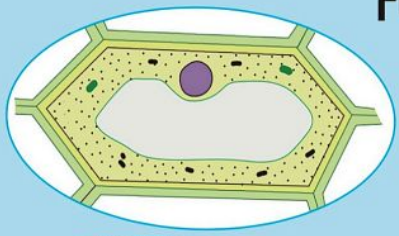
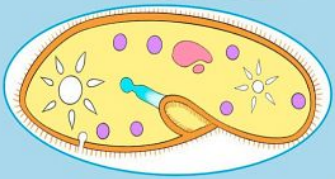
Biology

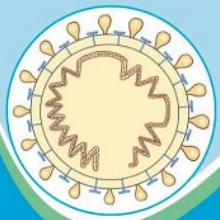
for Secondary Schools

Student's Book

Form One







Tanzania Institute of Education

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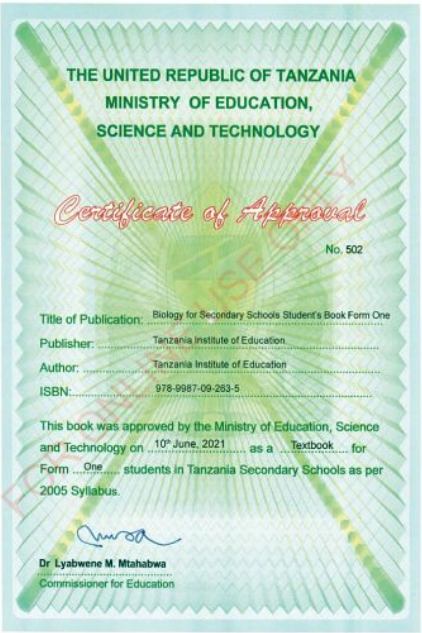

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Dr Lyabwene M. Mtahabwa
Commissioner for Education

Tanzania Institute of Education

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Tanzania Institute of Education
P.O. Box 35094
Dar es Salaam -Tanzania

Mobile numbers: +255 735 041 168 / 735 041 170
Email: director.general@tie.go.tz
Website: www.tie.go.tz

Table of Contents

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Editors:	Dr Bruno A. Nyundo & Dr Godfrey Kimaro (UDSM), Dr Cyrus Rumisha, Dr Alex Nehemia & Dr Godgift Swai (SUA), Dr Neema Mogha & Dr. Lilian G. Mulamula (DUCE), Dr Kessy A. Ngarawa (Morogoro-RRH) & Dr Enock J. Mbalamula (MUHAS)
Designer:	Ms Rehema H. Maganga (TIE)
Photographer:	Mr Chrisant Ignas (TIE)
Illustrator:	Alama Art and Media Production Co. Ltd
Coordinator:	Ms Mwanahamisi A. Jokolo (TIE)

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Dr Aneth A. Komba
Director General
Tanzania Institute of Education

Preface

This textbook, *Biology for Secondary Schools,* is written specifically for Form One students in the United Republic of Tanzania. The book is prepared according to the 2005 Biology Syllabus for Secondary Schools, Form I-IV issued by the then Ministry of Education and Vocational Training.

The book is divided into eleven chapters, which are: Introduction to Biology, Biology laboratory, Scientific processes in Biology, First Aid and safety in our environment, Waste disposal, and Personal hygiene and good manners. Other chapters are: Health, immunity and diseases, STIs, STDs, HIV and AIDS, Cell structure and organization, Classification of living things, and Viruses, kingdom Monera, and kingdom Protoctista.

In addition to the contents, each chapter comprises of illustrations, activities, exercises, and revision exercises. You are encouraged to do all activities and attempt all the questions. This will enhance your understanding and development of the intended competencies for this level.

Tanzania Institute of Education

Chapter One

Introduction to Biology

Introduction

There are various forms of life on earth ranging from the microscopic to macroscopic living things. In this chapter, you will learn about the basic concepts and terminologies of Biology, characteristics of living things, importance of studying Biology, and the relationship between Biology and other scientific fields. The competencies developed from this chapter will enable you to differentiate living from non-living things and relate Biology to other fields of study.

Basic concepts and terminologies of Biology

The term 'Biology' comes from two Greek words, **bios** that means 'life' and **logos** that means 'study'. Therefore, Biology is a branch of science that deals with the study of life. A person who studies Biology is called a **Biologist**.

Living things are also called **organisms**. They include, plants, animals, fungi, and **microorganisms**. Microorganisms are very small living things such as bacteria and some protozoans which cannot be seen by naked eyes. The size of organisms varies and ranges from very small ones like bacteria to very large ones like trees, birds, hippopotamus, and whales as shown in Figure 1.1.

(a) (b)

(c) (d)

Figure 1.1: Living things (a) tree (b) bird (c) hippopotamus (d) whale

Life

Life is the state of living in which plants, animals, and other living organisms have and non-living things do not have. The basic unit of life is **cell**. All living things are made up of cells. Cells are so small that they cannot be seen by naked eyes but can be seen by using a **microscope**. Microscope is an instrument that is used in scientific studies to enlarge very small things so that they can be easily seen and examined. This process is called **magnification**.

The simplest living things consist of one cell thus are known as **unicellular** organisms, for instance bacteria and amoeba. Larger and more complex organisms, for example human beings, fish, and trees are made up of millions of cells. They are known as **multicellular** organisms.

Branches of Biology

There are two main branches of Biology, namely **Botany** and **Zoology**. Botany is the study of plants and zoology

is the study of animals. A person who is specialised in the study of plants is called a **Botanist,** whereas a person who deals with the study of animals is called a **Zoologist**. However, there are many minor branches of Biology that deal with different aspects of living things. Examples are given in Table 1.1.

Table 1.1: Other branches of Biology

	Branch	Area of study
1	Anatomy	Physical structures of organisms
2	Cytology	Structure and functions of cells
3	Ecology	Relationship between organisms and their environment
4	Entomology	Insects
5	Genetics	Heredity and variation
6	Immunology	Immune systems
7	Microbiology	Microorganisms
8	Mycology	Fungi
9	Parasitology	Parasites
10	Taxonomy	Classification of organisms
11	Physiology	Physical and chemical processes taking place within living organisms

Characteristics of living things

Living things have characteristics that make them different from non-living things.

Activity 1.1: Identifying the characteristics of living things

Materials: Variety of living and non-living things

Procedure

1. Walk around the field or the school compound. Observe all the living and non-living things that you see.
2. Make a list of the observed things in your notebook.
3. Divide the things that you have observed into two groups; living and non-living.

4. In your groups, discuss the things that you have observed by answering the following questions.
   (a) Which ones are living? Why?
   (b) Which ones are non-living? Why?
5. Compare your findings with those from other groups.

Living things have seven characteristics which distinguish them from non-living things. These characteristics include:

Nutrition

Nutrition is the process by which living things feed on materials from the environment. Plants, blue-green algae, and some protoctists make their own food using sunlight, water, and carbon dioxide as shown in Figure 1.2.

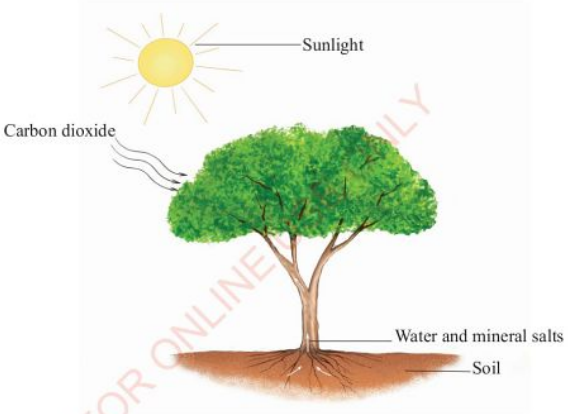


Figure 1.2: Plant

Animals and some protozoans feed on ready-made food. They may feed on plants, other animals, or microorganisms. Example of an animal that feeds on other animals is lion as shown in Figure 1.3. Food enables living things to grow, develop, and carry out other life processes.

Figure 1.3: Lion eating meat

Respiration

The food eaten by organisms contains energy. However, this energy is not in a directly usable form. The food has to be broken down within living cells in order to release the energy. This process is called respiration. In this process, food substances are broken down in the living cells to produce useful energy. The energy released can be used for growth, movement, and other activities.

Excretion

Processes such as nutrition and respiration are known as metabolism. They produce useful substances and by-products. Some of the by-products are harmful if left to accumulate in the body of an organism. Excretion is the process by which metabolic by-products are removed from the body of an organism. The by-products are also called **excretory products**. Examples of excretory products are urea, excess water, and carbon dioxide.

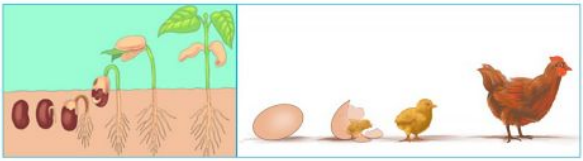
Urea and excess water are removed in the form of urine and small amounts are removed as sweat through the skin. Water vapour and carbon dioxide are removed during exhalation or breathing out.

Growth and development

Growth is caused by an increase in the number of cells that make up an organism. Therefore, growth is an increase in the size and weight of an organism.

Development occurs when cells become specialized to perform specific functions.

This causes an organism to change in shape and form, and becomes more complex. An example of growth and development in plants and animals is shown in Figure 1.4.



(a) (b)

Figure 1.4: Growth and development (a) bean seed to a plant and (b) an egg to a chicken

Sensitivity or irritability

Living things detect and respond to changes in their environment. The ability of an organism to detect and respond to changes in its environment is called **sensitivity** or **irritability**. The changes that organisms detect and respond to are called **stimuli** (singular: stimulus). For example, human beings can feel and react to heat, cold and pain. A snail hides its body inside its shell when touched. Heat, touch, and pain are examples of stimuli.

Plants also respond to stimuli. However, the responses may not be very fast or visible. *Mimosa pudica* is an example of a plant that clearly shows sensitivity. The leaves of *Mimosa pudica* folds when touched as shown in Figure 1.5.

(a) (b)

Figure 1.5: Sensitivity in the *Mimosa pudica* plant (a) before touching (b) after touching

Movement

All organisms can move on their own in response to their environment. Non-living things only move when pushed or pulled by someone or something. Some living things move from place to place in search for food, water, shelter, mates, or suitable environment. Movement involving the whole body of an organism is called locomotion. For example, animals can walk, run or crawl. Figure 1.6 shows an animal running.

Figure 1.6: Cheetah running

Plants show movement in terms of growth of their body parts, for instance movement of plant roots towards water and shoots towards light.

Reproduction

Living things produce new individuals of their own kind. For example, human beings give birth to human beings, maize seeds grow into maize plants, and chicks hatch from eggs of chicken as shown in Figure 1.7. Reproduction ensures the continuity of organisms. Non-living things do not reproduce.

Figure 1.7: Chick hatching from an egg

Exercise 1.1

1. Explain the term Biology.
2. Distinguish the following terms:
   (a) Nutrition and respiration
   (b) Botany and Zoology
   (c) Growth and development
3. Biology is more than a study of animals and plants. Explain.

The importance of studying Biology

The knowledge obtained from studying Biology is important for many reasons including:

(a) Helps to understand and care for the environment properly. It helps to learn about the plants, animals, and microorganisms that surround us and how they affect us.

(b) Helps to identify and group living things which makes it easier to learn more about them.

(c) Helps to appreciate the nature. Many fascinating things about different organisms and how they function are learnt through Biology.

(d) Helps to understand our bodies better.

(e) Helps to acquire research skills that are useful when carrying out scientific investigations. Such skills include measuring, observing, analysing, and making conclusion.

(f) Helps to improve food production. Scientists can use biological skills to develop higher-yielding and disease-resistant varieties of plants and animals. These new breeds of plants and animals are called hybrids. Figure 1.8 shows the indigenous and improved breeds of chicken.

(a) (b)

Figure 1.8: Chicken (a) indigenous breed (b) improved breeds

(g) Helps to improve the standard of living and care for animals and plants. Using skills from Biology you can determine causes, symptoms, and methods of transmission of infections and diseases.

(h) Helps to answer fundamental questions such as when and where did life originate? How do plants move? Without plants, will animals survive?

(i) Enables scientists to come up with ways to prevent, treat, and cure diseases. This has greatly improved the quality of people's lives. For instance, the first cure discovered for malaria was quinine. It was extracted from the bark of the Cinchona tree (or quinine tree). Quinine has prevented a number of deaths from malaria, especially in Africa.

(j) Lays foundation for specialising in careers such as teaching, nursing, medical, horticulture, and environmental science.

(k) Encourages international cooperation through biological research. For instance, biologists from all over the world cooperate to find cure for diseases such as COVID-19, AIDS, and Ebola.

The relationship between Biology and other scientific fields

Biology is not an isolated field of study.

Activity 1.2: Investigating the relationship between Biology and other scientific fields

Materials: Newspapers and magazines with articles on Biology, Agriculture, Medicine, Forestry, and other scientific fields

Procedure

1. You are provided with newspapers and magazines with articles on Biology, Agriculture, Medicine, Forestry, Nutrition, and other scientific fields.
2. Go through the articles and state which other fields of study, apart from Biology, are mentioned.
3. Look through any other magazines and journals. Do you see any biological references?
4. In groups, discuss the fields that you think are related to Biology. Give examples to illustrate these relationships.

Biology is related to many other fields of study such as Agriculture, Medicine, Pharmacy, Veterinary Medicine, and Nutrition. These areas involve research on living things. Biological findings have a direct impact on the development of these fields.

Agriculture

Agriculture is the practice of growing crops and rearing animals for food, money, or both. Biological research findings on crops and livestock have led to improved agricultural production. Scientists have developed breeds of crops and animals that mature quickly and produce high yields. For instance, indigenous breeds of chicken start to lay eggs when they are about eight months old compared to the improved breeds known as **layers** which can start to lay eggs as early as five months. An example of an improved layer breed is shown in Figure 1.9.

Figure 1.9: Improved layer breed

Researchers have also developed breeds of crops and animals that perform well under specific climatic conditions. For example, researchers have been able to develop varieties of maize seeds that are resistant to diseases and grow well even in harsh conditions.

Medicine and Pharmacy

Medicine is the study of the prevention, treatment, and cure of diseases. Pharmacy is the science of preparation and administration of drugs. Anatomy and Immunology form an important part of the study of medicine.

The study of Anatomy helps doctors to learn the structure of the body and how it functions. This makes it possible for them to know what is wrong in the body and how it can be treated.

In Immunology, scientists study the body's response to disease-causing agents. This knowledge is important in the formulation of vaccines and drugs that are able to fight and cure diseases, respectively. Some of these drugs and vaccines are made from animals, plants, fungi, or microorganisms.

Nutrition

The study of Biology is important in understanding the composition and value of different groups of foods. This knowledge is used by Dieticians to determine the kind of diets that are suitable for people with different health needs.

Biologists have also developed breeds of livestock and crops that yield products of higher nutritional value. Examples include varieties of sweet potatoes that are rich in vitamin A and a breed of Jersey cattle as shown in Figure 1.10, which produce milk with low butter content. Such breeds are known as improved breeds.

Figure 1.10: Jersey cow

Forestry

Forests are sources of fuel (firewood and charcoal), building materials, and medicinal plants. They also serve as water catchments. Biologists have developed varieties of trees that grow well in dry areas. Such trees are used to reclaim dry land for human settlement. This is called afforestation. Through Biological research, varieties of fast growing trees have been developed. The fast-growing trees are planted to replace deforested areas. This is called reforestation. Reforestation helps to preserve water catchments to ensure a continuous supply of water. Forests also prevent desertification. Figure 1.11 shows (a) deforestation due to excessive cutting of trees and (b) afforestation.

(a) Deforestation due to excessive cutting of trees (b) Afforestation

Figure 1.11: Deforestation and afforestation

Chapter summary

1. Biology is the study of life. People who study Biology are called Biologists.
2. The two main branches of Biology are Botany and Zoology.
3. Living things include plants, animals, fungi, and microorganisms.
4. The basic functional unit of life is the cell.
5. The seven characteristics of living things are nutrition, respiration, excretion, growth and development, sensitivity or irritability, movement, and reproduction.
6. The study of Biology is important because:
   (a) It helps us to gain knowledge about our environment and how to improve it.
   (b) It is a foundation for specialising in careers such as nursing, medical, and teaching.
   (c) It helps us to acquire research skills such as measuring, observing, analysis, and making conclusions.
   (d) It enables researchers to come up with improved breeds of crops and animals.
   (e) It enables scientists to come up with ways of preventing and treating diseases.
   (f) It encourages international cooperation.
7. Biology is related to other fields such as Agriculture, Medicine, Pharmacy, Veterinary Science, Nutrition, and Forestry.

Revision exercise 1

Choose the correct answer.

1. Which of the following is NOT a field of study related to Biology?
   (a) Agriculture
   (b) Astrology
   (c) Medicine
   (d) Nutrition

2. Which of the following is the reason for studying Biology?
   (a) Biology helps us to appreciate and improve the nature.
   (b) Biology deals with non-living objects in our environment.
   (c) Biology enables us to pollute the environment.
   (d) Biological research contributes to the development of low-yielding breeds of crops.

3. Which of the following is NOT a contribution of Biology in the field of Forestry?
   (a) Fast maturing plants.
   (b) Increased desertification.
   (c) Varieties of trees that grow well in arid areas.
   (d) Solutions to plant diseases and pests.

4. Which of the following is a branch of Biology?
   (a) Sociology
   (b) Agriculture
   (c) Anthropology
   (d) Botany

5. Group the following into living and non-living things.

(a) Human being	(b) Louse
(c) Rat	(d) Baobab tree
(e) Tortoise	(f) Ruler
(g) Car	(h) Computer
(i) Radio	(j) Bacteria

6. Outline four reasons why it is important to study Biology.

7. Using examples, explain how the following fields are related to Biology.
   (a) Medicine
   (b) Agriculture
   (c) Forestry
   (d) Nutrition

8. Write seven processes that take place in the bodies of living things.

9. Differentiate the following:
   (a) Unicellular and multicellular organisms
   (b) Cytology and taxonomy

10. Excretion is the process of removing metabolic by-products from the body of an organism. Give three (3) examples of excretory products eliminated by the living things.

Chapter Two

Biology laboratory

Introduction

A laboratory is a room or building where scientific experiments or demonstrations are carried out. A Biology laboratory is specifically designed for carrying out biological experiments. In this chapter, you will learn about laboratory rules, the differences between Biology laboratory and other school facilities, common laboratory apparatus and safety symbols. The competencies developed from this chapter will enable you to carry out biological experiments properly and take precautions when conducting experiments.

Concept of the Biology laboratory

Biology laboratory is a room or building specifically designed for carrying out biological experiments. A **laboratory** should have good qualities which include adequate space for carrying out experiments, proper lighting, good ventilation, a source of water, a source of heating, and adequate space for storing apparatus, chemicals, models, and specimens as shown in Figure 2.1. The Biology laboratory should also have a fume chamber and a preparation room.

Adequate space

Adequate space is important to allow students to carry out experiments effectively. It also facilitates free movement in the laboratory, hence reducing chances of accidents.

Proper lighting

Proper lighting helps students to see instructions, warning signs, safety symbols, labels on reagent bottles, and procedures for carrying out experiments. Laboratory lighting should provide enough light without causing harmful reflected rays, which can be distracting. Improper lighting may also cause errors in experiments.

Figure 2.1: Laboratory

Good ventilation

Good ventilation is an important aspect to ensure safety in the laboratory. It helps in the circulation of air and removal of fumes and gases to prevent suffocation. Hence, this protects laboratory users from exposure to toxic substances.

A source of water

Water is used as a solvent, for boiling, washing, and cleaning of laboratory apparatus and specimens. Laboratory water should be pure and clean to avoid contamination that may compromise test results and affect laboratory users.

Source of heating

A reliable source of heating is needed to ensure successful experiments. For example, heating water, and reagents.

Adequate storage room

This is used for keeping apparatus, chemicals, biological models, and specimens.

Laboratory rules

As you learn Biology, you will perform experiments that require the use of chemicals, fragile equipment, and hazardous specimens. It is therefore important for you to observe proper laboratory rules. This will ensure your safety, safety of others, and safety of equipment in the laboratory. The following rules should be observed:

(a) Do not enter the laboratory in the absence of a teacher or laboratory technician.

(b) Do not handle or use apparatus, chemical or specimens in the absence of a teacher or laboratory technician.

(c) Do not taste any substance in the laboratory.
(d) Know the location of all exits.
(e) Do not leave experiments unattended.
(f) Turn off gas and water taps when not in use.
(g) Do not point burners or hot substances towards other people in the laboratory.
(h) Do not take laboratory equipment, chemicals, or specimens out of the laboratory.
(i) Do not eat, drink, or smoke in the laboratory.
(j) Do not play or run in the laboratory.
(k) Do not smell gases directly. Smell gases by waving them towards your nose and sniffing gently.
(l) Read the labels on containers before using the contents. Do not exchange labels.
(m) Dispose all waste materials after every experiment. Do not return unused materials to their original containers.
(n) Dispose solid waste in the dustbin and liquid waste in the sink.
(o) After each experiment, clean all the equipment you have used.
(p) Avoid touching yourself while performing experiments. Clean your hands with soap and water after every experiment.
(q) Do not touch electrical equipment with wet hands.
(r) If you do not understand something, ask your teacher or technician before proceeding.
(s) Be aware of the locations and operation procedures of all safety equipment such as First Aid kits and fire extinguishers.
(t) Dress properly for laboratory activities. Tie back long hair. Do not wear dangling jewellery, very loose clothing, or sandals. Shoes must cover the feet completely.
(u) Report all accidents immediately to your teacher or to the laboratory technician.
(v) Never use dirty, chipped, or cracked equipment.
(w) Handle live specimens carefully. In case of animal bites or insect stings, report the incident to your teacher or to the laboratory technician.
(x) Do not use unlabelled chemicals.

Distinguishing Biology laboratory from other school facilities

The Biology laboratory is different from other school facilities such as classrooms, library, as well as Physics and Chemistry laboratories as shown in Figure 2.2.

(a) (b)

Figure 2.2: Other school facilities (a) classroom (b) library

Some of the objects found in the Biology laboratory are biological charts, models, specimens, cages, and aquaria.

Activity 2.1: Comparing Biology laboratory with other school facilities

Materials: Notebook or exercise book, pen or pencil, and ruler

Procedure

1. Visit the school library, storage room, Physics laboratory, and Chemistry laboratory.
2. Record what you have observed in all the facilities you have visited.
3. Visit the school Biology laboratory and record what you have observed.

