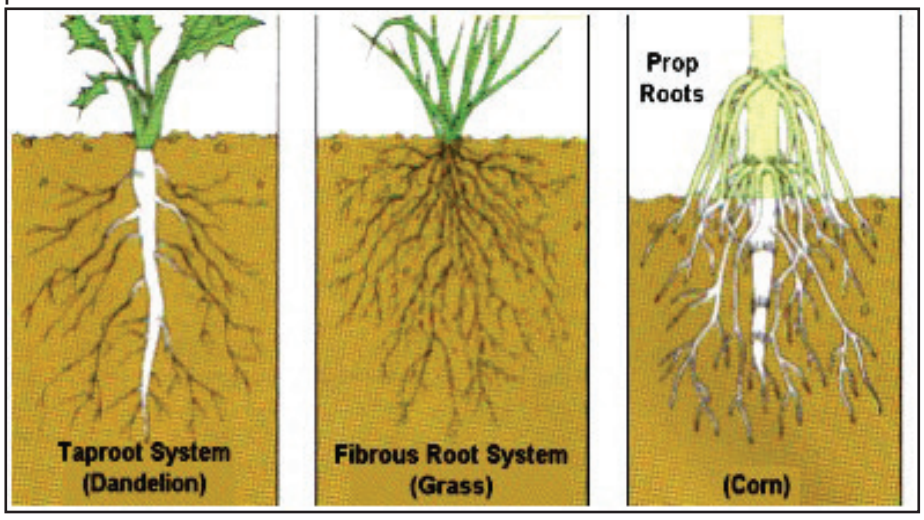
**Roots**

The roots are very important to a flowering plant. The general root structure comprises the main roots, root hairs and root cap. The key function of all roots is to anchor the plant as well as to absorb mineral nutrients and water from the soil. Roots form a pathway for water and dissolved substances from the soil into the stem.

**Types of Root Systems**

1. *Fibrous roots.* Observe the root system of grass. You will notice that there are many slender roots of about the same size that spread out in all directions from a common point at the base of a stem. Such root system is called fibrous.
2. *Taproot*. Observe the root system of a bean plant. You will notice that the plant has a main root originating from the base of the stem. Such a root is called the tap root. Smaller roots branch sideways from the main root. These are called lateral roots. Taproots grow straight down, some as deep as 15 feet. Taproots develop from the initial root that emerges from the part of a seed called the radicle.
3. *Adventitious roots.* Some plants have roots that originate above ground from stems or leaves but not roots and are called adventitious roots. They include the *prop roots* of corn/maize and certain other

plants.




**Modified roots**

Do you remember the key functions of the root?

Apart from their key functions, some roots are adapted to other functions. Roots with adaptation are referred to as modified roots. Some roots are modified for support, food storage and breathing.

**Activity 5.3: Finding out about modified roots**

In this activity, you will observe modified roots and how they are adapted for other specific functions.

**What you need**

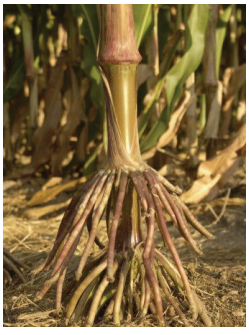
Pictures of root tubers, prop roots, buttress roots, clasping roots and roots of mangrove tree.

**1. Root tubers**

cassava carrot sweet potato



2. prop roots butress roots clasping roots



3. roots of mangrove tree

**What to do**

In groups of 3 to 4, observe carefully the pictures 1, 2 and 3 provided. Discuss what makes the pictures of the roots different from the "normal" roots. Identify the possible uses of the roots in pictures 1, 2

and 3. Write down your discussion and present it to the rest of the class.

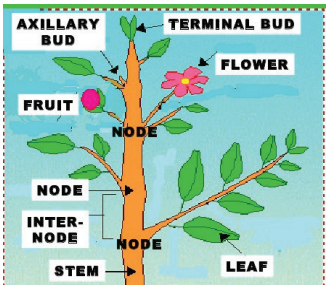
**Stems**

The stem makes up the largest part of some kinds of plants. For example, the trunk, branches, and twigs of trees are all stems. Other plants, such as cabbage and lettuce, have such short stems and large leaves that they appear to have no stems at all. The stems of plants, like potatoes, grow partly underground. Stems above the ground are either hard and woody or soft as herbs.

**Parts of the Stem**

The stem is the main part of the shoot and comprises:

1. Branch: a side stem that develops from an axillary bud.
2. Node: the point of origin of a branch/leaf/ flower on a stem.
3. Internode: the section of stem between two successive nodes.
4. Axillary bud: Found at the node. It develops into a branch/leaf/ flower.
5. Terminal bud: located at the tip of the stem or branch. It increases the length of the stem forming new leaves and axillary buds.