Questions

1. What are the differences between the Biology laboratory and other school facilities you have visited?
2. What are the similarities between the Biology laboratory and the other school facilities?

Biological charts

These are presentations of complex biological systems into simple pictures or diagrams. The chart can include a single sheet representing a particular system or several sheets that represent a variety of systems. They are used during learning and teaching of biological concepts. Charts are useful in reinforcement of biological concepts. Figure 2.3 shows a chart of the human skeleton.

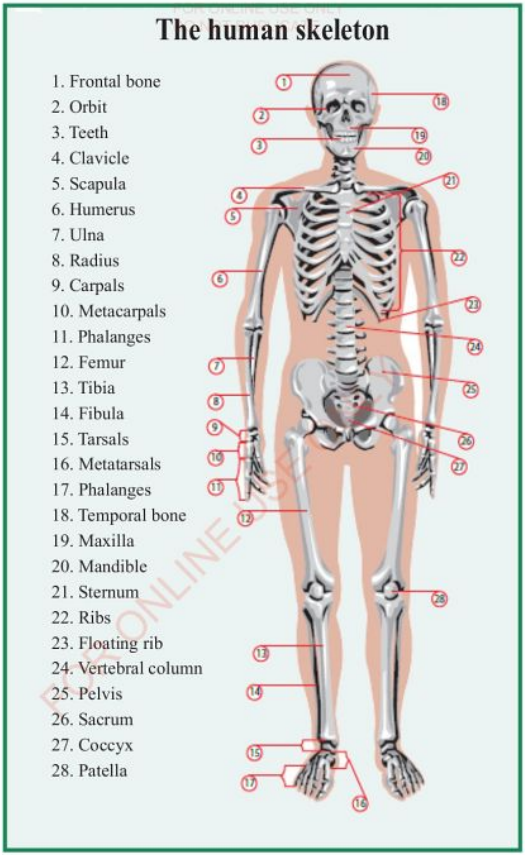


Figure 2.3: Chart showing parts of the human skeleton

Biological models

These are sculptures that represent a particular organ or system of a real organism. They are usually made in three dimensions, hence representing the real part of an organism. Models are also used during teaching and learning process to reinforce concepts. Examples of models that are commonly used in teaching and learning Biology, include models of the human eye, lungs, heart, ear, and skeleton. Most of the models used in Biology are made up of plastic materials. Examples of biological models are shown in Figures 2.4 and 2.5.

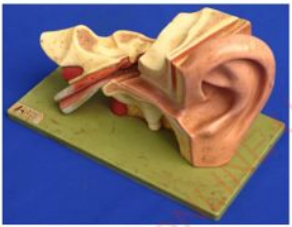


Figure 2.4: Model of the human ear

A model of the human skeleton is the sculptural representation of the framework of bones that support the body of a human being as shown in Figure 2.5. Often, it is made up of plastic materials. The model is usually used to reinforce learning and teaching of the human skeletal system. It is important as it enhances teaching and learning of abstract concepts.

Figure 2.5: Model of the human skeleton

Preserved specimens

These are collected organisms or parts of organisms that are preserved for learning purposes. Organisms that are usually preserved include leaves, roots, fruits, insects, and other small animals such as worms, rats, fish, and amphibians. Figure 2.6 shows examples of preserved specimens.

Figure 2.6: Preserved specimens

Cages

A cage is an enclosure often made of wire mesh or bars, in which birds, mice, rabbits, or other small animals are kept as shown in Figure 2.7.

Figure 2.7: Rabbit in a cage

Aquarium

This is a special vessel that is used in the laboratory for keeping live aquatic animals such as fish as shown in Figure 2.8. Aquaria can be of different shapes and sizes.

Figure 2.8: Aquarium

Common Biology laboratory apparatus and equipment

A wide variety of tools and equipment are needed in order to conduct Biology practicals. The following are some common apparatus and their uses.

A hand lens

This is mainly used to magnify specimens that are under observation. A hand lens enables a scientist to magnify small organisms or their parts in order to observe them clearly. An example of a hand lens is shown in Figure 2.9.

Figure 2.9: Hand lens

Magnification is calculated as follows:

$$\text{Magnification of a drawing} = \frac{\text{Size of drawing}}{\text{Size of an actual object}}$$

For example, if the length of the drawing is 8cm and the actual length of the object is 2 cm, then:

$$\text{Magnification of the drawing} = \frac{8}{2} = 4$$

Sweep nets

A sweep net is used for catching small flying organisms such as butterflies and grasshoppers. An example of a sweep net is shown in Figure 2.10.

Figure 2.10: Sweep net

Scoop nets

These are used for catching fish and other aquatic animals. An example of a scoop net is shown in Figure 2.11.

Figure 2.11: Scoop net

Pooter

This is the device that scientists use to pick up small organisms such as insects, without hurting them. The pooter has two tubes. The scientist suck through one tube and the organism is drawn into the pooter through the other tube. An example of a pooter is shown in Figure 2.12.

Figure 2.12: Pooter

Quadrat

A quadrat is a square wooden or metallic grid which is used to estimate the number of organisms in an area. An example of a quadrat is shown in Figure 2.13.

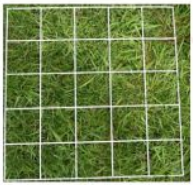


Figure 2.13: Quadrat

Specimen bottle

This is a glass or plastic container where the specimens are kept for storage. An example of a specimen bottle is shown in Figure 2.14.

Figure 2.14: Specimen bottle

Petri dish

This is a shallow glass or plastic container used during close observation of specimens. It may also be used for growing microorganisms. An example of a petri dish is shown in Figure 2.15.

Figure 2.15: Petri dish

Mortar and pestle

A mortar is a small hard bowl made of clay materials. A pestle is a tool used to crush specimens or samples. A mortar and pestle are usually used for crushing or grinding solid substances. An example of mortar and pestle is shown in Figure 2.16.

Figure 2.16: Mortar and pestle

Crucible and lid

This is the container that is used for heating substances at very high temperatures. Figure 2.17 shows a crucible and lid.

Figure 2.17: Crucible and lid

A dissecting kit

The dissecting kit contain tools for dissection of specimens. An example of a dissecting kit is shown in Figure 2.18. Some of the items included in the

dissecting kit are as follows:

(a) Forceps for holding specimens.
(b) A pair of scissors for cutting specimens or objects.
(c) Scalpels for cutting.
(d) A needle for loosening internal parts.
(e) Pins for holding specimens in place.
(f) Hand lens for magnifying small specimens or their parts.

Figure 2.18: Dissecting kit

Thermometer

This is a tool used to measure temperature. An example of a thermometer is shown in Figure 2.19.

Figure 2.19: Thermometer

Heat sources

These are used for heating various things in the laboratory. Examples of heat sources in the laboratory are Bunsen burner, spirit burner, and kerosene stove as shown in Figure 2.20.

Figure 2.20: Heating sources (a) Bunsen burner (b) kerosene stove (c) spirit burner

Dropper

This is used to add liquids into experimental containers drop by drop. An example of a dropper is shown in Figure 2.21.

Figure 2.21: Dropper

Test tube

This is a clear cylindrical glass container that is open at the top and rounded at the bottom. The top has a flared lip to enable easy pouring of liquids. Test tubes are used to hold chemicals and sometimes to heat substances over a short period of time. An example of a test tube is shown in Figure 2.22.

Figure 2.22: Test tube

Test tube rack

This is the device designed for storing test tubes so that they may not roll or break. An example of a test tube rack is shown in Figure 2.23.

Figure 2.23: Test tube rack

Test tube holder

This is an instrument used to hold a test tube during heating. Examples of test tube holders are shown in Figure 2.24.

(a)

(b)

Figure 2.24: Test tube holder (a) metallic with wooden handle (b) wooden

Beaker

A beaker is a wide cylindrical glass or plastic container. It is used for mixing substances, measuring, or heating liquids.

The top has flared lip to enable easy pouring of substances. An example of a beaker is shown in Figure 2.25.

Figure 2.25: Beaker

Measuring cylinder

This is a glass or plastic container that is marked to measure the volume of liquids. It has a small curled lip for easy pouring of liquids and a wide base so that it does not tip over easily. An example of a measuring cylinder is shown in Figure 2.26.

Figure 2.26: Measuring cylinder

Filter funnel

This is a laboratory device that is wide at the top and narrow at the bottom. A filter paper is usually folded into a cone shape and placed in the filter funnel to separate solids from liquids during filtration. An example of filter funnel is shown in Figure 2.27.

Figure 2.27: Filter funnel

Stoppers

These are used to seal test tubes and other glass containers. They can be made of cork, glass, or plastic. Examples of stoppers are shown in Figure 2.28.

Figure 2.28: Stoppers

Syringes

These are used for transferring small quantities of liquids. An example of a syringe is shown in Figure 2.29.

Figure 2.29: Syringe

Spatula

This is used for scooping powder or crystalline substances from containers. An example of a spatula is shown in Figure 2.30.

Figure 2.30: Spatula

White tiles

White tiles are used during experiments that involve colour changes. The container with the reacting substances is held over the white tile. The plain white colour of the tile makes it easy to note colour changes. An example of a white tile is shown in Figure 2.31.

Figure 2.31: White tile

Watch glass

A watch glass is a shallow dish that is used as an evaporating surface or cover for beakers. An example of a watch glass is shown in Figure 2.32.

Figure 2.32: Watch glass

Mounting needle

A mounting needle is used to lift small delicate specimens. An example of a mounting needle is shown in Figure 2.33.

Figure 2.33: Mounting needle

Microscope slide and cover slip

A specimen to be observed on a microscope is placed on a slide with a drop of a liquid and covered with a cover slip. The microscope slide is a small flat piece of glass that is used to hold specimen under observation. An example of a microscope slide and cover slip is shown in Figure 2.34.

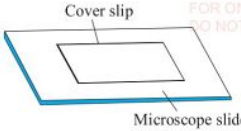


Figure 2.34: Microscope slide and cover slip

Exercise

Answer the following questions

1. (a) What is a laboratory?
   (b) List five equipment that are found in a Biology laboratory.
2. List any ten laboratory rules.
3. Explain the uses of the following laboratory apparatus:
   (a) Bunsen burner
   (b) Measuring cylinder
   (c) Mortar and pestle

The microscope

A microscope is an instrument that is used during scientific studies to magnify very small specimens so that their details can be seen. The smallest structures of cells, tissues, and organs of organisms can be studied well if magnified by the microscope. There are two types of microscopes: Light microscope and Electron microscope.

The electron microscope

The electron microscope uses beams of electrons to magnify specimens. The maximum useful magnification of most electron microscopes is about million times (1 000 000×). These microscopes are very expensive. They are mostly found in research centres.

The light microscope

This is the type of microscope that depends on light to illuminate and magnify tiny specimens. For this matter it differs from electron microscope by having lower magnification. The maximum useful magnification of most light microscopes is about one thousand times (1 000×). This type of microscope is commonly used in schools and health facilities. An example of a light microscope is shown in Figure 2.35.

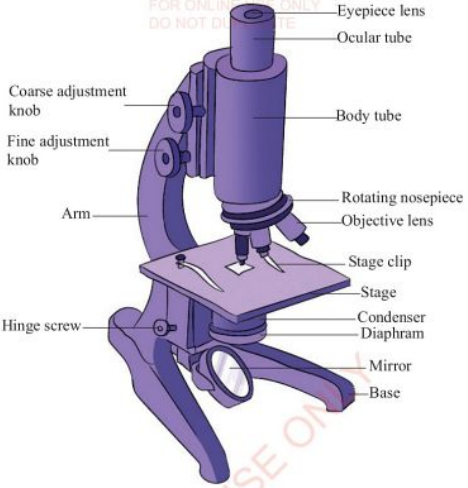


Figure 2.35: Parts of a light microscope

The parts of the light microscope are described in Table 2.1.

Table 2.1: Parts of light microscope and their functions

Part	Function
Eyepiece	Has a lens that magnifies the specimen either five times (5×), ten times (10×), or fifteen times (15×)
Body tube	Supports the eyepiece and the rotating nosepiece
Rotating nosepiece	Supports the objective lenses. Rotates to allow changes from one lens to another
Objective lenses	Magnifies the object under observation. Light microscope usually has three objective lenses: low power, medium power, and high power. A higher power lens reveals more details of the specimen

Part	Function
Coarse adjustment knob	Rises or lowers the body tube in order to bring the image into focus
Fine adjustment knob	Rises or lowers body tube in order to bring the image into sharp focus
Arm	Supports the body tube, knobs, stage, diaphragm and mirror. It is one of the parts that is held when moving the microscope.
Ocular tube	Allows light to pass straight from the objective lens to the eyepiece lens
Stage	Surface on which the specimen is placed
Stage clip	Holds the slide containing the specimen in place
Mirror	Reflects and directs light to the specimen under observation
Condenser	Concentrates light onto the specimen that is placed on the stage
Diaphragm	Regulates the amount of light passing from the mirror to the condenser
Hinge screw	Rises and lowers the stage to keep the specimen in the right position for observation
Base	Provides firm support for the microscope

How to use the light microscope

(a) Place the microscope on the laboratory bench or table. Make sure it is not too near the edge. Position the microscope such that the arm faces you and the stage faces away from you.

(b) Mount the specimen on the microscope slide. Cover it with a cover slip.

(c) Make sure that the low objective lens is in line with the eyepiece lens.

(d) Place the slide with the specimen on the stage. Hold it in place with the stage clip.

(e) While looking through the eyepiece, use your hand to adjust the mirror so that the light is directed to the specimen on the stage. Always keep both eyes open when looking through the eyepiece.

(f) Adjust the coarse adjustment knob to bring the specimen into focus.

(g) Adjust the fine adjustment knob to bring the specimen into a sharp focus.

Total magnification = eyepiece magnification × objective lens magnification

For example, if the eyepiece magnification is 5× and the objective lens magnification is 40×, then the total magnification is $5 \times 40 = 200\times$

(h) Rotate the nosepiece to a higher power objective lens if you want to observe more details of the specimen as shown in Figure 2.36.

Figure 2.36: Student using light microscope

How to care for the light microscope

(a) Turn the adjustment knob slowly. Always start with the coarse adjustment knob.
(b) Lift the microscope using both hands, one hand holding the arm and the other holding the base.
(c) When not in use, cover the microscope with clean cloth and store it in dry, dust-free place.
(d) Clean dirty lenses using lens tissue or a soft cloth.
(e) Do not place the microscope at the edge of the table or bench as it could be knocked over.
(f) When not in use for a long time, remove the lenses and put them in a desiccator.
(g) Do not touch the microscope with wet hands.
(h) Do not touch the surface of the mirror or the lenses with your fingers.
(i) Lubricate the moving parts regularly.
(j) Always use the cover slip in order to protect the lenses of the microscope from getting into contact with the specimen.
(k) Remove the slides from the stage immediately after use.
(l) Move the objective lenses up when storing the microscope.
(m) When storing the microscope rotate the rotating nosepiece so that the low magnification lens is in line with the eyepiece lens.

Activity 2.2: Using a light microscope

Materials: Light microscope, microscope slide and cover slip, knife or scalpel, onion bulb, forceps, mounting needle or glass rod, iodine solution, and blotting paper

Procedure

1. Use the knife to cut the onion bulb into four pieces lengthwise.
2. Obtain a fresh leaf from one of the quarters.

3. Use a pair of forceps to peel a thin layer from a leaf as shown in Figure 2.37.

Figure 2.37: Peeling a thin layer from an onion leaf

4. Trim the thin layer to approximately 5 mm x 5 mm using the scalpel or knife.
5. Put a drop of water on the microscope slide. Place the trimmed thin layer of onion leaf in the drop of water using a glass rod or a mounting needle as shown in Figure 2.38.

Figure 2.38: Placing the thin layer of onion leaf on the slide

6. Gently cover the specimen with a cover slip making sure that no air bubbles are trapped inside as shown in Figure 2.39.

Figure 2.39: Covering the specimen using the cover slip

7. Dry any excess water from the sides of the cover slip using a blotting paper.
8. Mount the slide on the stage of the light microscope. Hold it in place with the stage clips.
9. Observe the specimen under the low power objective lens then under the medium power objective lens.
10. Remove the specimen from the microscope stage. Remove the specimen from the slide and put a new specimen. Put a drop of iodine on the specimen. Repeat the procedures. Iodine makes the specimen clear. Use blotting paper to eliminate any excess iodine.
11. Observe the specimen again under low power and medium power objective lenses.
12. Draw what you have observed.

Safety signs

These are instructions and warning signs that are found on apparatus and chemical containers in the laboratory. Some may be found in or on the boxes in which chemicals and apparatus are kept. These signs must be observed to ensure safety in the laboratory. Table 2.2 shows interpretations of some safety signs.

Table 2.2: Interpretation of some safety signs

S/N	Safety sign and interpretation	Effects of failure to observe the precautions
1.	 No entry	One can get health related effects in case he or she enters or passes in the restricted areas
2.	 No smoking	Fire can erupt or it can cause health related problems to the smoker and non-smoker.
3.	 Fragile	Items can easily break and result into a loss
4.	 Explosive	Can explode and cause injury to a person

S/N	Safety sign and interpretation	Effects of failure to observe the precautions
5.	 Corrosive	Can cause body wounds or burn various things such as clothes and furniture
6.	 Flammable	Can cause fire accidents
7.	 Toxic, poison or danger	Can cause death if touched, swallowed, or inhaled
8.	 High voltage	A person can get electric shock that may cause death

S/N	Safety sign and interpretation	Effects of failure to observe the precautions
9.	 Strong radiation	Can cause dangerous effects such as skin damage, blindness, and various types of cancers
10.	 Biohazard	Can cause disease or infections
11.	 Slippery floor	A person may slip, fall down, and get injured
12.	 Caution	Accidents can occur
13.	 Emergence exit	Injuries or death can occur

Chapter summary

1. A Biology laboratory is a room or building specifically designed for carrying out Biology experiments.
2. Laboratory rules and safety symbols must be observed to ensure safety in the laboratory.
3. The Biology laboratory is different from other school facilities. Some of the things found in the Biology laboratory are preserved specimens, cages for keeping live specimens, models of organs or system of organisms, aquaria, charts showing organisms and parts of organisms, and biological apparatus.
4. Biological apparatus are tools and equipment needed for effective studying of Biology.
5. Some of the apparatus used in studying Biology are: Hand lens, sweep nets, scoop nets, pooters, specimen bottles, quadrats, petri dishes, mortars and pestles, crucibles, dissecting kits, thermometers, Bunsen burners, spirit burners, droppers, spatulas, test tubes, test tube racks and holders, and beakers. Other apparatus are measuring cylinders, filter funnels, stoppers, syringes, white tiles, watch glasses, mounting needles, slides, cover slips, and microscopes.
6. There are two types of microscopes: light microscope and electron microscope.
7. The total magnification in a microscope is calculated using the formula:

Eyepiece magnification	×	Objective lens magnification

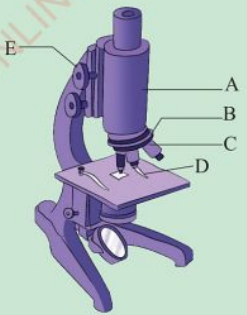
Revision exercise 2

1. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement in the space provided.
   (a) A Biology laboratory is similar to a classroom except for the presence of chemicals. _____
   (b) It is not allowed to eat, drink, smoke, play, or run in the laboratory. _____
   (c) A Bunsen burner, a desiccator, and kerosene burner are heat sources in the biology laboratory. _____
   (d) A cage can be used to store chemicals temporarily before they are used for an experiment. _____
   (e) If warning signs are incorrectly interpreted it can lead to accidents. _____

2. Fill the gaps in the following table:

Size of drawing	Size of object	Magnification
8 cm	(a) _____	2×
7.5 cm	2.5 cm	(b) _____
(c) _____	4 cm	3×
6 cm	(d) _____	1.5×

3. Name the parts of the microscope labelled A-E in the diagram and state their functions



4. State four important reasons for observing laboratory rules.
5. What do the following safety symbols mean?

(a)

(b)

(c)

6. Explain the possible dangers of using chemicals with toxic signs.
7. State the functions of the following parts of a microscope:
   (a) Eye piece
   (b) Arm
   (c) Mirror
   (d) Stage
   (e) Base
   (f) Body tube
8. According to the laboratory rules, what should you do in the following situations?
   (a) While boiling water, you realize that you need to get a book from the classroom.
   (b) There is unused acid left in the test tube after you finish your experiment.
   (c) You need to perform an experiment but there is nobody in the laboratory.
   (d) You need to use water and there is a bottle containing a clear liquid on the bench but you are not sure of its contents.
   (e) Your classmate is bitten by a mouse during a learning activity.
   (f) You have finished Biology experiments for the day.
   (g) Your classmate suggests that you carry the apparatus out of the laboratory so that you can repeat the experiments during your free time.
   (h) One of your classmates has brought some peanuts in the laboratory.
   (i) You need to smell the gas provided or produced during an experiment.
   (j) You need to switch off electricity.

9. Draw the following apparatus and state their functions:
   (a) Hand lens
   (b) Mortar and pestle
   (c) Petri dish
   (d) Beaker
   (e) Bunsen burner
   (f) Dropper

10. Where can you see the following safety signs in real life situation?
   (a) Slippery floor
   (b) Flammable
   (c) High voltage
   (d) Strong radiation
   (e) Biohazard

11. What is the importance of a Biology laboratory?

Chapter Three

Scientific processes in Biology

Introduction

Science is studied through a procedure that follows systematic processes. Among the processes that are conducted to carry out scientific studies include observation, measurement, and experimentation. In this chapter, you will learn about the use of sense organs to make correct observation. You will also learn how to measure mass, length, and temperature. Likewise, you will learn the steps for carrying out scientific studies commonly known as the scientific methods. The competencies developed from this chapter will enable you to properly apply scientific process in solving different life problems.

There are basic skills that are essential in scientific studies. You will need these skills as you study Biology. These skills include observation, measurement, and experimentation.

Observation

Observation is one of the methods of studying Biology. As you have learned in chapter one, Biology is the study of life. Through observation one can study living things in many ways.

One way is by using **sense organs**. An example of using sense organs in making observations is shown in Figure 3.1.