**Functions of the Stem**

1. Conduct water and mineral salts from the roots to the leaves.
2. Carry food from the leaves to other parts of the plant.
3. Help in formation of buds, leaves and flowers.
4. Support leaves in good light conditions to maximise photosynthesis.
5. Support flower in position for pollination.
6. Hold fruits in better position for dispersal.

The vessel that carries water and minerals through the stem is called the ***xylem***. The vessel that carries manufactured food through the stem is called the ***phloem***.

**Modified Stems**

Some stems are adapted to carrying out other functions. These stems are called modified stems.

Stems can be modified:

1. To protect the plant from animals that eat it
2. To store food and water
3. For vegetative reproduction
4. To give support to the plant

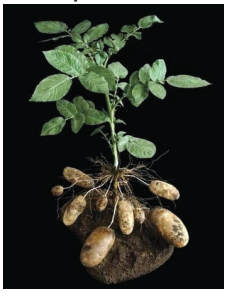
Vegetative reproduction is a form of reproduction that involves formation of new young plants from other parts of the parent plant except the flowers.

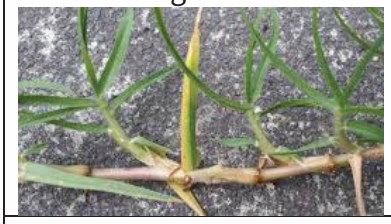
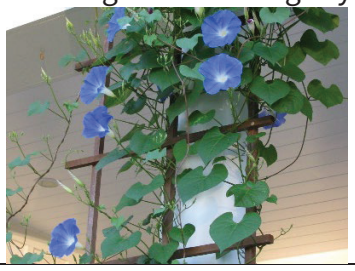
**Activity 5.4: Finding out about modified stems**

In this activity, you will observe pictures of modified stems. You may be familiar with some of the plants from which they were obtained.

**What you need**

Pictures of:

| | | |
|---|---|---|
| 1. sugarcane stem  | irish potato stem tuber  | ginger rhizome  |

| | |
|---|---|
| couch grass rhizome  | cassava stem cutting  |
| banana sucker  | strawberry runner(stolon)  |
| Bean plant  | Morning glory  |
| Kei apple  | |

**What to do**

In groups of 3 to 4, observe carefully the picture groups 1, 2, 3and 4 provided. Discuss what makes the pictures of the stems different from the "normal" stems studied earlier in this chapter. Identify the possible uses of the stems in picture groups 1, 2, 3 and 4. Write down your discussion and present it to the rest of the class.

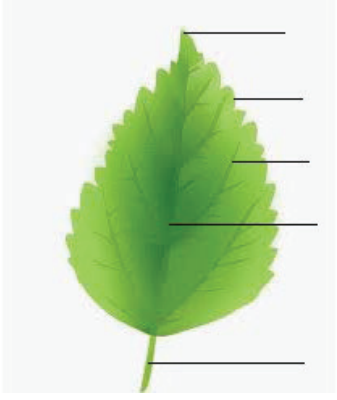
## Leaves

Leaves are the main sites for photosynthesis. You may have learnt that photosynthesis is the process by which plants make food. Most leaves are usually green, due to the presence of chlorophyll. However, some leaves may have different colours, caused by other plant pigments. Leaves are also sites for gaseous exchange and transpiration which take place mainly through the stomata.

## Structure of a Leaf

Do you recall the parts that make up a typical leaf?

Using the knowledge you have on parts of a leaf attempt to name the parts on the figure below.



A typical leaf consists of a lamina (the broad part of the leaf, also called the leaf blade) and a leaf stalk/petiole (the stalk attaches the leaf to a stem).

| monocotyledonous plant leaf (grass) | dicotyledonous plant leaf (bean) |
|---|---|
|  |  |

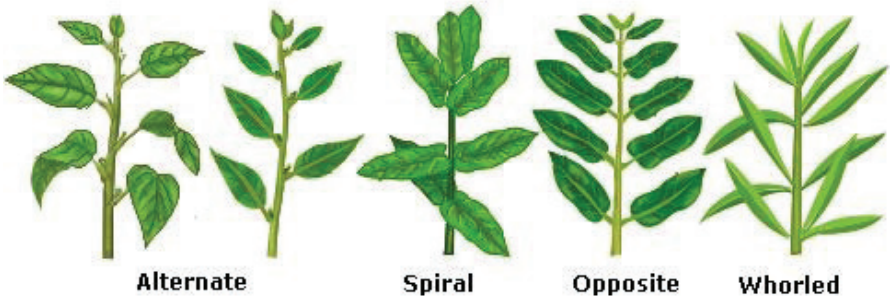
A leaf also has a midrib, which stretches the length of the leaf and branches to each side forming veins of vascular tissue. The edge of the leaf is called the margin while the tip is called the apex.