(a) (b)

Figure 3.1: Using sense organs to make observations (a) seeing (b) tasting

We have five sense organs. These are eyes, ears, skin, nose, and tongue. The observation process with the help of sense organs enables you to study living organisms. For instance, if you have a coconut, you can use your sense organs to determine that:

(a) It is round – by seeing
(b) It contains a liquid– by hearing the sound when shaken
(c) It has a rough husk – by touching
(d) It has a good smell – by smelling (after breaking the coconut)
(e) It has a sweet taste – by tasting (after breaking the coconut)

Activity 3.1: Making observations using sense organs

Materials: Colourful pictures, insects, preserved specimens, flowers, perfume, whistle, bell, stones, wooden objects, pieces of cloth, ice, hot water, and lukewarm water.

Procedure

1. Carefully observe the specimens provided using your sense organs.

Caution
Do not taste anything you are provided in the laboratory. They may be contaminated with poisonous materials or they may be poisonous themselves.

2. Note down the features of each specimen you have observed.
3. Draw a table similar to Table 3.1 on your exercise book. Record the observations by putting a tick (√) on each object.

Table 3.1: Observations of objects using sense organs

Object	Sense			
	Sight	Hearing	Smell	Touch
1. Flower				
2. Perfume				
3. Whistle				
4. Cloth				

The use of sense organs to make observations has many advantages in everyday life. For example, when you see dark clouds, you know that it is likely to rain. When you hear the school bell ringing in the morning, you know it is time to begin the school routine. You like a perfume because it smells nice. When you get near fire, you feel the heat and move away. When cooking you taste food to ensure it is delicious.

However, observations made using the senses are disadvantageous because they are often **subjective**. This means that they are based on a person's interests, opinions, or situation rather than facts. For instance, one may feel a bowl of water lukewarm, while another may feel it warm and yet another person may feel it hot. For this reason, scientists use standard units of measurement when carrying out scientific investigations. These units remain constant everywhere.

Measurements

Scientists use specific instruments and units of measurement in their investigations. The standard system of measurement used by scientists all over the world is called the **International System of Units (SI units)**. This system ensures precision in the presentation of scientific results and the uniformity of data presentation internationally. It also enables scientists to confirm results from other parts of the world. Table 3.2 shows some common measurements in Biology and their units.

Table 3.2: Fundamental quantities

Measurement	SI unit	Symbol	Other common units
Mass	Kilogram	Kg	Grams (g)
Length	Metre	m	Millimetre (mm), Centimetre (cm) Kilometre (km)
Temperature	Kelvin	K	Degrees Celsius (°C), Degrees Fahrenheit (°F)
Time	Second	s	Minutes (min), Hour (Hr)

Mass

Mass is the quantity of **matter** in an object. Everything in the world is made up of matter.

Mass is measured using a weighing balance or a weighing scale. It is often expressed in grams (g) or kilograms (Kg), whereby 1000 g = 1 Kg. The weighing balance can be manual or electronic. Examples of weighing scales are shown in Figure 3.2 and 3.3.

(a) (b)

Figure 3.2: Weighing scales (a) beam balance (b) digital scale

Figure 3.3: Using a beam balance to measure mass

Activity 3.2: Measuring the mass of objects

Materials: Weighing balance, weights (0.5 Kg, 1 Kg, 2 Kg, and 5 Kg), stones, flour, sugar, notebook, coins, text book, and pencil or pen

Procedure

1. Put a weighing scale on a flat surface such as a table.
2. Put half a kilogram weight on the platform.
3. Add a small amount of flour until the weighing scale balances.
4. What is the mass of the flour you have measured?
5. Record your results in your notebook.
6. Repeat procedure 2, 3, and 4 above using different weights to measure the different materials you have collected.
7. Compare your results with your classmates. Are the results the same?

Length

Length is a measurement of the distance or dimension from one point to another. For example, we can measure the length of a piece of thread, a desk, a wall, or a fish. Figure 3.4 shows examples of instruments for measuring length and Figure 3.5 shows how to use one of the length measuring instruments.

Length can be measured using a ruler or tape measure. Common units of expressing length are millimetres (mm), centimetres (cm), metres (m), and kilometres (km). These units can be converted into other units as shown in Table 3.3.

Table 3.3: Conversion of some measurements

10 mm = 1 cm	1000 m = 1 km
100 cm = 1 m	100 000 cm = 1 km

(a)

(b)

Figure 3.4: Instruments for measuring length (a) ruler (b) tape measures

Figure 3.5: Measuring the length of a wall using a tape measure

Activity 3.3: Measuring length of objects

Materials: Ruler, metre rule, tape measure, desks, books, notebook, and a pen or pencil

Procedure

1. Take a ruler and put it at one end of your desk. Make sure that the zero mark corresponds to the edge of the desk.
2. Put a mark where the 30 cm mark ends. Again, put the zero mark where you put the 30 cm mark and continue measuring until the whole length is completed.
3. Record the measurement in your notebook.
4. Add up your measurements. What is the length of your desk?
5. Measure the length of your desk using a metre rule. Which instrument is easier to use?
6. Compare your findings with those of your classmates. Did you get the same measurements?

Temperature

Temperature is the measure of how hot or cold a substance is, or it is the degree of hotness or coldness of a substance. It is a physical property that explains the common notions of hot and cold. The common units for measuring temperature are Kelvin (K), degrees Celsius (°C), and degrees Fahrenheit (°F). These units relate as follows:

$$K = {}^{\circ}C + 273.15$$

$${}^{\circ}F = \left[\left(\frac{9}{5}\right) \times {}^{\circ}C\right] + 32$$

$${}^{\circ}C = \frac{5}{9}(F - 32)$$

The normal human body temperature is between 36 °C and 37 °C.

We use thermometer to measure temperature. For example, we can use a thermometer to measure human body temperature. We can also use thermometers to measure the temperature of liquids such as water. The boiling point of water is 100 °C and its freezing point is 0 °C. Figure 3.6 shows an example of using a thermometer to measure temperature.

Figure 3.6: Using thermometer to measure the temperature of water

Activity 3.4: Measuring the temperature of different things

Materials: Thermometer, beakers, hot water, cold water, and ice cubes

Procedure

1. Carefully take a thermometer from its case and hold it at the top. Do not touch the bulb.
2. Shake it for a few seconds, then read the number that corresponds to the mark.
3. Put the thermometer bulb under your armpit and wait for two minutes.
4. Read the number that corresponds to the mark.
5. What is your body temperature?
6. Use the thermometer to measure the temperature of hot water, cold water, and the ice cubes by dipping the bulb into a container with the substance you want to measure. Observe the movement of the mark inside the thermometer until it stops moving.

Record the number that corresponds to the mark.

7. Record the temperature in degrees Celsius in your notebook.
8. Compare your results with those of your classmates. Are they the same?

Exercise 3.1

1. Give examples of fundamental quantities.
2. Why do we make observations?

The scientific method

Science is the knowledge and systematic study of the structure and behaviour of the natural and physical world. It is based on facts that can be proven using observation and experiments. In order to study situations and come up with solutions to the problems, scientists follow a set of steps called the scientific method.

The scientific method is a way of studying things by testing facts systematically. It follows seven steps which are: identifying the problem, formulating a hypothesis, experimentation, observation and recording data, data analysis and interpretation, conclusion, and reporting results.

Identifying the problem

This is where a scientist makes a puzzling observation. The observation can be made in the environment or from the work of other scientists. An example of such an observation is: 'Earthworms are mostly found in the soil in moist and well-shaded areas'. After making an observation, the scientist asks questions that can be answered by gathering evidence. For example: 'What conditions make earthworms prefer moist shaded areas to dry well-lit areas?'

Formulating a hypothesis

A hypothesis (plural: hypotheses) is a suggestion of the answer to the question asked. It is an intelligent guess that tries to explain an observation. For example: 'Earthworms prefer moist and well-shaded areas.'

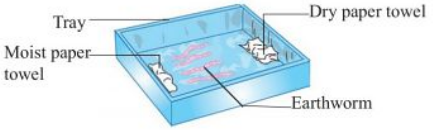
Experimentation

An experiment is a scientific procedure carried out under controlled conditions to determine whether a hypothesis is correct or not. In an experiment, a scientist uses **variables** to test a hypothesis. Variables are conditions or factors that can change or be changed, for example temperature, speed, and light. They can be classified as dependent, independent, and controlled variables.

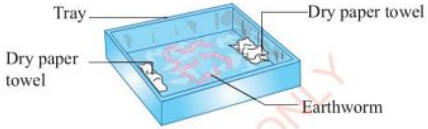
Dependent variable: This is the condition or factor that is measured or tested to obtain the results of the experiment.

Independent or manipulated variable: This is a condition or a factor that the researcher changes systematically to obtain different results.

Controlled variable: This is the condition or factor that is kept constant during the experiment. For example, Figure 3.7 shows an experiment that can be used to test if earthworms prefer moist areas.



(a) Set-up A



(b) Set-up B

Figure 3.7: Experiment to investigate the conditions preferred by earthworms

In set-up A:

(a) The direction in which the earthworms move is the factor under investigation. This is the dependent variable.

(b) The moisture content of one of the paper towels is varied. This is the independent variable.

(c) The amount of light allowed is kept constant. This is the controlled variable.

Set-up B: is the **control experiment**. In this set-up, the paper towels are not moistened. The independent variable is not changed.

The control experiment proves that the independent variable determines the direction of movement of earthworms.

Observation and data recording

The scientist observes what happens from the time the experiment is set up to the time it ends. It is important to note all the changes made in the independent variable and the resulting changes in the dependent variable. For example, the results of the experiment in Figure 3.7 can be recorded in a table as shown in Table 3.4 below. The result in the first row is given as an example.

Table 3.4: Results

Drops of water on paper towel	Movement of earthworms
0	Random
2	
4	
6	
8	
10	
12	

Data analysis and interpretation

At the end of the experiment, the scientist analyses the observations and data recorded. The scientist may also look for patterns or trends in the data.

For example, in this experiment it may happen that: 'As more drops of water were added to one paper towel, more earthworms moved to that side of the tray.'

Conclusion

A conclusion is a statement that summarizes what a scientist has learnt from an experiment. When scientists reach a conclusion, they state whether the data or information collected supports their hypothesis. Conclusions often lead scientists to pose new questions and plan new experiments to answer them.

It is important to remember that results of an experiment may prove or disprove a hypothesis. From this experiment, it can be concluded that: 'Earthworms prefer moist conditions to dry conditions.' This confirms the hypothesis.

Based on the conclusion, a hypothesis can be accepted, modified, or rejected. Another hypothesis is then formulated which suggests why the first hypothesis was correct or wrong. Hence, scientific research is a never-ending process as shown in Figure 3.8.

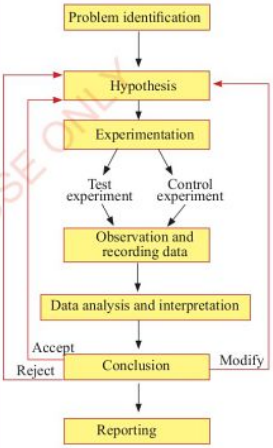


Figure 3.8: Steps in the scientific method

Reporting results

Scientists communicate their results to others in a final report. They can present the results to the scientific community by publishing their final report in a journal or at seminars, conferences, workshops, and meetings.

Note: If your results do not support the hypothesis:

(a) Do not leave out the experimental results.
(b) Give possible reasons for the difference between your hypothesis and the experimental results.
(c) Give ideas for further investigations to find answers to the problem.

Simple biological experiments

Biological experiments can be done to study different features of living things. As you learn Biology, you will often carry out experiments to test hypotheses or to learn more about organisms. Perform activities 3.5 and 3.6 in the laboratory.

Activity 3.5: Observing different types of leaves

Materials: Different types of leaves, hand lens, notebook, and pen or a pencil

Procedure

1. Go outside the classroom with your group members.
2. Pick leaves from various plants. Watch out for hairy or thorny plants and those known to be poisonous.
3. In the Biology laboratory examine each leaf closely as follows:
   (a) Look at the size, shape, and colour.
   (b) Feel the texture of the leaf.
   (c) Smell the leaf.
4. Using a hand lens, observe the patterns on each leaf.
5. Draw each leaf and list its characteristics.
6. Discuss the following with your group members:
   (a) How are the leaves similar?
   (b) How are the leaves different?

Activity 3.6: Collecting and observing the characteristics of animals

Materials: Preserved specimens of insects and other small animals, sweep nets, a pen or pencil, notebook, bottles, and hand lenses

Procedure

1. Go outside with your group members.
2. Use sweep nets to catch insects such as grasshoppers, termites, cockroaches, and butterflies as shown in Figure 3.9. Sweep nets can also be used to catch small animals such as millipedes, and frogs.

Figure 3.9: Using sweep nets to collect insects and other small animals

3. Put the collected insects and other small animals in specimen bottles.

Caution
Avoid collecting dangerous organisms such as wasps, scorpions, spiders, and centipedes.

4. Observe the external features of the organisms you have caught then use hand lens to observe the details of the same features. The features include number of legs, eyes, and the way they move as shown in Figure 3.10.

Figure 3.10: Using hand lenses to observe insects and other small animals

5. Record your observations in a notebook.
6. Draw each organism you have observed and list its features.
7. Release or preserve the organisms you have used in your observation.

Chapter summary

1. Observation, measuring, and experimentation are skills that we need when studying Biology.
2. We use our sense organs to make observations. These organs are:
   (a) Eyes for seeing (b) Nose for smelling (c) Ears for hearing
   (d) Tongue for tasting (e) Skin for feeling.
3. Scientific measurements are taken using specific instruments and expressed in specific units. Some basic biological measures are:

Measure	Instrument	SI unit
Mass	Weighing scale	Kilogram (Kg)
Length	Ruler, tape measure	Metre (m)
Temperature	Thermometer	Kelvin (K)

4. The scientific method is a set of steps that scientists use to study things systematically. It involves:
   (a) Identifying the problem;
   (b) Formulating a hypothesis;
   (c) Experimentation;
   (d) Observation and recording data;
   (e) Data interpretation;
   (f) Conclusions; and
   (g) Reporting results.
5. Simple biological experiments are performed to study different features of living things.

Revision exercise 3

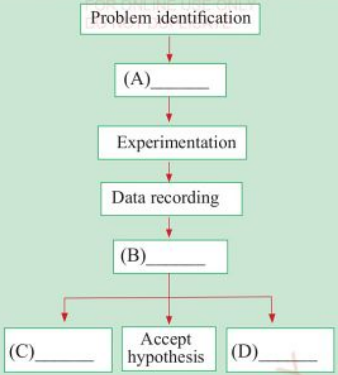
Choose the correct answer.

1. The first step in the scientific method is_____.
   (a) experimentation
   (b) collecting data
   (c) identifying the problem
   (d) formulating a hypothesis

2. Conditions or factors that can change or be changed in an experiment._____
   (a) Hypothesis (c) Variables
   (b) Problems (d) Conclusions

Fill in the blanks

3. The standard system of measurement used by scientists all over the world is called_____.
4. _____ is the distance from one point to another.
5. _____ is a statement that summarises what a scientist has learnt from an experiment.
6. The following flow chart represent the scientific method with some stages missing. Use it to answer the questions that follow:



(a) Fill the gaps in the flow chart.

(b) What is a hypothesis?

(c) How is a hypothesis tested in a scientific method?

(d) What is a scientist supposed to do if the hypothesis is rejected?

7. What is a scientific method?

8. (a) Convert the following temperatures to degrees Fahrenheit
   (i) 36 °C (ii) 40 °C

   (a) Convert the following temperatures to Kelvin
   (i) 100 °C (ii) 0 °C

   (b) Convert the following temperatures to degrees Celsius
   (i) 57 K (ii) 273 K (ii) 142 °F (iv) 43 °F

   (c) How many millimetres are in
   (i) 1 cm? (ii) 1 m?

   (d) Convert the following to metres
   (i) 300 mm (ii) 5500 cm

9. What unit and instrument will you use to measure?
   (a) Time? (b) Mass?
   (c) Temperature? (d) Length?

10. (a) What is a variable?
    (b) Distinguish between dependent and controlled variables.

11. (a) Name the five sense organs and their functions.
    (b) Give one weakness of using sense organs to make observations.

12. Why is it important for scientists to use a standard system of measurement?

13. Using relevant examples, explain how a quantity of matter can be estimated through local observation.

14. What is the importance of control experiment when testing a given hypothesis?

15. Identify the step of the scientific method in each of the following situations:
    (a) John is not feeling well, he goes to see a medical doctor at a nearby hospital.
    (b) The doctor asks John several questions about how he feels.
    (c) The doctor orders John's body temperature, blood, and urine samples for observation in the laboratory.
    (d) The laboratory technician diagnose malaria parasites in John's blood.
    (e) The doctor confirms that John has malaria and prescribes medicine for him.

Chapter Four

First Aid and safety

Introduction

In life activities, a person can get involved in accidents or fall ill suddenly and therefore may need immediate assistance. In this chapter, you will learn about First Aid, safety measures to consider when giving First Aid, and how to provide First Aid to various kinds of victims. You will also learn ways of preventing accidents and maintaining safety at home and school. The competencies developed from this chapter will enable you to provide First Aid to different patients and victims.

First Aid

First Aid is an immediate assistance given to a person soon after an injury or illness before the victim gets professional medical help. It consists of a series of simple and potentially life-saving activities. An individual can be trained to perform First Aid with minimum materials found in the First Aid kit. First Aid is important because it saves life, and helps to reduce pain and suffering, and brings hope and encouragement to the patient. It also prevents an illness or injury from becoming worse, removes the fear of death, and helps the patient to recover from shock.

The First Aid kit

The First Aid kit is a container such as a box or bag with items that are used to give help during an emergency. An example of a First Aid kit is shown in Figure 4.1.

(a) (b)

Figure 4.1: First Aid kit (a) closed First Aid kit (b) open First Aid kit

This container should be clearly labelled 'First Aid Kit' and kept in a safe and easily accessible place. For instance, it can be kept on shelves, placed on the wall in the laboratory or in the staff room. Everyone at home, school, and workplace should know where it is kept. Table 4.1 shows some components of the First Aid kit and their respective uses.

Table 4.1: Some components of the First Aid kit and their uses

Item	Use
Soap	Washing hands, wounds, and equipment
Painkillers	Relieving pain
Scissors or razor blades	Cutting dressing materials such as gauze, bandages, plasters, and threads
Safety pins	Securing bandages
Bandages	Keeping dressings in place and securing fractures and dislocated bones or muscles
Cotton wool	Cleaning and drying wounds
Thermometer	Measuring body temperature
Disposable sterile gloves	Covering the hands to avoid infection of wounds and prevent direct contact with a victim's body fluids
Petroleum jelly	Soothing bruised skin and for treatment of burns and blisters
Liniment	Reducing muscle pain
Torch	Source of light
Whistle	Blown to call for help
Plaster or adhesive bandage	Covering small wounds
Sterile gauze	Covering wounds to protect them from dirt and germs
Antiseptic	Cleaning wounds to kill germs
Gentian Violet solution (GV)	Antiseptic to clean wounds and reduce bleeding
Iodine tincture or spirit	Antiseptic agents to clean wounds and prevent infections from microbes

Note: All items should be replaced regularly as they approach expiry date

Safety when rendering First Aid

When rendering First Aid to a victim, it is important to consider your safety and the safety of the victim. Do not touch a victim with bare hands. Always wear protective gears such as plastic gloves, mask, and eye protector. Body fluids such as blood, pus, saliva, and mucus can spread infectious agents such as Hepatitis B Virus, (HBV), Corona Virus, Ebola Virus, and Human Immunodeficiency Virus (HIV). In addition, wash your hands thoroughly with soap and running waterimmediately after providing First Aid.

The following are First Aid procedures that can help people in various situations.

Bruises

A bruise is usually caused by a minor injury on the skin. It forms when the small blood vessels near the skin's surface are broken, causing small amounts of blood to leak into the tissues. Bruises cause discolouration, pain, and swelling of the skin.

Procedure for providing First Aid to a bruise victim

(a) Elevate the injured area if possible and apply a cold compress such as a clean cloth dipped in cold water or ice wrapped in a cloth as shown in Figure 4.2.

Figure 4.2: Applying cold compress on a bruise

(b) Take the victim to a nearby health care facility if pains and swelling persist.

Snake bites

Victims of snake bites are usually very frightened. It is important to first calm them down and reassure them. Fear increases the pulse rate and if the snake is venomous, the venom spreads in the body more rapidly. Most snake bites occur on the arms or legs. In places where venomous snakes are common, anti-venom serum is usually available for First Aid. The venom can cause death if the victim is not immediately provided with First Aid or treatment. Symptoms of a victim of snake bite includes swelling and severe pains.

Procedure for providing First Aid to a snake bite victim

First Aid for a victim of snake bite is provided using the following procedure:

1. Immediately move the victim away from the area where the bite occurred. If the incident occurred while in a water body, move the victim to a dry area to avoid drowning.
2. Calm the victim and let him or her lay or sit down and reassure the victim that many snakes are non-venomous.
3. Remove all jewellery, for example bangles, and tight clothing such as shoes and socks from the injured part, as these can cause harm if swelling occurs.
4. Keep the wound at heart level or lower in order to reduce the flow of venom to other parts of the body. For example, if a person has been bitten on the leg, lower the leg so as to slow down the blood flow.
5. Wear gloves, and clean the wound using soap and water or cotton wool containing spirit to kill germs. Cover the wound using a bandage or a clean piece of cloth as shown in Figure 4.3.

Figure 4.3: Washing a snake-bite wound with soap and water

6. Take the victim to a nearby health care facility immediately after the First Aid. The following that should be observed when giving First Aid to a victim of snake bite:
   (a) Do not tie the bitten area because that will cause swelling due to restricted blood flow.
   (b) Do not cut the bitten area because that will cause more opening of the wound.

(c) Do not suck the blood from the bitten area because it can cause infection to both the victim and the First Aid provider.
(d) Do not apply herbs unless you are certain that they are helpful to that particular kind of venom.
(e) Do not provide the patient with hot drinks, coffee, and tea as it can accelerate the rate of heart beat thus leading to rapid spreading of venom throughout the body.

Insect bites and stings

Some common stinging insects are bees and wasps as shown in Figure 4.4. Other biting insects include mosquitoes, ants, and tsetse flies.

(a) (b)

Figure 4.4: Stinging insects (a) wasp (b) bee

Most insect bites and stings are more painful but less harmful. The bites and stings are usually characterized by a sharp pain followed by mild swelling and soreness. However, people who are allergic to stings can develop serious reactions such as nausea, diarrhoea, breathing difficulties, dizziness, and swelling of the lips, throat, or tongue.

Procedure for providing First Aid to an insect bite and sting victim

1. When a person is stung by a bee, the sting remains in the skin. Remove the sting by scraping gently using a blunt object such as a plastic card as shown in Figure 4.5. Do not use your fingers or sharp objects because this will cause the sting to release more venom into the body.

Figure 4.5: Removing a bee sting

2. Wash the stung area with soap and water. Apply baking soda paste on the bee sting. Use the ratio of 1 teaspoon of water to 3 teaspoons of baking soda. The sting is acidic, baking soda is a base therefore, it neutralizes the acid.
3. Apply a cold compress to relieve pain and swelling.
4. The victim should be rushed immediately to the nearby health facility if he or she develops allergic reactions.

Electric shock

When dealing with a victim of electric shock, it is important to observe the following:

(a) Do not touch a person who is still in contact with electric current, which may cause electrocution.
(b) Do not go near high voltage wires until the current is switched off.

Procedure for providing First Aid to an electric shock victim

1. Turn off the source of electricity. If it is not possible to do that move the victim from the electric current using a dry non-metallic object, such as dry piece of wood as shown in Figure 4.6.

Figure 4.6: Removing an electric shock victim from the electric source

2. The victims should be laid on their backs on a flat surface.
3. Loosen any clothing around the neck to ensure there are no obstructions in the mouth and throat.
4. Check for symptoms of blood circulation such as breathing or coughing. This is best felt by placing the fingers to the side of the voice box at the neck to feel the pulse rate. If the person is not breathing, begin mouth to mouth resuscitation. The victim's mouth should be covered by a clean cloth, dental dam, or pocket mask.
5. Place both hands on the lower part of the victim's chest with one hand covering the other and interlocked as shown in Figure 4.7.

Figure 4.7: Interlocking hands placed on the victim's chest

6. Press downwards sharply then release the pressure.
7. Repeat this 14 times at approximately 80 compressions per minute.
8. With one hand on the victim's forehead and the other on the chin, tilt the head backwards in order to open the airways as shown in Figure 4.8.
9. Observe to see if the victim's chest rises and falls.

Figure 4.8: Tilting the head to open air ways

10. If the person does not get well put him or her in the recovery position to allow blood circulation and air movement as shown in Figure 4.9.

Figure 4.9: The recovery position

11. If the situation persist, lay the victim on his or her back while legs raised as shown in Figure 4.10.

Figure 4.10: Legs slanted for easy recovery

12. Take the victim to a nearby health facility for medical service.

Exercise 4.1

1. What is First Aid?
2. Why is it important to calm and reassure the victim of snake bite as much as possible?
3. Explain how to provide First Aid to a person who is bitten by an insect.

Bleeding

Bleeding can occur from a visible wound or from an internal organ. Excessive bleeding can cause death.

Procedure for providing First Aid to a bleeding victim

1. Calm down and reassure the victim.
2. Put on gloves before attending the victim.
3. Place the victim in a comfortable resting position.
4. Raise the injured part and support it in position. Do not move the injured part if this cause pain to the victim or if a fracture is suspected.
5. If the wound is dirty, wash it with clean water from the middle of the wound outwards.
6. Cover the wound with a sterile dressing cloth and gently clean the surrounding skin.
7. Dry the skin with sterile dressing as shown in Figure 4.11.
8. Dress the wound and bandage it firmly.

Figure 4.11: Cleaning a bleeding wound

9. If bleeding does not stop, take the victim to a nearby heath facility.

Procedure for providing First Aid to a severely bleeding victim

1. Use your fingers to apply direct pressure to the bleeding point or points for 5 to 15 minutes. If the wound area is large and there is no fracture, press the sides of the wound firmly but gently together.
2. Lay the victim down in a suitable and comfortable position. Raise the injured part and support it in position. However, do not do that if it causes pain or an underlying fracture is suspected.
3. Carefully remove from the wound any foreign bodies that are visible, and can easily be picked out or wiped off with a dressing material. Do not remove any objects that

are stuck in the wound because this can lead to more bleeding.

4. If dressing material is available, apply it directly over the wound and press it down firmly. Cover the dressing material with a pad of soft material. Hold the dressing material and pad in position using a firm bandage as shown in Figure 4.12.

Figure 4:12: Dressing a wound

5. If the bleeding persists, take the victim to a nearby health facility.

Procedure for providing First Aid to a nose bleeding victim

1. Have the person sit with the head tipped slightly forward.
2. Ask the person to pinch the nose and breathe through the mouth for a few minutes as shown in Figure 4.13.

Figure 4.13: Nose bleeding victim pinching the nose

3. If the bleeding does not stop, take the person to a nearby health facility.

Internal bleeding

Sometimes bleeding occurs inside the body. Blood may also leak from the body through natural openings. At other times, the blood remains inside the body causing pain and shock, even though there are no symptoms of blood loss.

A person may be losing blood inside his or her body if you notice any of the following:

(a) Blood running out of the mouth.
(b) Blood flowing out of the ears.
(c) Blood in the stool.
(d) Blood in the urine.
(e) Blood or a substance that looks like coffee granules in vomitus.
(f) Blood flowing from a woman's birth canal after an injury or during pregnancy.

If you notice any of the above mentioned signs take the victim to a nearby health facility as quickly as possible.

Vomiting

Vomiting may be caused by consuming contaminated foods and drinks. Vomiting leads to loss of large amounts of water and mineral salts from the body within a short time. Loss of water and mineral salts leads to body weakness and tiredness. Therefore, the vomiting victim needs First Aid for quick restoration of water, mineral salts, and energy.

Procedure for providing First Aid to a vomiting victim

The following are the important steps to be taken to help a person who is vomiting:

1. Place the patient in a safe and clean place.
2. Make sure that the patient is seated or lying on the side so as to prevent chocking.
3. Give the patient plenty of fluids with a mixture of salt, sugar, and lemon or ginger juice to prevent nausea. The ratio of sugar and salt should be 1:3 respectively. In 1litre of water, there should be 1 tea spoon of sugar and 3 tea spoons of salts.
4. Give the patient a lot of fruit juice to restore water, mineral salts, and energy.
5. If vomiting persists, take the patient to a nearby health facility immediately.

Muscle cramps

Muscle cramps are sudden, involuntary, and painful contractions of a single muscle or a group of muscles. The causes of muscle cramps include poor coordination of the muscles during exercise, cold or excessive loss of salts and body fluids due to too much sweating, and severe diarrhoea or persistent vomiting.

Procedures for providing First Aid to a victim with foot muscle cramps

1. Help the victim to stand with his or her weight on the front of the foot. When the first contraction is over, let the victim sit down.
2. Straighten the victim's knee and draw his or her foot firmly and steadily upward towards the shin. Massage the muscle as in Figure 4.14.

Figure 4.14: Massaging a cramped foot

3. Get medical help if the cramp persist.

Procedure for providing First Aid to a thigh muscle cramps victim

1. If the cramp is at the back of the thigh, straighten the victim's knee by raising the leg. If the cramp is at the front, bend the knee forward.
2. Massage the affected muscle firmly with your fingers until the pain ceases.
3. Get medical help if the cramp persists.

Hiccups

Hiccups are short, repeated, noisy and deep intakes of air. They are caused by involuntary contractions of the **diaphragm** against a partially closed **windpipe**. Short attacks are simply a nuisance, but if the attack is prolonged, it may become worrying, tiring and painful.

Swallowing large quantities of air or eating too much or certain foods may cause hiccups.

Procedure for providing First Aid to a hiccups victim

1. Hiccups can be stopped by increasing the concentration of carbon dioxide in the blood for a short time. For example, by advising the victim to hold breathe as long as possible, blowing up a balloon, and breathing into a paper bag as shown in Figure 4.15.

Figure 4.15: Breathing into a paper bag

Caution
Breathe into a paper bag and not plastic bag. Plastic bags can block air passage and cause suffocation.

2. Hiccups can also be stopped by stimulating the vagus nerve which runs from the brain to the stomach by drinking water, pulling gently on the tongue, placing half a teaspoon of dry sugar on the tongue, startling and suckling if the victim is a baby.

Poisoning

A poison is any substance that causes harm if it is swallowed, inhaled or absorbed into the body. Poisons include laboratory chemicals, kerosene, household cleaning detergents, pesticides, poisonous plants, and medicine. Figure 4.16 shows examples of containers of some common poisons.

Figure 4.16: Containers of some common poisons

Symptoms of poisoning include burns or redness around the mouth, breath with chemical odour, burns, odour on the victim's body clothing, vomiting, diarrhoea, difficulty in breathing, and abdominal cramps.

Procedure for providing First Aid to a poisoned victim

1. Identify which poison is involved. Different kinds of poison have different ways of management. Containers of most industrial produced chemicals or poisons have instructions for management of poisoning that they may cause. It is advised to take the container with the patient to the health facility.
2. If the poison is in the eye, wash the eye using clean lukewarm water and encourage the victim to blink as much as possible. Do not rub the eye.
3. If the poison is on the skin, remove any contaminated clothing and pour clean water on the affected area for ten minutes. Cover the area with a soft clean cloth. Do not apply grease or ointments.
4. If the poison has been inhaled, move the person outside where there is plenty of fresh air. If the victim is not breathing, start mouth-to-mouth resuscitation.
5. If the poison has been swallowed, give a glass of milk, water, or both to the victim. This helps to dilute and neutralize the poison.
6. Do not induce vomiting if the poison is a corrosive substance such as bleach, detergent, laboratory acid, disinfectant, paint thinner, toilet cleaner, and turpentine.
7. Induce vomiting if the poison is non-corrosive, for example vomiting due to alcohol, soap, or sleeping pills. Vomiting can be induced by putting your finger in the victim's throat or by making the victim gargle soapy water or raw egg yolk.
8. Take the victim to a nearby health facility immediately after providing the First Aid.

Activity 4.1: Practising First Aid skills

Materials: The First Aid kit

Procedure

1. Get a classmate. Practise how to give First Aid to victims of bruises, snake bites, insect stings and bites, electric shock, bleeding, vomiting, muscle cramps, hiccups, and poisoning.
2. You and your classmate should both get a chance to act as the

victim and the First Aid provider.
3. Ask your teacher for help where you encounter difficulties.

Exercise 4.2

1. Explain the procedure for providing First Aid to a person bitten by a snake.
2. (a) What is muscle cramp?
   (b) Mention the causes of muscle cramps.
3. How will you provide First Aid to a bleeding victim?

Safety at home and school

Many accidents occur at our homes as well as at school. There are, however, certain groups of people who are at a higher risk than others. These include children, the elderly, and the handicapped. Common accidents at home and school include drowning, falling, poisoning, choking, bites, stings, cuts and scratches, electric shock, injury or fractures, and burns from fire and hot substances or chemicals. Figure 4.17 shows some accidents at home and school.

Figure 4.17: Common accidents at school and home

Preventing accidents and maintaining safety at home and school

Activity 4.2: Maintaining safety at home and schools

Materials: Notebook, pencil or pen, manila paper, coloured pencils or paint, and cleaning equipment

Procedure

1. Take a walk around your home or school compound and note down all the things that can cause accidents.
2. Suggest the possible ways to prevent such accidents from occurring.
3. Demonstrate with your fellow students how you can maintain safety at home and school by

cutting grass, burning rubbish or collecting sharp objects, and properly disposing them.

4. In groups, prepare posters to educate the community on how to maintain safety at home and school.

There are many simple ways of preventing accidents at home and school. Table 4.2 gives a summary of how to make our homes and school safer.

Table 4.2: A summary of common accidents and the ways to prevent them

Accident	Prevention and safety measures
Fire, burns and scalds	(a) Switch off Bunsen burners and cookers when not in use (b) Do not run in the laboratory (c) Store oxidants, flammable, and explosive substances far from sources of heat (d) Do not allow children to play in the kitchen (e) Have fire extinguishers at home and school and train the members how to use them
Drowning	(a) Do not go swimming alone (b) Use a bridge when crossing rivers and streams (c) Avoid going near water bodies when it is dark (d) Do not allow children to play near water bodies (e) Cover or fence all water pools at home and school
Falls	(a) Always walk carefully (b) Avoid playing risky games such as climbing trees and walls (c) Put up safety signs to show where there are stairs or steps, steep slope, and slippery surface. (d) Do not run unnecessarily (e) Wipe spilled liquids on the floor immediately (f) Do not leave fruits and vegetable peels on the floor

Accident	Prevention and safety measures
Poisoning	(a) Label all containers clearly (b) Store all poisonous substances in a safe locked place when not in use (c) Use poisonous substances as directed on the labels (d) Do not taste things in the laboratory
Choking	(a) Do not talk while eating (b) Sit upright when eating or drinking (c) Eat slowly and discourage eating competitions (d) Do not give children small objects to play with as they could swallow them
Bites and stings	(a) Do not disturb animals (b) Stay away from beehives and wasps nests (c) Cut bushes and tall grass that could harbour dangerous animals
Cuts and scratches	(a) Store sharp tools in a safe place (b) Dispose broken glass and empty tins properly (c) Do not walk barefoot outside (d) Do not allow thorny bushes to grow very near the house (e) Do not give children sharp objects to play with
Electric shock	(a) Switch off electrical appliances that are not being used (b) Do not touch electrical equipment with wet hands (c) Do not touch any loose electrical appliances (d) Do not push sharp objects into electric sockets

Chapter summary

1. First Aid is an immediate assistance given to a sick or injured person before getting professional medical service.
2. First Aid helps to save life, prevents conditions from getting worse, promotes recovery, reduces pain, and reassures the victim.
3. A First Aid kit contains items needed to carry out First Aid. These include plasters, bandages, sterile gauze, antiseptic, soap, painkillers, scissors, razor blades, safety pins, cotton wool, a thermometer, disposable gloves, petroleum jelly, liniment, oral rehydration salts, a torch, and a whistle.

4. We should immediately give First Aid to victims of burns and scalds, bruises, snakebites, insect bites and stings, electric shock, bleeding, vomiting, muscle cramps, hiccups, poisoning, and drowning.
5. Common accidents that can happen at home or school are fires, burns and scalds, drowning, falling, poisoning, choking, bites and stings, cuts and scratches, and electric shock.
6. We should strive to prevent accidents both at home and at school.

Revision exercise 4

Choose the correct answer.

1. If you do not have gloves, you can also use_____ to protect your hands.
   (a) socks
   (b) plastic bags
   (c) tins
   (d) a piece of cloth

2. When giving First Aid to a snake-bite victim, you should NOT_____.
   (a) cut the wound
   (b) calm them down
   (c) remove jewellery from the bitten part
   (d) lower the bitten area

3. Match each item from **Column A** with a corresponding item in **Column B**.

Item	Use
(i) Antiseptic	(a) Reduction of muscle pain
(ii) Petroleum jelly	(b) Covering hands to avoid infecting wounds
(iii) Scissors	(c) Measuring body temperature
(iv) Liniment	(d) Cleaning hands, wounds, and First Aid equipment
(v) Plaster	(e) Soothing sore muscles
(vi) Disposable sterile gloves	(f) Covering small wounds
(vii) Bandage	(g) Washing wounds to kill germs

Item	Use
(viii) Soap	(h) Keeping dressings in place and immobilising injured limbs
	(i) Cutting dressing material
	(j) Soothing chapped skin

4. Write **TRUE** for the correct statement and **FALSE** for an incorrect statement in the space provided against each question.
   (a) Vomiting should be induced if a person has swallowed kerosene. _____
   (b) First Aid helps to reassure the victim. _____
   (c) Bee stings should be removed using a needle. _____
   (d) Before taking a snake-bite victim to hospital, you must first capture the snake. _____
   (e) It is important to reduce the rate at which poison spreads in the body when giving First Aid to a victim. _____
   (f) You should move a victim of electric shock using a metallic object. _____
   (g) A person whose nose is bleeding should lay down. _____
   (h) We can use clean water, salt, and sugar to make a rehydration drink for a vomiting victim. _____
5. What is the importance of First Aid kit?
6. Identify six items found in the First Aid kit and state their uses.
7. (a) What are bruises?
   (b) How would you provide First Aid to a victim with bruises?
8. Explain the symptoms of a poisoned victim.
9. Why is it not advisable to induce vomiting to a victim who has taken corrosive poison?
10. Briefly discuss how you can prevent accidents at home and school.
11. Give reasons why it is necessary to cover your hands when giving First Aid to a bleeding person.

Chapter Five

Waste disposal

Introduction

Most human activities generate some form of wastes. Wastes should be properly disposed to prevent their effects on human beings, other living things, and the environment. In this chapter, you will learn about the concept of waste, types of wastes, sources of waste, waste disposal, basic principles of waste disposal, effects of poor waste disposal, and proper ways of disposing waste in the surrounding community. The competencies developed from this chapter will enable you to use proper methods of waste disposal to conserve the environment.

Meaning of waste

Wastes are unwanted or unusable materials or substances in our environment. Waste can also refer to materials that are no longer needed. For example, food left-overs, packaging materials, broken items, human excreta, scrap metal, and industrial waste.

Types of wastes

There are different criteria used to classify wastes. Basing on the physical states; wastes can be classified into solid, liquid, sludge, or gas.

Solid waste

Solid waste is hard waste material, for instance household garbage, bottles, plastics, papers, broken glasses, scrap metals, old tyres, empty cans, and construction waste. Example of these wastes are shown in Figure 5.1.

Solid waste can be classified into different categories, for example household waste, industrial waste, and medical or hospital waste.

Figure 5.1: Solid waste

Liquid waste

These are wastes in liquid form. Examples of liquid wastes include waste water from households, industries, agriculture, mining areas, and chemicals from laboratories. Liquid wastes may contain a wide range of potential contaminants resulting from the mixing of different waste water as shown in Figure 5.2.

Figure 5.2: Liquid waste

Sludge

These wastes are intermediate between liquid and solid states, for instance a mixture of faeces and urine.

Gaseous waste

These are wastes in gaseous form, for example ammonia, carbon dioxide, and sulphur dioxide gases from industries and motor vehicles as shown in Figure 5.3.

Figure 5.3: Gaseous waste from an industry and vehicle

Gaseous wastes have the capacity to spread over a wide area. This endangers both the environment and human beings. Hence, appropriate control measures are recommended in order to prevent its negative effects. Such effects can include worsening of respiratory diseases, and corrosion of iron sheets and walls of buildings.

Other categories of wastes

Wastes can also be categorised as recyclable and non-recyclable, biodegradable and non-biodegradable, and hazardous and non-hazardous.

Recyclable waste

Wastes that can be processed to make useful products are called recyclable wastes. Examples of recyclable wastes are metallic objects, plastic bottles, glass, and paper wastes. These objects are often returned to industries as raw materials and new objects can be made from them. Examples of these wastes are shown in Figure 5.4.

Figure 5.4: Recyclable wastes (scrap metals)

Non-recyclable waste

Wastes that cannot be processed to make new objects are called non-recyclable wastes. Examples of non-recyclable materials include hazardous chemical containers, used batteries, empty spray bottles, empty aerosol cans, mirrors, bulbs, and medical wastes. Example of these wastes are shown in Figure 5.5.

Figure 5.5: Non-recyclable wastes

Biodegradable waste

These are wastes from living things, that can be decomposed easily by bacteria and fungi. Example of biodegradable wastes include food remains, wood, grass, paper, and cotton clothes.

Non-biodegradable waste

These are wastes that cannot be easily decomposed by bacteria and fungi. Some can remain in the soil for a long period whereas others cannot decompose at all. Examples of such wastes are plastic material, glass, metals, and some pesticides.

Hazardous waste

These are wastes with a potential to cause harmful effects to humans or the environment. They are considered harmful because they may either contain toxic substances or disease causing organisms. Examples are industrial and hospital wastes.

Wastes that can transmit infections or cause diseases are referred to as biohazardous wastes.

Non-hazardous waste

These are wastes with no potential harmful effects to humans or the environment. They include leaf litters, grasses, and wood. If allowed to accumulate in the environment they do not cause infections and diseases.

Sources of waste

Households, industries, markets, schools, and hospitals are among the places where waste can be produced. Table 5.1 show sources of wastes.

Table 5.1: Sources of waste

Source	Waste generated	Examples
Household	Sewage	Urine, faeces, and water
	Waste water	Water from laundry and bathrooms
	Plastics	Shopping bags, containers, water and juice bottles, straws, old utensils, and old toys
	Papers	Newspapers, cardboard, old books, and magazines
	Glasses	Broken utensils, bottles, and window panes
	Plant matter	Tree roots, stem, branches, rotten fruits and vegetables, leaves, and peels
	Old furniture	Broken chairs, tables, and cupboards
	Old clothes	Torn shirts, dresses, blouses, trousers, and towels
	Electronic wastes	Mobile phones, batteries, and old electronic appliances
	Farm animal wastes	Animal faeces and urine, carcasses

Source	Waste generated	Examples
Industries	Scrap metals	Tins, pieces of iron, copper
	Coolants and lubricants used in machines	Used oil and grease
	Industrial chemicals	Mercury, cyanide, and sulphur
	Waste gases	Carbon monoxide, sulphur dioxide, and ammonia
	Waste water	Dirty water, sludge
	Plastic and metal containers	Used cans and bottles
	Slaughterhouse wastes	Waste water, animal dung, animal blood
	Construction and demolition wastes	Pieces of glass, pieces of wood, broken tiles, pieces of iron sheets, dust and rubble.
Health facilities	Soiled dressings, chemicals, amputated organs, wastes from maternity wards	Used bandages and cotton wool, used needles, blades, plastic containers and syringes, reactants and medicines, placenta, and blood

Activity 5.1: Categorising wastes

Materials: Pen or pencil and note book or exercise book

Procedure

1. Go around the school compound.
2. Observe the types of wastes that are disposed off at school. List them down in your notebook.
3. Classify the wastes as liquid, solid and gaseous, then, state whether they are biodegradable, non-biodegradable, and hazardous or non-hazardous.
4. Write your answer in your note book or exercise book.

Exercise 5.1

1. What is waste?
2. State four criteria used to classify waste.
3. Using relevant examples differentiate between hazardous and non-hazardous waste.

Waste disposal

Waste disposal refers to collection, transportation, processing, re-use and other activities that help to get rid of wastes. This helps to reduce adverse effects of wastes on human health, animal health, and the environment.

Basic principles of waste disposal

There are three basic principles that can help us to better manage waste. These are:

(a) Re-using

Instead of throwing the waste away, they can be re-used. For instance, we can use an empty margarine container to store sugar or use a glass bottle to keep milk instead of disposing them.

(b) Recycling

Some wastes can be changed to other usable products. For example, broken glass can be melted and used to make new glass bottles.

(c) Reducing

This is the act of minimising the amount of waste produced. For example, you can carry a woven basket instead of buying plastic bags each time you go shopping.