When you critically observe the veins of a given leaf, they form a pattern. This pattern or arrangement of veins in a leaf is called **venation. In** monocotyledonous plant leaves, the veins run in straight lines across the length of the leaf without converging at a point, hence they have parallel venation. In dicotyledonous plants, the veins of the leaf have a network-like appearance, forming a pattern known as reticulate venation.

## Leaf Arrangement

When you observe leaves on different plants you will notice that they are arranged differently on the stems. Leaf arrangements are classified as either alternate, spiral, opposite or whorled.

a) **Alternate** - the leaves alternate on each side of the stem.
b) **Spiral** - the leaves are arranged in a spiral pattern along the stem.
c) **Opposite** - two leaves arise at the same point, with the leaves connecting opposite each other along the branch.
d) **Whorled** - three or more leaves connected at a node.



## Leaf Form

When you closely observe a number of leaves, you will discover that their leaf blades/laminae are not the same. Depending on the leaf

Banana leaf (entire)

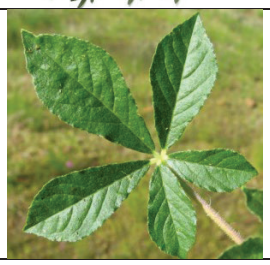
Cassava leaf (lobed)

blade, leaves may be simple or compound. In a **simple leaf**, the leaf blade is either completely undivided as in the banana leaf or it has lobes, but the separation does not reach the midrib, e.g. cassava leaf.

In a **compound leaf**, the leaf blade is completely divided, forming leaflets. Each leaflet may have its own stalk, but is attached to the midrib. **Compound trifoliate** leaves have only three leaflets. **Compound pinnate** leaves have leaflets arranged in pairs, opposite one another or alternately along the midrib of a leaf. **Compound bipinnate** are leaves with two orders of leaflets each of which is divided further. **Compound digitate** leaves have leaflets radiating out from the end of the leaf stalk like fingers of the palm.

**Compound leaves**

| Leaf form | Image |
|---|---|
| Compound trifoliate e.g. bean, strawberry, *Desmodium* |  |

| Leaf form | Image |
|---|---|
| Compound pinnate e.g. cassia |  |
| Compound bipinnate e.g. acacia |  |
| Compound digitate/palmate e.g. African spider herb |  |

**Activity 5.5: Classifying leaves**

In this activity, you will observe different forms of leaves and classify them.

**What you need:**

1. Collect small branches with leaves attached. (black jack, hibiscus, mango, cassia/indigofera, cassava, pumpkin, wild millet, *lantana camara*, jacaranda/flambouyant, pawpaw/morning glory/sweet potato or yam)

2. Group/sort the collected leaves according to:
   i) arrangement of leaves on the stem (opposite, alternate, whorl, and spiral)
   ii) leaf types (simple & compound) depending on whether the lamina is divided into leaflets or not.
   iii) external structural characteristics – leaf petiole/leaf sheath, texture of leaf lamina (hairy or non-hairy), leaf

apex (round or pointed), leaf margin (serrated of entire), leaf base (swollen or not swollen), type of venation (parallel or network).

**Fill in the table below.**

**Table of Characteristics for Five Leaves**

| Structural characteristics | SPECIMENS | | | | |
|---|---|---|---|---|---|
| | A Black jack | B Cassia | C Cassava | D Wild millet | E Hibiscus |
| 1. Leaflets/leaf lobes or not | | | | | |
| 2. If leaflets are present, state the number | | | | | |
| 3. Texture of lamina (hairy or non-hairy) | | | | | |
| 4. Type of venation (parallel or network) | | | | | |
| 5. Leaf margin (entire or serrated) | | | | | |
| 6. Leaf sheath or petiole | | | | | |

3. Construct a flow chart for the leaves using the characteristics in table.
4. Observe and identify external parts of leaves A and E, draw and label.

**Modified Leaves**

Some leaves are adapted to carry out other functions. These leaves are called modified leaves.

**Functions of modified leaves**

1. Storage of food and water
2. Vegetative reproduction
3. Support

4. Protection
5. Capture and digest insects

## Activity 5.6: Finding out about modified leaves

In this activity, you will observe pictures of modified leaves and how they are adapted for a specific function.

**What you need:**
Pictures of:

1. Leaf tendrils

watermelon

passion friut

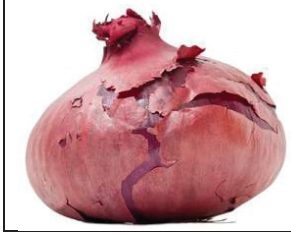
2.

venus flytrap

pitcher plant

3.

onion scale leaves



cactus spines

4.

*bryophyllum*

aloe vera

sisal

onion

5. swollen leaves

notebook, pen/pencil

**What to do**

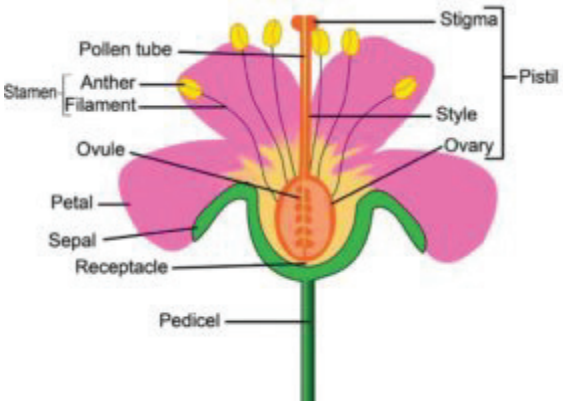
In groups of 3 to 4, observe carefully the picture groups 1, 2, 3, 4 and 5 provided. Discuss what makes the pictures of the leaves different from the "normal" leaves. Identify the possible uses of the leaves in picture groups 1, 2, 3, 4 and 5. Write down your discussion and present it to the rest of the class.

**Flowers**

Plants can be classified on the basis of presence or absence of flower into flowering and non- flowering plants.

**A flower** is a part of a flowering plant that is meant for reproduction. Flowers are attractive and appear in different colours and shapes.

**Parts of a Flower**




Most flowers have four main parts: sepals, petals, stamens, and carpels. The stamens are the male part whereas the carpels are the female part of the flower.

**Functions of the Main Parts**

1. **Sepals:** These are the small, leaf-like parts growing at the base of the petals. Collectively, sepals are known as the ***calyx***. The main function of the calyx and its sepals is to protect the flower during the bud stage.

2. **Petals:** They are often bright in colour as their main function is to attract pollinators such as insects, butterflies etc. to the flower. The petals are collectively known as the ***corolla***.

3. **Stamens:** These are the male parts of a flower. They are structurally divided into two parts:

    i) **Filament:** the part that is long and slender and attaches the anther to the flower.

    ii) **Anthers:** It is the head of the stamen and is responsible for producing the pollen which is transferred to the pistil or female parts of the same or another flower to bring about fertilization.

4. **Pistil:** This forms the female parts of a flower. Pistil consists of four parts:

   i) **Style** -is a long slender stalk that holds the stigma. The style directs pollen from the stigma to the ovaries.

   ii) **Stigma**– This is found at the tip of the style. It forms the head of the pistil. The stigma contains a sticky substance whose job is to trap pollen grains.

   iii) **Ovary** – The ovary holds the ovules.

   iv) **Ovules**– These are the egg cells of a flower. They fuse with pollen during the process of fertilization. The fertilized product forms the fruit and the ovules become the seeds of the fruit.

## Fruits

What goes through your mind when you see or think about a fruit? Most likely it is a thought of something juicy and sweet. The common fruits you may know include: mangoes, oranges, bananas and pineapples. However there are different kinds of fruits. *Are all fruits juicy, sweet and edible? Can you think of other kinds of fruits?*

In biology, a **fruit** is the part of a plant that develops from the flower. The fruit contains the seeds of the plant. The outer parts of the fruit cover and protect the seeds. When fruits are mature and ripe, the seeds they contain can be carried away and if they land in places with suitable conditions they develop into new plants.

### Activity of integration

One day, a group of children were taking a walk in their village. The children met a farmer at his garden, in one part of the garden, the farmer was growing *Amaranthus* (locally known as doodo/obuga) and kale/collard greens (locally known as Sukuma). The children noticed flowers on the plants and the farmer encouraged them to break the flowers off the plants. In the other part of the garden the farmer was

growing orange trees which also had flowers. The children wanted to break off the flowers from the orange trees but the farmer stopped them from doing this. The children were confused.

*Amaranthus* (Doodo/Obuga)

Kale/collard greens (Sukuma)

Orange tree

Your task is to write an explanation to help the children understand why the farmer allowed them to break flowers off some plants and not others.

## Chapter Summary

- The key parts of flowering plants are roots, stems, leaves, flowers and fruits.
- Roots, stems, leaves, flowers and fruits are essential for carrying out life processes.
- Some roots, stems, leaves and fruits are adapted to carry out special functions.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