Methods of waste disposal

There are many ways of disposing wastes. The following are the major ones:

Burying

Some forms of wastes can be buried in the ground. Burying can take the following forms.

Pit latrine: A pit latrine is made by digging a hole in the ground. A wooden or concrete platform with a hole over the pit is built so that people can use the latrine safely. Figure 5.6 shows the cross-sectional structure of a pit latrine.

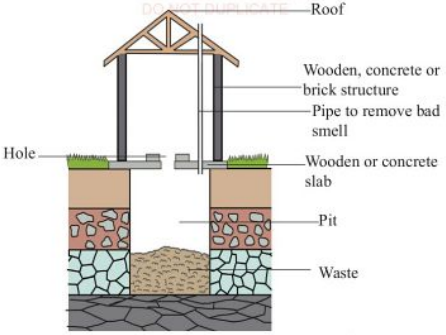


Figure 5.6: Pit latrine

The sewage in the pit is decomposed by bacteria. When the pit is full it is covered with soil and a new pit latrine is dug.

Tipping and landfills: In urban centres each household is supposed to have a litterbin for wastes. Trucks regularly collect the wastes and take them to dumping sites. This is called tipping. Dumping sites can be in the form of dump or landfill. Figure 5.7 shows a truck emptying wastes at a dump site.

Figure 5.7: Truck emptying wastes at a dump site

A landfill is a site for the disposal of wastes by burying them under the ground. There are two types of landfills:

(a) an open hole in the ground where waste is dumped and later buried, and

(b) a sanitary landfill, a structure built into the ground where waste is isolated from the environment using clay or plastic liner as shown in Figure 5.8.

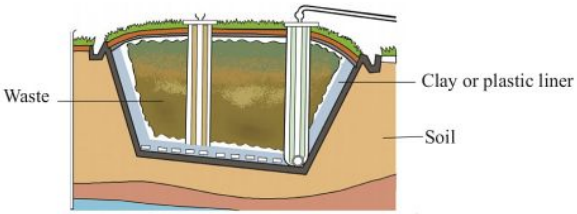


Figure 5.8: Sanitary landfill

However, even after a landfill is covered with soil, the wastes remains for a long time and can pollute the surrounding area. This happens because there is little oxygen and moisture in a landfill, therefore the wastes decomposes very slowly.

Incineration

Incineration is the process of burning materials until they are completely destroyed into ashes. Wastes are burnt inside a facility called an incinerator. An example is shown in Figure 5.9.

Incineration is usually done for hazardous materials such as health care wastes. It is important to wear protective clothings, gloves, mask, and gumboots to avoid contamination and inhalation of hazardous fumes during incineration.

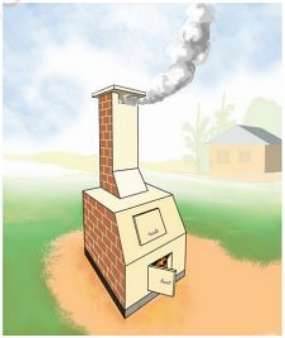


Figure 5.9: Incinerator

Recycling

Recycling is a process of turning waste materials into useful products. For example, used plastic material are taken back to the factory for making new plastic items. Also, waste paper can be used to make tissue paper or newsprint paper. Worn out car tyres can be retreaded and re-used. Some plastic items can be melted and remoulded into new items. Old glass bottles can be crushed and melted to make new bottles. Table 5.2 shows some examples of wastes that are recycled to make new useful items.

Table 5.2: Examples of wastes and their recycled products

	Waste	New product
1.	 Waste paper	 Tissue paper
2.	 Plastic waste	 Basin

Composting

Composting is the process of making manure from biodegradable organic waste. To do composting, dig a hole and throw in all organic waste produced domestically or commercially. Compost can also be produced using a heap instead of a hole. Figure 5.10 shows a cross-section through a compost heap.

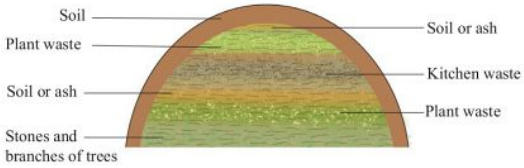


Figure 5.10: Cross-section through a compost heap

Examples of the organic biodegradable waste include branches of trees, grasses, leaves, sawdust, and kitchen waste. The heap is watered and turned regularly to encourage decomposition. After a few weeks, it decomposes into manure. When the compost manure is ready, it is used to fertilise farmland.

Non-biodegradable materials do not decompose into manure, therefore they should be handled properly.

Activity 5.2: Demonstrating ways of proper waste disposal

Materials: Notebook, pencil or pen, waste bins, shovels, waste dumps, rubber gloves, water, soap, marker pens, and manila sheets

Procedure

1. Go around the school and home environment.
2. Identify different types of wastes found in your environment.
3. Wear gloves and collect the wastes you have identified and listed in 2 above.
4. Sort the waste you have collected and suggest the proper ways of disposing them. For example:
   (a) make a compost heap using wastes from the kitchen or school farm;
   (b) throw unrecyclable wastes into the waste dump; and
   (c) take waste paper and plastics to a collection point if there is one.
5. Make a summary of what you have done on a manila sheet using marker pens.

Exercise 5.2

1. What is waste disposal?
2. State two ways that are commonly used to dispose wastes at home and school.
3. Using relevant examples distinguish recycling from re-using as principles of waste disposal.

Problems associated with waste disposal

Waste disposal has become a major problem due to bad practices of disposing waste in wrong areas. Due to lack of knowledge on the effects of poor waste disposal, people throw wastes indiscriminately on the environment. For example, people dispose wastes along footpaths, beaches, or along the roadside. Figure 5.11 shows wastes thrown along the beach.

Figure 5.11: Littered beach

The failure of urban cleaners to remove wastes from designated areas and inadequate disposal facilities increase waste disposal problem. Likewise, failure of local authorities to enforce the laws contribute to poor waste disposal.

Therefore, proper management of wastes should be emphasised. It is also important to promote and practice waste recycling. The public should be encouraged to buy products made from recycled materials. Figure 5.12 shows a symbol found on materials that can be recycled.

Fig. 5.12: Symbol for recyclable materials

The effects of poor waste disposal

Wastes are dangerous to everyone in the community if poorly disposed. Poor waste disposal may be associated with the following problems:

(a) Wastes in the streets and parks can be blown by the wind to other places and thus litter a wide area.

(b) Wastes on river banks and beaches may be carried by water and thus pollute aquatic environment.

(c) Wastes accumulated for a long time becomes breeding sites for cockroaches, houseflies, rats, and other pests that are vectors of many infectious organisms.

(d) Items such as broken glasses and discarded syringes can be hazardous in public places, especially to children who may use them as toys.

(e) Wastes can harm wildlife and domestic animals. Plastic bags can choke or suffocate animals when ingested. If swallowed, the bags may block the digestive tract of the animal leading to death.

(f) Wastes can block drainage channels and cause flooding during the rainy season.

(g) Rotten organic matter such as discarded vegetables and dead animals can cause water pollution if carried in waterways.

(h) Wastes degrade the natural beauty of the environment. This lower the value of areas such as beaches and gardens. An example of degraded beauty is shown in Figure 5.13.

Figure 5.13: Dirty environment

(i) When plastic and rubber materials are burnt, the smoke produced pollutes the air and can cause breathing difficulties.

(j) Plastic waste may interfere with the water cycle by preventing water from penetrating easily into the soil. Water may also accumulate inside plastic waste, thus creating breeding site for organisms such as mosquitoes, which transmit malaria parasites.

(k) Sewage and clinical wastes can transmit diseases.

(l) Decomposing wastes emit unpleasant smell.

Activity 5.3: Proper ways of disposing waste in the community

Materials: Notebook, a pen or a pencil, manila paper, coloured pens, paints and paint brushes

Procedure

1. Take a walk around your school. List down all the improperly disposed wastes that you see.
2. Visit a dump site or an incinerator in a school or hospital, a recycling plant or a sewage treatment plant. Note down the types of wastes disposed there. Are they properly disposed?
3. Discuss with your classmates the effects of poor waste disposal on the visited areas.

4. Write in your notebook the best ways of disposing wastes in the visited area.
5. Make a poster that can be used in awareness campaign on proper methods of waste disposal and the effects of poor waste disposal.

Exercise 5.3

1. Explain the advantages of proper waste disposal.
2. Why is waste disposal a problem to our environment? Give three reasons
3. Explain four effects of poor waste disposal.

Ways of reducing waste

Every initiative we take to decrease the amount of waste we produce helps in reducing the overall quantities of waste that needs to be disposed. This helps to conserve the environment by keeping it clean. The following are simple ways in which we can reduce waste:

(a) Use cloth instead of paper to wipe surfaces, for example windows and furniture. It is much cheaper and reduces the amount of waste paper in the environment.

(b) Use a cloth or woven shopping bags. Compared to plastic or paper bags, they hold more goods, are easier to carry, protect glass jars and bottles better, last longer, and save resources. An example of a woven basket is shown in Figure 5.14.

Figure 5.14: Woven shopping bag

(c) Collect and use plastic containers to store food. They are more durable than plastic bags. They leak less, reduce odours in the refrigerator, keep the food fresh for a long time, and prevent dry foods from moulds.

(d) Buy rechargeable batteries and their chargers instead of disposable batteries. Rechargable batteries can run almost anything from flashlights to digital cameras. In the long run, it is cheaper and better for the environment. An example of rechargeable battery is shown in Figure 5.15.

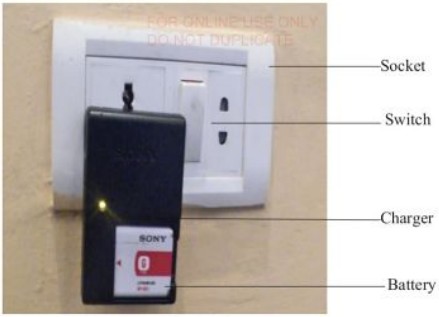


Figure 5.15: Charging a battery using a battery charger

(e) Initiate awareness campaigns in your community on the proper ways of disposing waste as many people are not aware of the effects of poor waste disposal.

(f) Use plastics that can be recycled or re-used and buy products made from recycled materials.

(g) Urban cleaners should collect and get rid of waste in public areas regularly.

Chapter summary

1. Waste refers to things that are no longer needed, or used.
2. Waste disposal refers to the ways that we use to get rid of waste.
3. Waste can be in solid, liquid, sludge, or gaseous form.
4. The basic principles of waste disposal are to:
   (a) reduce the amount of waste we produce,
   (b) re-use items, and
   (c) recycle waste.
5. Common methods of waste disposal are burying, incineration, recycling, and composting.
6. Methods of burying waste include the use of dumps, landfills, and pit latrines.
7. An incinerator is a facility used to burn hazardous waste materials.
8. Recycling is the process of turning waste into usable products.

9. The effects of poor waste disposal include having dirty and untidy environment, creation of breeding sites for disease vectors, and pollution of the soil, water, and air.
10. We can reduce waste by:
    (a) using cloth instead of paper to wipe surfaces.
    (b) using cloth or woven shopping bags instead of plastic bags.
    (c) using plastic food containers instead of plastic bags.
    (d) using rechargeable batteries.
    (e) using plastics that can be recycled or re-used.
    (f) buying products made from recycled materials.

Revision exercise 5

1. Choose the word or phrase from the box that best matches each of the following phrases and write it in the space provided.

Incineration	Organic matter
Pit latrine	Waste disposal
Recycling	Biodegradable waste
Biohazardous waste	Landfill
Tipping	Re-use

(a) Discarded vegetables and dead animals._____
(b) Getting rid of wastes._____
(c) Site for dumping waste and covering it with soil._____
(d) Burning of wastes._____
(e) Making useful products from wastes._____
(f) Using a product more than once._____
(g) Waste products that can transmit diseases._____
(h) Wastes collected in litterbins and later collected by trucks._____

2. Effective ways of reducing waste are displayed in each of the following EXCEPT_____.
   (a) using recycled materials
   (b) using rechargeable batteries
   (c) buying new plastic shopping bags every time we go shopping
   (d) using cloth instead of paper to clean windows

3. Medical waste is described as_____.
   (a) biohazardous
   (b) reusable materials
   (c) biodegradable
   (d) recyclable

4. Which of the following can be caused by burning plastic waste materials?
   (a) Bruised skin
   (b) Joint pains
   (c) Heart problems
   (d) Breathing problems

5. The following are reasons why waste disposal is a problem EXCEPT_____.
   (a) inadequate litterbins
   (b) disposal of waste in wrong areas
   (c) enforcing punishments to discourage littering
   (d) failure of cleaners to collect waste from public places

6. Which among the items below does NOT emit gaseous waste?
   (a) Car
   (b) Chair
   (c) Incinerator
   (d) Insecticide sprays

7. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.
   (a) Using cloth instead of paper to clean windows helps to reduce waste. _____
   (b) Biohazardous waste can spread infections and diseases. _____
   (c) We should buy new paper shopping bags each time we go shopping. _____
   (d) Biodegradable waste cannot decompose. _____
   (e) Compost heaps are one of the ways in which we can recycle kitchen waste. _____
   (f) Plastic bags can suffocate animals if ingested. _____
   (g) The best way to dispose sewage is by incineration. _____

8. Give three examples of each of the following:
   (a) Clinical waste
   (b) Household waste
   (c) Industrial waste

9. Explain three methods of waste disposal.
10. What can be done to reduce waste at home and school?

Chapter Six

Personal hygiene and good manners

Introduction

Personal hygiene and good manners are the basis for making an individual socially accepted in any community. Good manners involve behaviours such as honesty, respect for others, politeness, and helping others, while personal hygiene is concerned with cleanliness behaviours that can help in maintenance of good health. In this chapter, you will learn the concepts and principles of personal hygiene and good manners. You will also learn about the requirements of personal hygiene and good manners, and the ways of maintaining proper personal hygiene and good manners during puberty. Lastly, you will learn the importance of personal hygiene and good manners. The competencies developed from this chapter will enable you to successfully maintain good health and demonstrate behaviours that are socially acceptable within your family, neighbourhood, and community.

Concepts of personal hygiene and good manners

Personal hygiene is the practice of keeping the body, belongings, and the environment clean in order to maintain good health. Due to its necessity in life, personal hygiene skills are primarily emphasised to young people. Such skills include body cleanliness, and wearing clean clothes. As an individual grows, the personal hygiene responsibilities advances from self-help to helping others and maintaining their hygiene at family level and the surrounding community.

Good manners are behaviours that are socially acceptable. They include honesty, respect for others, politeness,

and helping others. These behaviours are also learnt throughout our lives from a tender age. They enable a person to be accepted by the society. In this manner personal hygiene is also part of good social manners.

Principles of personal hygiene

(a) Brush teeth at least twice a day; in the morning and before going to bed. Figure 6.1 (a) shows a girl brushing teeth.
(b) Take bath twice every day. Figure 6.1 (b) shows a person taking bath.

(a) (b)

Figure 6.1: Cleanliness (a) brushing teeth (b) bathing

(c) Always wear clean clothes.
(d) Wash hands with soap and clean running water after visiting the toilet and before eating.
(e) Rinse the mouth with clean and safe water after eating.
(f) Keep the environment clean. The environment includes bedroom, home, village, desk, classroom, and school.
(g) Cover the mouth and nose with a clean handkerchief or tissue when sneezing or coughing as shown in Figure 6.2.

Figure 6.2: Covering the nose and mouth while sneezing or coughing

(h) Keep nails short and clean.
(i) Do not share handkerchiefs, towels, and clothes, especially underwears.

(j) Comb hair every day as shown in Figure 6.3 or keep hair well plaited.

Figure 6.3: Students with well-kept hair

(k) Change beddings regularly.
(l) Wear comfortable and well-fitting clothes.
(m) Do not spit on the ground. Spit onto a tissue paper.
(n) Avoid picking nose and biting nails.
(o) Avoid touching other people's body fluids such as blood, urine, vomitus, and saliva with bare hands.
(p) Use a clean toilet for relieving yourself.
(q) Make sure pets are kept clean. Keep pet litter out of the living room.

Principles of good manners

(a) Maintain a good posture when sitting or standing. A proper sitting posture is shown in Figure 6.4.

Figure 6.4: Good sitting posture

(b) In a conversation:
   (i) Speak in a clear voice. Do not shout.
   (ii) Do not interrupt when another person is talking.
   (iii) Do not use foul language.
   (iv) Listen attentively to what the other person is saying.
   (v) Avoid dwelling on topics that are boring or embarrassing to other people.
   (vi) Do not dominate the conversation. Give other people a chance to talk.
   (vii) Be respectful when you disagree with someone's opinion.

(c) Welcome visitors warmly. Introduce them to people they do not know.

(d) Be helpful to other people. If possible, give assistance to the needy as shown in Figure 6.5.

(e) Give up your seat to an elderly person, handicapped, or pregnant and breast feeding woman when on a crowded bus or train.

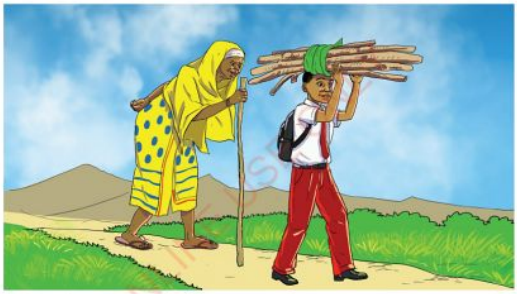


Figure 6.5: Boy helping an old woman to carry firewood

(f) Greet people politely. If sitting, then stand upright. If walking or running, then stand still.

(g) Be punctual when meeting or visiting someone.

(h) Dress properly according to the occasion and the social norms of the community.

(i) Cover the mouth when coughing or yawning.

(j) While eating:
   (i) Chew when the mouth is closed.
   (ii) Chew at a reasonable pace.
   (iii) Use proper serving spoons to serve food.
   (iv) Do not talk.
   (v) Avoid issues that are likely to make other people lose appetite.

(vi) Serve yourself reasonable portions of food.

(vii) Do not waste food. Finish what you have on your plate.

(viii) Avoid criticizing the food prepared by other people.

(k) Say 'please' when requesting for something.

(l) Say 'thank you' when given something or allowed to do something.

(m) Show respect to others.

Requirements of personal hygiene and good manners

The following things can help us to maintain personal hygiene and good manners:

(a) Listen to the advice from other people. Good advice helps us to improve personal hygiene and maintain good manners.

(b) Acquire and use the items needed to keep yourself and the environment clean. These items include soap, towels, combs, brushes, toothbrushes, basins, buckets, scissors, dustbins, and brooms.

Activity 6.1: Maintaining personal hygiene

Materials: Clothing, soap, water, comb, brush, towel, basins, bucket, toothbrush, handkerchief, and charts showing how to take care of the body and clothes

Procedure

1. In groups, discuss the requirements of personal hygiene.
2. Role play on how to clean your bedroom, body, and clothes.
3. Compare your methods with those of the other group members. What can you learn from them?

Importance of personal hygiene and good manners

(a) Personal hygiene is important for good health. Some skin conditions such as scabies and ringworm affect people who do not adhere to personal hygiene.

(b) They make a person more acceptable and respectable in the community.

(c) They are important for personal appearance. A well-groomed and behaved person is more attractive than a dirty and ill-mannered one.

(d) Maintaining personal hygiene and good manners makes us good role models to other people in the community.

(e) They promote peace of mind, thus enabling people to concentrate on their work, studies, and other activities.

(f) They improve confidence of an individual.

Activity 6.2: Investigating the importance of personal hygiene and good manners.

Materials: Wall pictures, charts, educational slides, and films depicting people with good personal hygiene and good manners, power point projector, DVD player

Procedure

1. Look at the wall pictures and charts.
2. Watch the power point slides, and DVD film.
3. In groups, discuss the aspects of personal hygiene and good manners you have observed.
4. Role play how to maintain personal hygiene and good manners.
5. Discuss the importance of personal hygiene and good manners.
6. Present what you have discussed to the class.

Maintaining proper personal hygiene during puberty

Puberty is the period when young girls and boys begin to mature biologically, psychologically, and socially, and become capable of reproduction. Usually puberty occurs between ages of 10 to 14 years for girls and 12 to16 years for boys.

During this time, they develop secondary sexual characteristics which create distinct differences between males and females. Puberty leads to **adolescence**, which is a transitional period between childhood and adulthood.

Secondary sexual characteristics and changes in girls at puberty

The features that develop in girls at puberty include:

(a) Development and increase of breast size.
(b) Sweat and oil glands become more active leading to changes in body odour.
(c) Increase in secretion of mucus from the vagina.
(d) Beginning of ovulation and menstruation.
(e) Development of hair under the armpits and in the pubic areas.
(f) Increase in height and weight.
(g) Development of a soft and high pitched voice.
(h) Development of pimples in some girls.
(i) Broadening of hips and pelvic girdles.

Some of the features that develop in girls at puberty are shown in Figure 6.6 (a).

Secondary sexual characteristics and changes in boys at puberty

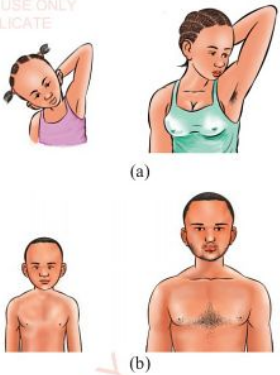
The features that develop in boys at puberty include:

(a) Enlargement of testes and penis.
(b) Sweat and oil glands become more active leading to changes in body odour.
(c) Sperm production begins.
(d) Development of hair under the armpits, pubic regions, chest, abdomen, and beard for some boys.
(e) Increase in height and weight.
(f) Development of a deep and coarse voice.
(g) Development of facial pimples in some boys.
(h) Wet dreams begin.
(i) Development of muscles on chest and shoulders.

Some of the features that develop in boys at puberty are shown in Figure 6.6 (b).

Development of these changes is facilitated by good nutrition.

(a) Therefore, adolescent girls and boys should eat balanced meals.
(b) Girls should eat iron rich food such as red meat and beans to enhance blood production and prevent anaemia.
(c) Adolescent boys and girls should reduce eating foods with high amount of sugar, fats or oil, and salt to prevent non communicable diseases.



(a)

(b)

Figure 6.6: Physical changes at puberty (a) a girl (b) a boy

Measures for maintaining personal hygiene during puberty

It is important to maintain personal hygiene so as to prevent bad odour and infections during puberty. The following are important measures in maintaining personal hygiene during puberty:

(a) Take a bath at least twice daily as the body produces more sweat at this stage. Use toilet soap and deodorant if possible. Lemon or lime can also be used to minimize the smell of sweat.
(b) Wear clean clothes all the time and wash dirty bedding and clothes frequently.

(c) Girls should wear good quality, clean, and safe **sanitary pads** during menstruation and change them often. Wash your hands with soap and clean water after handling menstrual hygiene products.

(d) Use a new razor blade or a pair of scissors to shave the hair growing under the armpits and pubic regions.

Good manners during puberty

During puberty, young people undergo emotional changes. They may experience strong emotions such as anger or anxiety and sudden mood changes. Their moods change suddenly. Teenagers also start to get attracted to members of the opposite sex. Despite these changes, it is important to maintain good behaviours. The following measures can help adolescents to behave well:

(a) Resist bad peer pressure, for example consumption of narcotic drugs or involvement in rebellious behaviours.

(b) Get counselling from a reliable people, for example your teachers, parents, healthcare workers, or religious leaders, if you have a problem.

(c) Apologize if you hurt other people's feelings.

(d) Do not engage in sexual acts before marriage.

(e) Be respectful to your elders even when you have different opinions from them.

(f) Get involved in positive extracurricular activities such as gardening, sports and games, school clubs, debate, and drama.

Activity 6.3: Demonstrating personal hygiene and good manners during puberty.

Materials: Samples of good cosmetics, soap, power point projector, charts showing people with good personal hygiene and good manners, posters, and slides showing the effects of drug abuse and bad peer pressure.

Procedure

1. Look at the posters and slide shows.
2. Look at the samples of personal hygiene products.
3. In groups, discuss how to maintain proper hygiene and good manners during puberty.
4. Role play on how you can maintain proper hygiene and good manners in different situations.
5. Discuss what can happen if you do not maintain proper hygiene and good manners.
6. Present what you have discussed to the class.

Chapter summary

1. Personal hygiene is the practice of keeping your body and environment clean in order to maintain good health.
2. Good manners refers to behaviour that is socially acceptable.
3. Some ways of maintaining personal hygiene include keeping the body clean, wearing clean clothes, covering the mouth and nose when sneezing or coughing, eating healthy and safe food, relieving yourself in a clean toilet, and cleaning your surroundings.
4. Principles of good manners include:
   (a) speaking respectfully
   (b) being helpful to others
   (c) being punctual
   (d) dressing properly
   (e) chewing food with the mouth closed
5. Personal hygiene and good manners are important because they:
   (a) help to maintain good health,
   (b) help to earn respect in the community,
   (c) improve one's appearance, and
   (d) make us good role models.
6. Puberty is the stage when young people mature biologically, psychologically, and socially, and become capable of reproduction.
7. During puberty, it is important to maintain good personal hygiene in order to be healthy and prevent bad body odours.
8. At puberty, emotional changes may affect one's behaviour. However, it is important to resist bad behaviours such as:
   (a) taking narcotic drugs
   (b) sexual promiscuity
   (c) being rude to elders

Revision exercise 6

1. Personal hygiene is important for good health and personal appearance.
   (a) What is personal hygiene?
   (b) Outline six principles of personal hygiene.
2. Maintenance of personal hygiene requires various items. List any six items and their uses.
3. Using relevant examples answer the following questions:
   (a) What is good manners?
   (b) Outline any six principles of good manners.
4. Using relevant examples:
   (a) Describe bad habits you have seen among your classmates.
   (b) State the effects of each bad habit described in 4(a) above on respective individuals.
5. How can you maintain good manners when you are invited for dinner at your neighbour's house?
6. You have been invited to a friend's party. The party will last up to 9 p.m. You are very eager to attend the party but your parents disapprove your request. What should you remember when discussing this issue with your parents?
7. (a) What is puberty?
   (b) Puberty causes both physical and emotional changes in adolescents. Using relevant examples differentiate these types of changes in adolescents.
8. Describe five things you should do and five things you should not do during puberty.
9. Explain three important things to consider in order to prevent unpleasant odour and diseases during puberty.
10. Explain any two diseases that may be caused by lack of personal hygiene during puberty.
11. Identify the violated principle of personal hygiene or good manners, its effect, and the possible remedies required in the following situations:
    (a) Most of the classmates furiously left the dining table because of Mr. Tumbotumbo's talkative behaviour while eating.
    (b) Many students in the class do not want to form a group with Mzilikazi because his pants smell unpleasantly.
    (c) "It is very difficult to talk to Mrs. Mwendokasi, before you finish a sentence she interrupts", Mama Salumu complained.
    (d) "Do not seat very close to Neiwada as she yawns and coughs without covering her mouth", Lazarus warned her young sister.
    (e) "I hate Mr. Malikauli's behaviour of spiting everywhere", Nsenga remarked.

Chapter Seven

Health, immunity and diseases

Introduction

A healthy person is the one whose body is physically, mentally, and socially well. The human body has a mechanism to resist infections and diseases. In this chapter, you will learn about health and immunity, types of immunity, factors affecting body immunity, and common infections and diseases. The competencies developed from this chapter will enable you to protect yourself and others from common infections and diseases.

Health and immunity

Health is a state of being physically, mentally, and socially well and not merely the absence of diseases. A person's health can be affected by factors such as diet, physical fitness, hygiene, social circumstances, heredity, environment, medical care, and immunity.

How to maintain good health

For people to maintain good health, they should:

(a) Reduce intake of unhealthy food such as canned foods that contain chemical preservatives, bottled juices that contain, extra sugar, and deep fried foods such as fried potatoes. They should also reduce intake of refined foods and increase intake of fresh fruits, vegetables, and whole grains.

(b) Have regular physical exercise at least 30 minutes per day and three days per week.

(c) Get sufficient sleep in a well-ventilated room at least 8 hours per day.

(d) When facing problems seek help from parents, counsellors, and teachers.

(e) Allow time for leisure.

(f) Take medical drugs only when prescribed by a registered health practitioner.

(g) Avoid smoking.
(h) Avoid narcotic drugs such as bhang (marijuana), heroin, and cocaine.
(i) Eat balanced diet.
(j) Drink enough amount of clean and safe water.
(k) Always keep the body clean.

The body's defence systems

The human body has defence systems that either prevent microorganisms from entering the body or combat them when they manage to enter the body. There is a defence system in the skin, eyes, ears, digestive system, and blood that prevent the entry of microorganisms.

Skin

Intact skin is a physical barrier against entry of pathogens. Sweat glands in the skin produce sweat, which contains antibacterial agents that kill bacteria. Sebaceous glands of the skin produce oily substance (sebum) which contains antibacterial agents that kills bacteria on the skin.

Eyes

Tear glands found in the upper eyelids produce tear. This fluid contains anti-bacterial agents. Eye lashes, eye lids, and eye brows prevent dust particles and other foreign bodies from entering the eyes.

Ears

The lining of the ear canal produces waxy material, which traps bacteria, viruses, and small dust particles.

Digestive system

Salivary glands in the mouth produce saliva, which is a mild antibacterial agent. The mouth also has useful organisms, which protect it from various infections. Hydrochloric acid produced by the stomach walls also destroys and kills most bacteria taken in with food. Likewise, the digestive juices produced in the small intestine digest and kill the bacteria in the intestine.

Blood

Blood comprises of lymphocytes and phagocytes. The lymphocytes produce antibodies that destroy pathogens. The phagocytes likewise engulf the microorganisms invading the body through the blood, thus defending the body against disease-causing organisms.

Immunity

The human immune system consists of white blood cells, the lymphatic system, spleen, thymus, skin, and the bone marrow. These organs need to be kept in good condition in order for the body to have adequate immunity.

Immunity is the ability of the body to resist against infection. It builds defence against infections and thus helps an individual to remain healthy. Immunity is made possible by the immune system. The immune system recognise foreign materials known as **antigens**. Antigens are proteins that

are found on the surface of pathogens that cause infections and diseases. In response to antigens, the immune system produces chemical substances called **antibodies**. Antibodies fight against the invading antigens.

Types of immunity

Immunity can be classified as natural or artificial.

Natural immunity

This immunity is inborn and exists even before the body is exposed to an antigen. It can also result from natural exposure to an antigen. It is the inherited ability of the body to remain resistant or unaffected by a specific disease.

Artificial immunity

This immunity occurs when a person's immune system is induced to produce an immune response.

Natural and artificial immunity can either be active or passive. Active immunity involves inducing the body to produce its own antibodies to fight an infection. It takes several weeks to be activated but provides long-lasting protection. This is because it involves memory cells which recognise an infection if it recurs. Passive immunity is acquired when antibodies are produced by one person and then transferred to another person. This provides an instant but short-lived protection.

Natural active immunity

Natural active immunity is present even before the body is exposed to an infection or as a result of previous infection. When an infection occurs, the body produces antibodies to fight the antigens. For example, if a person has a wound, antibodies are produced to prevent the wound from getting infected. If a child is also infected with measles, the body develops antibodies against measles antigens and can therefore resist future attacks.

Natural passive immunity

This takes place when a mother passes antibodies to her baby during pregnancy and breastfeeding. The immunity lasts for a few weeks or months during which the baby develops its own immunity. Figure 7.1 shows a mother breastfeeding her baby.

Figure 7.1: Breastfeeding a baby

Artificial active immunity

This immunity is acquired through **immunisation** or **vaccination** using **vaccines**. A vaccine is a preparation containing inactivated or weakened disease-causing organisms. Some vaccines are orally taken while others are injected into the body as shown in Figure 7.2.

Figure 7.2: Vaccination by injection

The vaccine causes the body to produce antibodies as if it is being attacked by the real antigen. Some of the body's cells that take part in the immune response remain as memory cells which can rapidly reproduce themselves if a real infection occurs. This type of immunity is the one that is passed on during the routine immunisation of infants and children.

The incidences of diseases such as measles, tuberculosis, diphtheria, whooping cough, tetanus, yellow fever, chickenpox, Hepatitis B, and polio have been greatly reduced or eradicated through vaccination. For instance, after successful vaccination campaigns all over the world, smallpox was eradicated in 1979.

Artificial passive immunity

Artificial passive immunity is acquired when antibodies produced by one individual are injected into another individual. This immunity provides an instant response in short-term because the antibodies used are not the body's own, so no memory cells are created. Such immunity is used for potentially **fatal** diseases such as **rabies, tetanus,** and **Ebola**. It is also used in cases where the immune system is very weak, for example in AIDS patients.

Exercise 7.1

1. What is health?
2. Mention the factors affecting one's health.
3. Differentiate between:
   (a) natural active immunity and natural passive immunity
   (b) artificial active and artificial passive immunity

Activity 7.1: Vaccination

Materials: Vaccination card, notebook, pen or pencil, charts on vaccines, and vaccines

Procedure

1. Visit a nearby health care facility.
2. Look at charts with information on vaccines and vaccination.
3. Find out from the health practitioner which types of vaccines are available at the facility, to whom they are given and which methods are used to administer them.
4. Ask permission to observe while children are being vaccinated.
5. Inquire from the health practitioner how vaccines have been used to prevent diseases.
6. Write down what you have learned.
7. Present your report to the rest of the class.

Factors affecting immunity

Immunity can be affected by factors such as:

Poor nutrition

Poor nutrition has a negative effect on the immune system. People who do not get a balanced diet are easily attacked by diseases. It is important to have adequate amounts of proteins, carbohydrates, fats, vitamins, and mineral salts in our diet in order to improve the body's immunity.

Lack of vaccination

If a person is not vaccinated against some diseases, there is a higher chance of getting infected. For example, a child who is not vaccinated against measles may get the infection easily if there is an outbreak. Once a person

gets a disease, it is too late to vaccinate. He or she has to get medical service.

Genetic disorders

Some people are born with conditions that affect their immunity. For example, people with the sickle cell trait are less prone to malaria. Additionally, children with Down's syndrome are more prone to respiratory tract infections.

Incomplete treatment

If a sick person does not take a complete dose of treatment for an infection or disease, this may affect immunity. This is because the disease-causing organisms are not completely destroyed and can therefore be re-activated easily, causing the infection or disease to recur.

Attack by pathogens

Pathogens are organisms that cause diseases. Some pathogens such as HIV destroy white blood cells, which are important part of the immune system. This makes the body more susceptible to infections.

Extreme stress

Stress is the failure of a person to cope with the problem he or she is facing. A person may experience stress when he or she contracts disease or gets bad news such as death of a close relative. A person may also experience stress due to accidents or any other condition that affect the body, for example loss of body parts like legs or arms. These situations may lower body immunity.

Damage to the skin

The skin acts as a barrier, preventing organisms from entering the body. When the skin is damaged, for example due to severe burns or numerous cuts, this barrier becomes weak. Disease-causing organisms can therefore enter the body more easily.

Age

Children under five years and people above sixty years have lower immunity to some diseases such as malaria and flu.

Infections and diseases

An infection occurs when pathogens invade the body. Pathogens are organisms that cause diseases. They include viruses, bacteria, fungi, protozoa, and worms.

A disease is a condition that interferes with the health of the body. It can be caused by an infection, an inborn condition, or environmental and social factors. Diseases are usually characterised by certain symptoms.

There is a difference between an infection and a disease. Infection simply means a disease-causing organism

is inside a person's body but an infected person does not always show symptoms of being unwell. A disease is a noticeable condition of being unwell after infection. Disease can cause the following negative effects:

(a) weakness and inability to work or study;
(b) increased cost of health care;
(c) stress to the sick person and the family;
(d) reduced productivity due to absenteeism from the workplace or reduced ability to work;
(e) permanent damage to the body; and
(f) death.

Diseases can be classified into two categories, communicable and non-communicable.

Communicable diseases

These are diseases which can spread from an infected person to another. They are caused by pathogens such as viruses, bacteria, fungi, protozoa, and helminths (worms). The pathogens can be spread in the following ways:

Droplet

Secretions from an infected person are transferred from the nose or mouth onto surfaces or hands by droplets produced when sneezing, spitting, coughing, or speaking. Examples of diseases spread by droplet infections are tuberculosis, COVID-19, and flu or influenza.

Contact

Some pathogens can be transmitted from an infected person to another through direct or indirect contract. Direct contact involves coming into contact with an infected person for example through skin to skin contact, kissing, and sexual intercourse. Indirect contact involves touching belongings of an infected person like clothing, combs, wound dressings; or touching contaminated surfaces like door knobs, utensils, or table surfaces. Scabies and measles are examples of contagious diseases.

Sexual intercourse

Some pathogens can be transmitted from an infected person to another through sexual contact. Examples are pathogens causing infections and diseases such as gonorrhoea, syphilis, HIV and AIDS, Hepatitis B, and Hepatitis C. These are also known as sexually transmitted infections (STIs), and diseases (STDs).

Contaminated food and water

Some pathogens are discharged in the faeces or vomitus of infected persons and can be transmitted through water, food, or both. Cholera and typhoid fever are spread in this way.

Vectors

Some pathogens are spread by organisms such as snails, mosquitoes,

and tsetse flies. Organisms that carry pathogens are known as vectors. Examples of diseases transmitted by vectors are malaria, sleeping sickness, dengue fever, and plague.

Communicable diseases can also be classified according to their occurrence.

An **epidemic** is a communicable disease outbreak that affects a large number of people in a short period of time at a given locality. Examples are cholera, meningitis, tuberculosis, and plague.

A **pandemic** is a communicable disease outbreak that becomes widespread in a large geographical area such as a continent or the whole world, for example, COVID-19, and AIDS.

An **endemic** disease outbreak occurs in a given area constantly. For example, malaria and bilharzia are endemic in many areas where there is stagnant water.

A **sporadic** disease outbreak occurs occasionally and at random intervals, for example Ebola and Rift valley fever.

Non-communicable diseases

These diseases are not infectious. They cannot be transmitted from one person to another. Non-communicable diseases may be caused by deficiency of nutrients, environmental pollutants such as smoke or harmful radiation, chemicals, and genetic defects. Examples of non-communicable diseases are sickle-cell disease, diabetes, cancer, ischaemic heart disease, and hypertension (high blood pressure).

Common infections and diseases

Table 7.1 shows examples of communicable infections and diseases whereas Table 7.2 shows examples of non-communicable diseases that are common in Tanzania. The tables also show causes, symptoms, modes of transmission, effects, and preventive measures against each infection and disease.

Table 7.1: Communicable diseases and infections

Disease	Cause and transmission	Risk factors	Symptoms	Effects	Prevention/ Control
COVID-19	Caused by Corona Virus -19 It can be transmitted through: • Coming into contact with an infected person • Inhaling air droplets from an infected person • Touching surface that have been contaminated by virus when touching eyes, nose and mouth	Anyone is at risk of being infected with Covid-19 • However people with underlying medical conditions such as diabetes, hypertension, sickle cell anaemia, HIV and AIDS, asthma, and cancer are at higher risk	• Fever • Headache • Dry cough • Tiredness • Difficulty in breathing or shortness of breath • Joint aches and pains • Loss of smell or taste • Abdominal pain, diarrhoea, and vomiting **Note:** Infected individuals may be asymptomatic	• Lung damage, blood clotting, and can lead to death	• Avoid unnecessary gatherings • Frequently wash your hands thoroughly with soap and clean running water • Use hand sanitizers as often as possible • Wear masks when going to public places • Seek medical care at nearest health facility • Keep social distance • Isolation of patients • Seek immediate medical treatment

Disease	Cause and transmission	Risk factors	Symptoms	Effects	Prevention/ Control
Upper Respiratory Tract Infection (URTI) Example flu or influenza, and cough	Most of these diseases are caused by virus. However, some infections such as flu are caused by allergy Transmitted by: • Contacting body fluid of sick person • Air (air borne)	• Crowded areas • Having allergy to pollen, dust and some kind of smells like perfumes • Low body immunity	• Fever • Headache • Dry cough • Tiredness • Difficulty in breathing or shortness of breath • Running nose	Affects upper respiratory tract.	• Frequently wash hands thoroughly with soap and clean running water • Use clean and ironed handkerchiefs • Wear masks in public or dusty places • Seek immediate medical treatment
Ebola	Caused by Ebola virus Transmitted by: • Contacting body fluids from a sick person or a person that died recently from the disease • Consuming or contacting an infected chimpanzee or monkey	• Living in places where they consume chimpanzee or monkey meat • History of travelling to places with Ebola outbreak	• Fever • Body weakness • Bleeding through body orifices (nose, eyes, mouth, anus, urethra, and ears)	• Affects spleen and kidneys • Damage of the immune system • Death	• Restrict travel to places or countries with Ebola outbreak • Quarantine the affected areas and individuals • Avoid body contact with an infected person • Do not consume wild meat without knowing the source • Seek immediate medical treatment

Disease	Cause and transmission	Risk factors	Symptoms	Effects	Prevention/ Control
Cholera	• Caused by bacteria called *Vibrio cholerae* • Spread through ingesting contaminated food or drinks	• Poor environmental sanitation and hygiene • Water scarcity • Poor personal hygiene	• Watery diarrhoea like rice water • Vomiting • Sunken eyes	• Dehydration • Body weakness • Muscle cramps • May lead to death if not treated early	• Wash hands with soap and clean running water after using the toilet • Boil or treat drinking water • Wash hands with soap and clean running water before eating • Wash fruits and vegetables • Eat warm food • Use toilet properly • Cover the food • Pit latrines should be covered • Seek immediate medical treatment
Meningitis	• Caused by bacteria called *Meningococcus* sp. • Spread through droplets when coughing, sneezing, or kissing	• Living in crowded areas • Poor housing structure • Low immunity	• Fever • Headache • Vomiting • Seizures or fits • Stiff neck • Delirium	• Brain damage • Poor coordination of movements • Deafness • Paralysis	• Isolation of patients • Vaccination • Seek immediate medical treatment

Disease	Cause and transmission	Risk factors	Symptoms	Effects	Prevention/ Control
Tuberculosis (TB)	• Caused by bacteria called *Mycobacterium tuberculosis* • Spread by droplets when coughing or sneezing	• Low immunity • Visiting places with endemic TB cases • Poor living and working conditions • Smoking • Malnutrition • Indoor air pollution • Consumption of untreated milk from infected dairy animal	• Prolonged cough • Blood-stained sputum • Fever • Poor appetite • Weight loss • Lack of energy • Night sweats • Coughing	• Lung damage • Bone damage • Kidney damage • Bone infections • Hunchback • Damage to the immune system	• Vaccination • Avoid crowded areas • Avoid living in poorly ventilated houses • Patient who has started medical treatment should wear mask or be isolated for 14 days • Patients should cover nose and mouth when coughing or sneezing • Seek immediate medical treatment
Plague	• Caused by bacteria called *Yersinia pestis* • Spread by fleas found on rats	• Poor environmental sanitation • Poor procedures for handling and care of pet • Exposure to animals and insects • Poor public health inspection	• Inflammation of lymph nodes • Fever • Internal bleeding • Body aches • Coughing and shortness of breath	• Anaemia • Pneumonia	• Vaccination • Eliminating rats and fleas • Keeping house clean • Leftovers should be kept in tight vessels to discourage rat in houses • Seek immediate medical treatment

Disease	Cause and transmission	Risk factors	Symptoms	Effects	Prevention/ Control
Bilharzia/ Schistosomiasis	• Caused by *Schistosoma* sp. • Spread by aquatic snails	• Occupational factors like fishermen and paddy farmers • Poor environmental sanitation and hygiene • Access to water source	• Blood-stained faeces or urine • Abdominal pain • Fever • Tiredness • Enlarged liver and spleen	• Liver damage • Intestinal damage • Bladder damage • Kidney damage • Spleen damage • Anaemia	• Avoiding swimming in untreated stagnant water • Proper disposal of sewage • Wearing protective shoes when in water-logged areas • Draining stagnant water • Seek immediate medical treatment
Malaria	• Caused by a protozoa called *Plasmodium* sp. • Transmitted by female *Anopheles* mosquito	• Poor environmental sanitation and hygiene • Poor housing structure • Housing near breeding sites	• Chills • Fever • Sweating • Nausea and vomiting • Pain in joints • Headache • Abdominal pain	• Anaemia • Kidney failure • Liver damage • Brain damage • Spleen damage • Death	• Sleeping under treated mosquito nets • Draining stagnant water • Cutting long grass in residential areas • Using mosquito repellents • All septic tanks should be air tight and if possible fumigation should be conducted • Seek immediate medical treatment

Disease	Cause and transmission	Risk factors	Symptoms	Effects	Prevention/ Control
Scabies	• Caused by microscopic mites • Spread by skin-to-skin contact or sharing clothing, towels, and bedding	• Poor environmental sanitation and hygiene • Poor personal hygiene • Living in over crowded premises for example in prison, school, and dormitories • Age: young ones are likely to be infected • Water scarcity	• Intense itching • Rashes and burrows on the skin • Sores on the skin	• Persistent skin rashes • Damaged skin • Can lead to secondary infections	• Good personal hygiene • Wash contaminated clothes in hot water and dry them in the sun • Avoid sharing personal items, especially clothes and towels • Seek immediate medical treatment
Rabies	• Caused by Rabies virus Transmitted through: • Scratches or bites from infected cats, dogs, jackals, humans or other animal. • Organ transplants from infected people • Direct contact of eyes, nose, and mouth with the saliva of an infected animal	• Poor environmental sanitation • Poor procedure for handling and care of pet • Exposure to animals and insects • Poor public health law enforcement	• Fever • Pain at the site of the bite • Difficulty swallowing • Restlessness • Muscle spasms • Convulsions • Loss of feeling • Drooling • Foaming at the mouth	• Damage to the nervous system • Brain damage • Paralysis • Death	• Pets should be taken care of • Stay away from suspicious pets • When bitten by a dog or other animals report immediately to a nearby health care facility • Vaccination • Seek immediate medical treatment

Table 7.2: Examples of non-communicable diseases

Disease	Cause	Risk factor	Symptoms	Effects	Prevention/ Control
Diabetes	Caused by insulin disorder	• Family history of diabetes • Obesity • Elderly • Unhealthy eating	• Prolonged fatigue • Weight loss • Excessive thirst • Poor healing of wounds • Frequent urination • Extreme hunger	• Blurred vision • Blindness • Kidney failure • Nerve damage • Damage to arteries	• Control body weight • Regular exercise • Do not drink alcohol • Eat balanced diet • Seek immediate medical treatment
Rickets	Caused by deficiency of calcium or vitamin D	• Inappropriate complementary feeding process during young age • Prolonged breast feeding without supplementary feeding	• Bone pain or tenderness • Muscle weakness • Bowed legs or knock knees • Muscle spasms	• Bone deformities	• Adequate intake of foods rich in Vitamin D and calcium • Exposure to morning and evening sunshine • Seek immediate medical treatment
Acute malnutrition	Caused by low protein diet, low carbohydrate intake, unbalanced diet, overeating	• Infection • Poverty • Lack of nutrition knowledge • Teenage pregnancy that may lead to under weight babies • Family norms	• Swollen abdomen • Reddish hair • Change of skin colour • Weight loss • Swelling of knees • Loss of appetite	• Retardation of body and brain	• Adequate intake of protein • Balanced diet • Seek immediate medical treatment

Disease	Cause	Risk factor	Symptoms	Effects	Prevention/ Control
Cancer	• Caused by abnormalities in the genetic material as a result of mutations or due to carcinogens such as tobacco smoke, radiations, chemicals, and infectious agents Some cancer are caused by: • Viruses for example Human Papilloma Virus (HPV) which cause cervical cancer • Chemicals and radiation for example skin cancer	• Family history of cancer • Prolonged low consumption of fruits and vegetables • Chronic infections of diseases such as Hepatitis B • Exposure to harmful radiations such as X-rays • Having many sexual partners • Exposure to chemicals containing ingredients of mercury, lead, and cadmium • Ingesting food contaminated with toxins such as afflatoxins	• Unusual swellings (tumours), bleeding, severe pain and ulcers • Enlarged liver and lymph nodes • Coughing • Weight loss • Poor appetite • Excessive sweating	• Damage to lung, prostate gland, breast, cervix, blood (Leukemia) • Severe pain, loss of organ, and death	• Avoid getting into contact with carcinogens, for example tobacco smoke and radiations • Vaccination, for example HPV and Hepatitis B • Healthy life style • Wear protective gears when using chemicals such as pesticides • Seek immediate medical treatment

Disease	Cause	Risk factor	Symptoms	Effects	Prevention/ Control
Glaucoma	Caused by high pressure in the eyes	• Older age • Family history of glaucoma • Internal structure of the eye • History of diabetes	• Eye pain, blurred vision, and seeing cycles of light around bright lights	• Blindness • Rupture of eyes-blood vessels	• Regular eye check-up • Control blood glucose • Eat balanced diet • Seek immediate medical treatment

Exercise 7.2

1. Explain five factors that affect immunity.
2. Differentiate infections from diseases.
3. Explain the causes, symptoms, and effects of the following diseases:
   (a) COVID-19
   (b) Malaria
   (c) Diabetes

Activity 7.2: Investigating common infections and diseases

Materials: Charts showing infections and diseases, notebook and pen or pencil, manila sheet, and marker pens

Procedure

1. Visit a nearby health facility.
2. Find out from health practitioners the most common infections and diseases treated at the health facility.
3. Write down the names of the infections or diseases along with their causes, mode of transmission, effects, and how they can be prevented.
4. Ask for clarification where you do not understand.
5. Prepare a report using the information you have collected.
6. Present your report to the rest of the class.

Chapter summary

1. Health is a state of physical, mental and social well-being.
2. Immunity is the ability of the body to resist infection.
3. The types of immunity are:
   (a) Natural immunity which exists in the body even before an infection occur or due to natural exposure to an antigen.
   (b) Artificial immunity which develops when a person's immune system is induced to produce an immune response due to deliberate human action.
   (c) Active immunity which occur when the body is induced to produce antibodies.
   (d) Passive immunity which involves the transfer of antibodies from one person to another.
4. Immunity can be affected by poor nutrition, lack of vaccination, genetic disorders, incomplete treatment, attack by pathogens, extreme stress, damage to the skin, and age.
5. An infection takes place when pathogens invade the body. An infected person may or may not show symptoms.
6. A disease interferes with the health of the body. A disease is characterized by certain symptoms.
7. Communicable diseases can be spread from infected person to a healthy person through droplets, contact with an infected person or items, sexual intercourse, contaminated food and drinks, or through vectors.
8. Examples of communicable diseases are cholera, meningitis, tuberculosis, plague, bilharzia, malaria, scabies, and influenza.
9. Non-communicable diseases cannot be spread from affected person to a healthy person. They can be caused by malnutrition, environmental conditions, chemicals, genetic defects, and stress. Examples of non-communicable diseases are diabetes, rickets, acute malnutrition, glaucoma, and cancer.

Revision exercise 7

1. Choose the word from the box that best matches each of the phrases and write it in the space provided against each phrase.

disease	vaccination	infection
pandemic	pathogen	endemic

   (a) A disease that occurs over a wide geographical area._____

   (b) The invasion of the body by a disease-causing microorganism._____

   (c) A way of inducing resistance against an antigen._____

   (d) A condition that affects the health of the body and is characterized by a certain symptoms. _____

   (e) A microorganism that can affect health if it gets into the body._____

2. Fill in the blanks

   (a) Sickle cell anaemia is an example of a _____ disorder.

   (b) Cholera can be prevented by_____.

   (c) Tuberculosis can be spread by_____.

   (d) Contagious infections can spread easily by_____.

3. Outline five factors affecting immunity.

4. Mention three ways in which diseases are spread.

5. Differentiate the following terms.

   (a) Endemic and epidemic diseases

   (b) Communicable and non-communicable diseases

   (c) Health and immunity

6. (a) Name the types of immunity.

   (b) State one advantage and one disadvantage of:

      (i) passive immunity

      (ii) active immunity

7. A child complains to her mother that she has a headache and pain in joints. She also feels uneasy, vomits, and has abdominal pain. Her mother realizes that the child also has a fever. She takes her to hospital.
   (a) Which disease do you think the child is suffering from?
   (b) What is the cause and mode of transmission of the disease?
   (c) How can the disease be prevented?

8. A middle-aged man is regularly visiting the local traditional healer claiming that he has been bewitched. He has a prolonged cough and is emitting blood-stained sputum whenever he coughs. He cannot eat properly because he has poor appetite and suffers weight loss. He is surprised that he sweats a lot during the night.
   (a) What would you advise the man to do?
   (b) Which disease is he likely to be suffering from?
   (c) What is the cause, and how is the disease mentioned in 8 (b) above transmitted?
   (d) What are the prevention measures for the disease mentioned in 8 (b) above?

Chapter Eight

STIs, STDs, HIV and AIDS

Introduction

Sexually Transmitted Diseases (STDs) first begin as Sexually Transmitted Infections (STIs). An infection occurs when pathogens such as viruses, bacteria, protozoans, fungi, and worms invade the body. The infected person may not show any symptom of being unwell. In this chapter, you will learn about STIs and STDs; HIV and AIDS; risky situations, behaviour and practices; and how to care and support People Living With HIV and AIDS (PLWHA). The competencies developed from this chapter will enable you to protect yourself and others and provide necessary care and support for the people living with STIs, STDs, HIV and AIDS.

STIs and STDs

STIs stands for **Sexually Transmitted Infections** whereas STDs stands for **Sexually Transmitted Diseases.** STIs and STDs are transmitted through unprotected sexual intercourse with an infected person. Not all STIs turn into STDs.

Activity 8.1: Investigating STIs and STDs

Materials: Pamphlets, charts, magazines, and slides on STIs and STDs, LCD projector, notebook, and pen or pencil

Procedure

1. In groups of four students, discuss about STIs and STDs. Give examples of STIs and STDs and their effects.
2. Watch the slides and read the pamphlets, charts, and magazines on STIs and STDs.
3. Write down the symptoms of various STDs.
4. Present what you have discussed to the class.

Table 8.1 summarizes some common STIs and STDs and their causes, symptoms, effects, and how to prevent or control them.

Table 8.1: Causes, symptoms, effects, prevention, and control of STIs and STDs

Infection/ Disease	Cause and Transmission	Symptoms	Effects	Prevention/ Control
Gonorrhoea	Caused by a bacterium called *Neisseria gonorrhoea* Spread by: • Unprotected sexual intercourse and other types of contact • Sharing personal items such as towels, underwear, and swimsuits • Infection from mother to her child at birth	• Foul yellow discharge from the penis or vagina • Burning pain when urinating • Retention of urine in males • Itching in the genital parts • Irregular menstruation	• Infertility • Swollen and painful joints • Complications in the reproductive system for both male and female	• Abstain from sexual intercourse • Do not share personal items such as towels, underwears, and swimsuits • Seek immediate medical treatment

Infection/ Disease	Cause and Transmission	Symptoms	Effects	Prevention/ Control
Syphilis	Caused by a bacterium called *Treponema pallidum* It is spread by: • Unprotected sexual intercourse • Infection from a pregnant mother to the foetus in her womb • Blood transfusion with infected blood	Syphilis occurs in three stages: **First stage** (Occurs between 3–4 weeks after infection) • Painless sore on sex organs • A sore that disappears after a week **Second stage** (Occurs between 8–14 weeks after infection) • Fever • Joint pain • Rashes • Raised bumps on the skin • Swollen lymph nodes **Third stage** (Occurs 2 years after infection) • In this stage the effects of syphilis are noticed	• Damage to bones, teeth, skin, digestive system, eyes, and nervous system • Mental instability • Blindness • Stillbirth babies • Hearing problems • Can lead to death	• Abstain from sexual intercourse • Use screened blood for transfusion • Testing and treating pregnant women • Seek immediate medical treatment

Infection/ Disease	Cause and Transmission	Symptoms	Effects	Prevention/ Control
Trichomoniasis	Caused by a protozoan called *Trichomonas vaginalis* It is spread by: • Sexual intercourse • Sharing personal items such as towels, underwear, and swimsuits	• Frothy, smelly yellow discharge from the vagina • Vaginal itching • Pain when urinating • (Men usually show no symptoms)	• A baby with low birth weight • Premature birth • Complication in the reproductive system for both males and females	• Abstain from sexual intercourse • Do not share personal items such as towels, underwear, or swimsuits • Medical treatment for both partners even if one has no symptoms
Candidiasis	Caused by fungi called *Candida* sp. It is spread by: • Unprotected sexual contact • Sharing personal items such as towels, underwear, and swimsuits • Poor personal hygiene	• Thick white discharge from the vagina • Vaginal itching • Thick white patches in the mouth • Inflammation of the glans penis • Skin rashes	• Infection of the blood stream	• Abstain from sexual intercourse • Do not share personal items such as towels, underwear, and swimsuits • Improve personal hygiene • Seek immediate medical treatment
Genital herpes	• Caused by a virus called *Herpes simplex* • It is spread by sexual intercourse	• Recurrent fever • Ulcers or blisters around the penis or vagina • Pain in or around the genital organs • Headache	• Recurrent painful ulcers • For pregnant women can lead to stillbirth	• Abstain from sexual intercourse • Medical treatment for both partners even if one has no symptoms

Infection/ Disease	Cause and Transmission	Symptoms	Effects	Prevention/ Control
Hepatitis B	Caused by hepatitis B virus It is spread by: • Sexual intercourse • Blood transfusion from an infected person • Contaminated blades and needles	• Jaundice (skin and eyes look yellowish) • Dark tea coloured urine • Abdominal pain • Pale-coloured stool • Fever • Nausea and vomiting • Itching all over the body • Feeling tired (fatigue) • Joint pain	• Liver damage • Liver cancer • Death	• Abstain from sexual intercourse • Vaccination • Do not share clinical needles and blades • Use screened blood for transfusion • Seek immediate medical treatment
Chlamydia	Caused by bacteria called *Chlamydia trachomatis* It is spread by: • Unprotected sexual intercourse • Infection from mother to child at birth	• Bleeding from the vagina after sexual intercourse • Irregular menstruation • Lower abdominal pain	• Infertility • Complication in reproductive system for both males and females	• Abstain from sexual intercourse • Medical treatment for both partners even if one does not show symptoms • Regular attendance of clinic for early diagnosis and treatment

Infection/ Disease	Cause and Transmission	Symptoms	Effects	Prevention/ Control
		• Pain during urination • Pus discharge from the penis or vagina • Pain in the testicles • Most women show no symptoms		

Exercise 8.1

1. Explain the meaning of sexually transmitted diseases.
2. Outline the causes, symptoms, and effects of the following infections and diseases:
   (a) Syphillis
   (b) Candidiasis
   (c) Hepatitis B

HIV and AIDS

HIV stands for **Human Immunodeficiency Virus.** This is a virus (retrovirus) that causes the immune system to lose its efficiency, thus causing AIDS. AIDS stands for **Acquired Immunodeficiency Syndrome**. People with AIDS are vulnerable to infections and diseases because their immune system is weakened. AIDS occurs when HIV positive individual develops symptoms. HIV attacks a type of white blood cells (helper-T cells) which is essential for immunity. After being infected with HIV, a person can remain asymptomatic for years. The multiplication of HIV in the blood leads to massive destruction of helper-T cells. This weakens the immune system and the person develops opportunistic diseases. Low immunity make the person prone to diseases that would normally be fought off by the immune system. Examples of opportunistic diseases are pneumonia, TB, diarrhoea, Kaposi's sarcoma, and skin rashes. Death may result from these opportunistic diseases. Anti-retroviral drugs (ARVs) can slow the progress of AIDS but cannot cure it. TB as an opportunistic disease is a leading cause of death among HIV victims when untreated.

Transmission of HIV

HIV is found in body fluids of infected people, mostly blood, semen, vaginal secretions, and amniotic fluid. Sweat, saliva and tears have very low amount of the virus, unless they contain blood.

HIV can be spread by:

(a) Having unprotected sexual intercourse with an infected person.

(b) Blood transfusion from an infected donor. Figure 8.1 shows blood transfusion.

Figure 8.1: Blood transfusion

(c) Organ transplant from an infected donor.

(d) An infected mother to her child during pregnancy, birth, and breastfeeding.

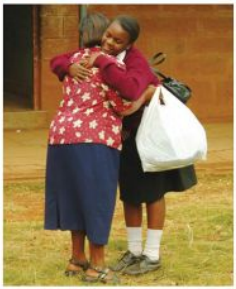
(e) Using unsterilized surgical or skin piercing instruments such as scalpels, needles, and circumcision blades that have been contaminated with blood containing HIV.

(f) Sharing toothbrushes, shaving blades or nail cutters with an infected person.

Note

HIV is not spread by casual contact such as hugging, shaking hands or touching unless both people have open wounds. Figure 8.2 shows examples of casual contacts that do not spread HIV.

(a)



(b)

Figure 8.2: Example of casual contacts that do not spread HIV (a) shaking hands (b) hugging

Symptoms of HIV and AIDS

There are several symptoms of HIV. Not everyone with HIV shows the same symptoms. It depends on the person's immunity and the stage of the disease. Some symptoms caused by HIV can be caused by other diseases such as influenza and tuberculosis. Therefore, the only way to tell whether a person has HIV infection or not is through testing.

There are four stages of HIV and AIDS:

Primary stage or window stage
This stage is accompanied by a flu-like illness. The HIV test is negative and a person looks healthy.

Asymptomatic stage
At this stage a person still looks healthy and doesn't show symptoms. Yet the HIV test will show positive results.

Symptomatic stage
This stage is characterized by severe damage to the immune system. At this stage some symptoms of AIDS are visible.

Full-blown AIDS
In this stage, one gets various opportunistic infections and diseases. A person becomes very ill and weak.

The symptoms of AIDS include:
(a) Loss of body weight, about 10% in 12 months.
(b) Persistent fever that lasts longer than a month.
(c) Painless flat hard lumps growing on the skin or in the mouth.
(d) Diarrhoea lasting longer than a month.
(e) Coughing for more than a month.
(f) Itchy rashes on the skin.
(g) White layer in the mouth and throat (oral thrush).
(h) Swollen lymph nodes, especially in the neck and armpits.
(i) Shortness of breath, gradually getting worse.
(j) Genital rashes.

People with HIV and AIDS suffer from opportunistic diseases, for example:
(a) Respiratory diseases such as pneumonia and tuberculosis.
(b) Brain infections leading to mental confusion, severe headache, and fits (seizures).
(c) Stomach or gut infections leading to severe diarrhoea lasting for weeks.
(d) Skin cancer such as Kaposi's sarcoma.

Effects of HIV and AIDS

The effects of HIV and AIDS include:
(a) Reduced labour and production force.
(b) Families spend a lot of money to treat patients with HIV and AIDS. This money would have been used for other needs such as food and education
(c) Increasing number of orphans, thus adding a burden to relatives and the society.

(d) Stress, stigma, and discrimination to some victims of HIV and AIDS.

(e) High cost of treatment and purchase of drugs incurred by the government.

(f) Reduced life expectancy.

Prevention and control

(a) Abstain from sexual intercourse.

(b) Use sterilized instruments during surgery and delivery.

(c) Wear disposable gloves when touching other people's body fluids.

(d) Only screened blood and organs should be used for transfusion and transplant respectively.

(e) Do not share toothbrushes and shaving blades.

(f) Avoid sharing underwear and towels

(g) People Living With HIV and AIDS (PLWHA) should adhere to advice from medical practitioners to avoid further transmission.

(h) PLWHA should be given anti-retroviral drugs (ARVs) which help to slow down the progression of the disease.

(i) Pregnant women should attend pre-natal clinics where they can be given drugs to prevent mother-to-child transmission.

(j) Provision of PEP (Post-Exposure Prophylaxis) within 72 hours following exposure to prevent HIV infection.

Exercise 8.2

1. What are opportunistic infections?
2. Explain how HIV is transmitted.
3. Explain seven ways through which HIV can be prevented.

Risky situations, behaviours, and practices that can lead to STIs and HIV infection

There are several activities and situations that put a person at a greater risk of being infected with STIs and HIV. These include:

(a) Transfusion using unscreened blood.

(b) Sharing unsterilized needles and blades in health facilities or at home.

(c) Sharing underwear and towels

(d) Drinking alcohol, smoking bhang (marijuana), and using other narcotic drugs such as heroin and cocaine. Drugs impair the judgement ability and make people more likely to engage in unprotected sex.

(e) Having immoral friends who pressure others into bad behaviours such as alcoholism, drug abuse, and sexual intercourse.

(f) Accepting favours and gifts such as money, clothes, and mobile phones from members of the opposite sex or strangers. These people may expect sexual favours in return.

(g) Failing to report sexual abuse or rape.

(h) Staying in secluded places with

members of the opposite sex or strangers.

(i) Sharing personal items such as towels, underwear, tooth brushes, needles, razor blades, and swimsuits.

(j) Going out alone or in the company of strangers, especially at night or visiting places such as bars, casinos, and night clubs.

How to avoid risky practices, situations, and behaviour

(a) Abstain from sexual intercourse before marriage.

(b) Only screened blood should be used for transfusion.

(c) Do not share sharp objects such as needles and blades. Use disposable needles and blades which should be disposed properly after use.

(d) Avoid drinking alcohol and taking all forms of narcotic drugs.

(e) Keep good company. Avoid immoral friends. Go out in the company of trusted family members or friends.

(f) Learn to resist bad peer pressure. Be firm and assertive when declining misleading advice.

(g) Do not accept gifts or favours from members of the opposite sex.

(h) Report all cases of sexual abuse, for example rape, to parents, teachers, trusted persons, and police. Go to a health facility as soon as possible.

(i) Avoid staying in very secluded areas with members of the opposite sex or strangers .

(j) Avoid risky places such as bars, night clubs, and casinos.

Note

Often we cannot tell if someone is infected with HIV, STIs or STDs just by looking at them. Only clinical tests can confirm whether a person is infected or not. HIV and AIDS, STIs, and STDs can infect people of any gender, age, religion, or race. Touching, shaking hands, or hugging people cannot transmit HIV.

Activity 8.2: Demonstrating necessary skills for avoiding risky behaviour that can lead to STIs, and HIV infection.

Materials: Charts, magazines, and pictures showing risky behaviour that can lead to STIs and AIDS and how to avoid such behaviours

Procedure

1. Observe pictures and charts showing risky behaviour and how to avoid such behaviours.
2. Read the magazines and charts showing risky behaviour.
3. Discuss with your classmates various life skills needed to avoid risky behaviours that lead to STIs and AIDS.
4. Write short notes on how to avoid risky behaviours that can lead to STIs and AIDS.

Importance of seeking health care for STIs, STDs, and opportunistic diseases

People who suspect that they have STIs, STDs or HIV and AIDS should seek medical care as soon as possible due to the following reasons:

(a) Early testing and treatment help to cure or slow down the development of the infection or disease in its early stages.

(b) Proper treatment can save life and prevent long-term effects such as infertility.

(c) Healthcare professionals can give appropriate counselling on how to manage the infections and diseases and how to avoid re-infection Figure 8.3 shows a youth attending counselling session.

Figure 8.3: Youth attending counselling session

(d) Testing gives peace of mind. It confirms whether one is infected or not, instead of worrying and guessing what the problem could be.

(e) Proper healthcare reduces the chances of infecting other people.

(f) Health care professionals can give appropriate guidance on how to enhance good health practices in order to prevent further infections and damages. These practices may include: proper nutrition, abstaining from sexual intercourse, and doing regular exercises.

Care and support for People Living with HIV and AIDS (PLWHA)

People with HIV and AIDS can live healthy lives for a long time if they get proper care and support. We can care and support them in the following ways:

(a) Giving them a balanced diet.

(b) Allowing them to rest when they feel unwell.

(c) Taking them to a health facility as soon as they start developing symptoms of illness.

(d) For youths, taking them to centres that provide HIV and AIDS information and medical care as shown in Figure 8.4.

Figure 8.4: Youths health services

(e) Providing them with ARV drugs, which slow down the HIV progression and severity.
(f) Allowing them to work and exercise if they can.
(g) Behaving in a loving way towards them and not being judgemental.
(h) Listening and helping them to cope with their conditions.
(i) Counselling them to stop behaviours that could worsen their condition, for example use of narcotics or having many sexual partners.
(j) Helping them to keep their bodies, clothing, and bedding clean.
(k) Avoiding discriminating or stigmatising them in various ways such as:
    (i) Branding them with bad names.
    (ii) denying them work opportunities.
    (iii) denying them education or health services.
    (iv) staying away from them.
    (v) refusing to share utensils or rooms with them.
    (vi) not involving them in decision-making.
    (vii) hiding them from the public.

Precaution

Remember to keep any wounds covered and always wear disposable gloves when handling faeces, urine, blood, or vomitus from People Living with HIV and AIDS (PLWHA) and other infectious diseases.

Care and support to PLWHA gives them hope, good health, peace of mind, long life, comfort, and a positive attitude for work. Discrimination leads to depression, loneliness, loss of hope, poor health, hastened death, and poor performance at work and school.

Activity 8.3: To demonstrate how to care for PLWHA in the community.

Materials: Gloves, charts, and magazines explaining how to care for PLWHA

Procedure

1. Discuss with your classmates the importance of giving care and support to PLWHA.
2. Perform a role play on how to care for PLWHA in the community as well as stigma and discrimination against PLWHA in your community.
3. Briefly explain the effects of stigma on PLWHA.

Chapter summary

1. STI stands for 'Sexually Transmitted Infection'.
2. STD stands for 'Sexually Transmitted Disease'.
3. HIV stands for 'Human Immunodeficiency Virus.
4. AIDS stands for 'Acquired Immunodeficiency Syndrome'.
5. HIV and AIDS occurs in four stages:
   (a) Primary or window stage;
   (b) Asymptomatic stage;
   (c) Symptomatic stage; and
   (d) Full-blown AIDS.
6. PLWHA stands for 'People Living With HIV and AIDS'.
7. Examples of STIs and STDs are:
   (a) Gonorrhoea
   (b) Syphilis
   (c) Trichomoniasis
   (d) Candidiasis
   (e) Genital herpes
   (f) Hepatitis B
   (g) Chlamydia
   (h) HIV and AIDS
8. HIV weakens an individual's immunity which leads to opportunistic infections.
9. People may have STIs or HIV and yet show no symptoms. Only clinical tests can confirm whether a person is infected or not.

10. People with HIV and AIDS can live a long and healthy life if they get proper care and support.
11. We should avoid risky situations, behaviour, and practices to avoid being infected with STIs such as HIV.

Revision exercise 8

1. Which of the following is NOT transmitted by sexual intercourse?
   (a) HIV and AIDS
   (b) Malaria
   (c) Hepatitis B
   (d) Gonorrhoea
2. _____is caused by a virus
   (a) Trichomoniasis
   (b) Syphilis
   (c) Genital herpes
   (d) Candidiasis
3. Caring for PLWHA is important because _____.
   (a) it can cure AIDS
   (b) it gives the victim hope
   (c) the victim gets many visitors
   (d) it makes the victim depressed
4. Hepatitis B can be prevented by _____.
   (a) vaccination
   (b) using mosquito nets
   (c) eating a balanced diet
   (d) not shaking hands with infected people
5. Genital herpes can cause all of the following except _____.
   (a) painful ulcers
   (b) blindness
   (c) death of babies born to infected mothers
   (d) recurrent fever

6. The second stage of HIV and AIDS____.
   (a) has flu-like symptoms
   (b) is full-blown AIDS
   (c) has no symptoms
   (d) has few symptoms

7. The following are symptoms of the second stage of syphilis except _____.
   (a) painless sore on sex organ
   (b) swollen lymph nodes
   (c) joint pains
   (d) fever

8. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.
   (a) There is no health care available for people with STDs. _____
   (b) Syphilis can lead to brain damage. _____
   (c) Hepatitis B is caused by bacteria. _____
   (d) Towels cannot spread STIs. _____
   (e) There is no cure for HIV. _____

9. Explain the meaning of the following terms:
   (a) STI
   (b) STD
   (c) HIV
   (d) Opportunistic infection
   (e) ARV

10. List three STIs and STDs caused by:
    (a) Virus (b) Bacteria

11. Write short notes on the following:
    (a) Stages of HIV and AIDS
    (b) Prevention and control measures against HIV and AIDS

12. Using examples,
    (a) Mention five ways of preventing STIs.
    (b) Briefly explain five ways through which a person can contract HIV.
    (c) Outline five habits that can lead to STIs and STDs.
    (d) Mention five ways in which PLWHA are stigmatised in the society.
    (e) Give two precautions that you should take when caring for PLWHA.

13. Explain the importance of the following:
    (a) Early testing and proper treatment of opportunistic infections and diseases for PLWHA.
    (b) Proper and early healthcare for PLWHA.
    (c) Staying in secluded places with persons of the opposite sex or strangers.
    (d) Staying away from immoral friends.
    (e) Reporting immediately all cases of sexual abuse to parents, teachers and police.

14. How can the following risky behaviours or practices contribute to HIV infection?
    (a) Drinking alcohol
    (b) Sharing razor blades
    (c) Having immoral friends
    (d) Drug abuse

Chapter Nine

Cell structure and organization

Introduction

All living things are made up of cells. The cell is the basic functional unit of life. In this chapter, you will learn about the meaning of a cell, characteristics of the cell, and the functions of different parts of animal and plant cells. You will also learn the similarities and differences between plant and animal cells. In addition, you will learn the concept of cell differentiation and its importance to the formation of tissues, organs, and organ systems. The competencies developed from this chapter will enable you to learn other biological processes better.

The cell

In 1665, Robert Hooke, an English scientist, designed a microscope and used it to examine cork from the bark of a tree. He noticed that, the cork was made up of many box-like units which were packed together to form a structure like a honeycomb. He called these units cells. This is how the cell was discovered. All living things are made up of cells. Life processes take place inside the cell. Therefore, cells are the basic functional units of life.

The observations and conclusions by Hooke and other scientists led to the development of the cell theory. The theory is a widely accepted explanation of the relationship between cells and living things. The following are components of the cell theory:

(a) All living things are composed of cells.
(b) Cells are the basic unit of structure and functions of living things.
(c) All cells are produced from other cells.

(d) Cells contain inherited information which controls their activities.
(e) All cells are basically the same in chemical composition.
(f) All life processes take place in the cells.

The cell theory applies to all living things, no matter how big or small. Since cells are common to all living things, they can provide information about life. Scientists can study cells to learn about nutrition, growth, reproduction, respiration, movement, sensitivity, and excretion.

Types of cells

Based on nuclear organisation, there are two basic types of cells: **prokaryotic** and **eukaryotic cells**.

Prokaryotic cells

The prokaryotic cell is a type of a cell in which nuclear material (chromosomes, DNA) are not bound with a membrane. The cell is found in organisms called **prokaryotes**. Prokaryotes are single-celled organisms such as bacteria and blue-green bacteria. Figure 9.1 shows the structure of a bacterium as an example of a prokaryotic cell.

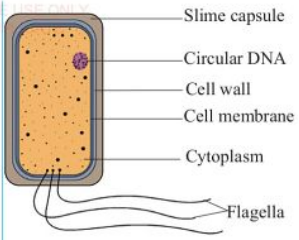
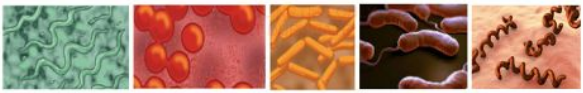


Figure 9.1: Generalised structure of a bacterium

The following are characteristics of prokaryotic cells:
(a) They do not have true nucleus as they lack membrane bound nucleus.
(b) They do not have membrane-bound organelles such as mitochondria.
(c) They reproduce by binary fission and sometimes by conjugation.
(d) Mostly they are smaller in size than eukaryotic cells.
(e) Some prokaryotes have whip-like structures called flagella for locomotion or hair-like structures called pili for attachment.
(f) Can be rod, spherical, spiral, comma, and corkscrew shaped. Figure 9.2 shows various shapes of prokaryotes.
(g) Have circular DNA.



(a) (b) (c) (d) (e)

Figure 9.2: Shapes of prokaryotes (a) spiral (b) spherical (c) rod (d) comma and (e) corkscrew shaped

Eukaryotic cell

These are types of cells whose organelles are enclosed in membranes. The cells are found in organisms called **eukaryotes**. Eukaryotic cells can be in form of unicellular organisms such as amoeba and euglena, or multicellular organisms such as animals and plants. Figure 9.3 shows the structure of *Euglena* sp. as an example of a eukaryotic cell.

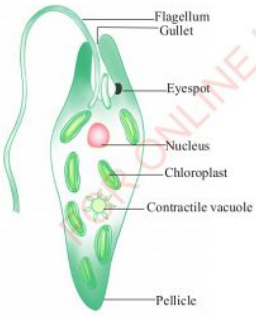


Figure 9.3: Structure of *Euglena* sp.

The following are the characteristics of eukaryotic cells:

(a) They have a membrane-bound nucleus.
(b) They are generally larger and more complex than prokaryotic cells.
(c) They contain specialized membrane-bound organelles such as mitochondria.
(d) They have linear DNA material.

Activity 9.1: Observing different types of cells

Materials: Onion bulb or leaves of *Tradescantia* sp., scalpel, forceps, microscope, microscope slides, permanent microscope slides of eukaryotic and prokaryotic cells, charts and models of different types of cells, notebook, and a pen or pencil

Procedure

1. Prepare specimens of onion bulb or leaves of *Tradescantia* sp. as in Activity 2.2.
2. Observe the slides under low and medium power lenses.
3. Draw and label your observations.
4. Compare your observations with the charts and models of eukaryotic and prokaryotic cells.

5. Discuss with your group members the similarities and differences between the prokaryotic and eukaryotic cells.

Animal and plant cells

Both animals and plants are made up of eukaryotic cells. However, these cells differ in their structure and functions.

The animal cell

Figure 9.4 shows the structure of an animal cell as seen under the light microscope.

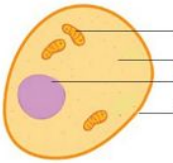


Figure 9.4: Generalised structure of an animal cell

Activity 9.2: Observing animal cells

Materials: Wooden spatula, clean stick or scalpel, mounted needle, microscope slide and a cover slip, microscope, and a Bunsen burner

Procedure

1. Rinse your mouth with clean water several times in order to remove any food particles.
2. Sterilise the scalpel handle by passing it through a non-luminous flame several times.
3. Let it cool.
4. Gently scrap inside your cheek with the sterilised scalpel handle. A clean wooden spatula may be used instead of a scalpel handle.
5. Place the material you have obtained on a microscope slide.
6. Add a drop of water to the material.
7. Using forceps, a mounted needle, or sharp pencil point, carefully lower a cover slip over the material on the slide.
8. Use a low-power objective lens to observe the specimen under a microscope. Refer to Activity 2.2 for help in using the microscope.
9. Draw what you see. Compare your diagram with Figure 9.5

Figure 9.5: Human cheek cells

Functions of the parts of an animal cell

Cell membrane

The cell membrane is a thin layer that encloses the whole cell. The cell

membrane is made up of two layers of lipids and protein molecules. This membrane is flexible and semi-permeable. Semi-permeable means that it allows certain substances to pass in or out of the cell. Flexibility of animal cell membrane and the lack of cell wall gives it an irregular shape.

Cytoplasm

This is a jelly-like substance made up of water and dissolved chemical substances. The cytoplasm is the site for many chemical reactions in the cell. Cell organelles such as the vacuoles, nucleus, and mitochondria are suspended in the cytoplasm.

Nucleus

This is a spherical organelle suspended in the cytoplasm. The nucleus consist of **nucleolus** and a fluid called **nucleoplasm**. It is surrounded by a membrane called the **nuclear membrane**.

The functions of the nucleus are to:

(a) determine the chemical processes that take place in the cell;
(b) control the functions of all parts of the cell;
(c) determine the cell's size, shape, and functions; and
(d) determine the hereditary characteristics of a cell.

Cell vacuoles

Cell vacuoles are fluid-filled spaces bound by a membrane. Animal cells have small and temporary vacuoles mainly used to secrete and excrete waste from the cell.

Mitochondria

Mitochondria(singular: mitochondrion) are oval-shaped organelles that have two membranes as shown in Figure 9.6. The outer membrane is smooth. The inner membrane has folds called **cristae**. The role of mitochondria is to produce energy for the cell. That is why they are sometimes referred to as 'power houses of cells'.

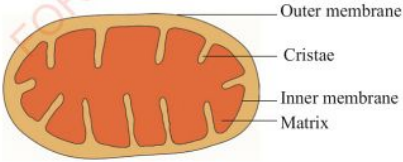


Figure 9.6: Mitochondrion

The plant cell

Figure 9.7 shows a generalised structure of a plant cell as seen under a light microscope.

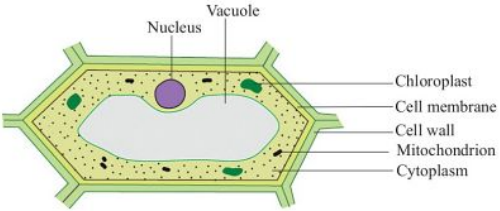


Figure 9.7: A generalised plant cell

Similar to the animal cell, the plant cell has a cell membrane, cytoplasm, nucleus, and mitochondria. These organelles function in the same way as those of an animal cell. However, plant cells have additional structures which serve specific roles in plants. These structures are:

The cell wall

This is a strong covering made of **cellulose** surrounding the cell membrane. The cell wall is fully permeable. It allows the passage of water and minerals. The cell wall protect and support the cell. The cell wall gives the plant cell a definite shape.

Chloroplasts

Chloroplasts are oval organelles that contain green pigments in plants. This pigment is called **chlorophyll**. It is important in **photosynthesis,** the process by which green plants make their own food. Chlorophyll absorbs light energy needed for photosynthesis.

Cell vacuole

Plant cells have a large and permanent vacuole that usually occupies the central part of the cell. This vacuole contains sap and is surrounded by a membrane called **tonoplast**. The cell vacuole is filled with water, causing the cytoplasm to be pushed outwards against the cell wall. This makes the cell firm, hence helps plant cell to maintain their shape.

Activity 9.3: Observing the plant cell

Materials: Onion, knife, forceps, mounted needle, microscope, microscope slide, and cover slip

Procedure

1. Separate a fleshy leaf from an onion bulb.
2. Cut a small square of the leaf.
3. Using forceps, peel off the epidermis from the inner surface of the square.
4. Put it on a microscope slide, and add a drop of water.
5. Using forceps, a mounted needle, or sharp pencil point, carefully lower a cover slip over the epidermis specimen.
6. Use a low-power objective lens to examine the specimen under a microscope.
7. Draw what you see under the microscope. Compare your diagram with Figure 9.8.

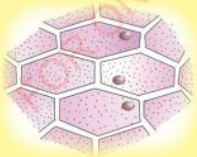


Figure 9.8: Onion epidermal cells

Similarities and differences between plant and animal cells

Activity 9.4: Comparing plant and animal cells

Materials: Microscope, microscope slides, onion bulb, scalpel, iodine, blotting paper, and permanent slides of cheek cells

Procedure

1. Prepare a specimen of onion cells (plant cells) as in Activity 2.2
2. Observe the slide under a low power lens then medium power lens.
3. Draw and label what you have observed.
4. Repeat steps 2–3 using the prepared slides of human cheek cells.
5. Draw and label what you have observed.
6. What are the similarities and differences between plant and animal cells?

Similarities

Plant and animal cells are similar in that they both have a cell membrane, cytoplasm, a nucleus, cell vacuoles, and mitochondria.

Differences

The differences between plant and animal cells are shown in Table 9.1.

Table 9.1: Differences between plant and animal cells

Plant cell	Animal cell
1. Has a cell wall	1. No cell wall
2. Has chloroplast	2. Lacks chloroplast
3. Has a large and permanent centralised vacuole	3. Has small and temporary vacuoles
4. It is regular in shape	4. It is irregular in shape
5. Nucleus is placed at the periphery	5. Nucleus is centrally positioned
6. Stores food in form of starch	6. Stores food in form of glycogen

Exercise

1. What are the differences between prokaryotic and eukaryotic cells?
2. Mention two structures that are found in plant but not in animal cells.
3. Draw a diagram of an animal cell and label the parts which perform the following functions:
   (a) Site for energy production.
   (b) Control all the functions of the cell.
   (c) Where organelles are suspended.
   (d) Allow passage of some substances.

Cell differentiation

An organism that is made up of one cell is called a **unicellular** organism. Examples of such organisms are *Amoeba* sp., *Paramecium* sp., and bacteria. In such organisms, only one cell carries out all the life processes such as respiration, reproduction, and excretion.

Organisms made up of more than one cell are called **multicellular** organisms. A multicellular organism consists of a few to millions of cells. These cells have different functions and have features that make them better suited to carry out these functions. This is called **cell differentiation**. Cell differentiation is the process in which a cell changes from one form to another and become more specialised to perform specific functions.

A group of cells that perform the same function form a **tissue**. Examples of animal tissues are bone, muscle, and blood. Examples of plant tissues are xylem and phloem. Figure 9.9 shows some examples of animal tissues.

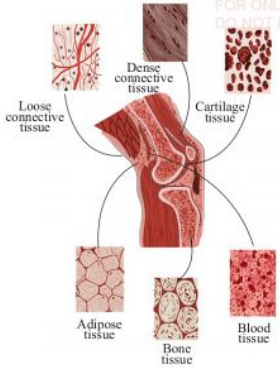


Figure 9.9: Examples of animal tissues

An **organ** consists of different tissues that work together to perform a certain function. Animal organs include the heart, liver, stomach, and brain. Plant organs include the stem, flowers, fruits, leaves, and roots. Figure 9.10 show an example of a plant organ.

Figure 9.10: A flower

An **organ system** is made up of organs that work together to perform a certain function. Examples of systems are respiratory system, digestive system, reproductive system, hormonal system, skeletal system, and blood circulatory system. For example, the blood circulatory system transports blood to all parts of the body. It consists of the heart, blood vessels, and blood itself.

An **organism** is made up of different organ systems working together. Therefore, there is special organisation from the cell to tissue to organ to organ system to organism. Figure 9.11 shows an example of organ system in the human body.

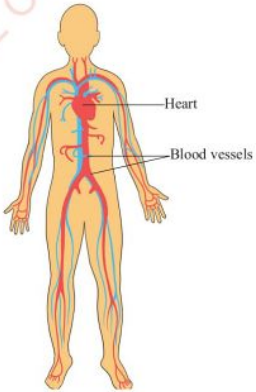


Figure 9.11: The human blood circulatory system

Importance of cell differentiation

Cell differentiation leads to **division of labour**. Division of labour means specific cells performing specific functions. This helps the body to carry out all life processes at the same time and more efficiently.

Specialized animal cells

The following are examples of specialised animals cells:

White blood cells

White blood cells can change their shapes so as to engulf and destroy harmful microorganisms. Some contain digestive enzymes which destroy the microorganisms. Figure 9.12 shows the structure of a white blood cell.

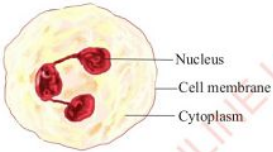


Figure 9.12: Structure of a white blood cell

Red blood cells

Red blood cells lack nuclei and are bi-concave in shape. This provides a large surface area for transporting oxygen from the lungs to various parts of the body. They also contain haemoglobin which carries oxygen to different parts of the body. Figure 9.13 shows the structure of a red blood cell.

Figure 9.13: Structure of a red blood cell

Sperm cell

The sperm cell fertilize the female egg in order for reproduction to take place. The sperm cell has a tail which enables it to swim to the egg and a pointed head which enables it to penetrate the egg. Figure 9.14 shows the structure of a sperm.

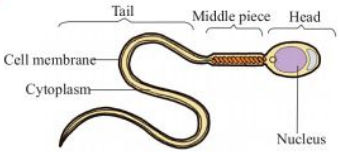


Figure 9.14: Structure of a sperm

Specialized plant cells

The following are examples of specialised plant cells:

Root hair cells

These cells absorb water and mineral salts from the soil. The root hair helps to increase the surface area for absorption. Figure 9.15 show the structure of a root hair cell.

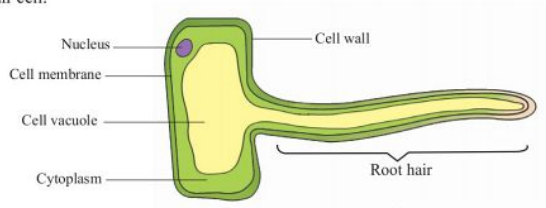


Figure 9.15: Root hair cell

Guard cell

Guard cells surround the stomata. The inner walls of guard cells are thicker than the outer walls. This makes them expand irregularly. The guard cells control the opening and closing of **stomata** (singular: stoma) on the leaf. When the guard cells expand, the stoma opens. When they contract, the stoma closes. Stomata are tiny pores used for gaseous exchange and loss of excess water. Figure 9.16 show the structure of a guard cell.

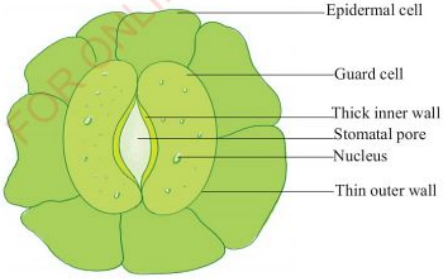


Figure 9.16: Structure of guard cells showing stoma

Xylem vessels

Xylem vessels are made up of hollow dead cells with walls made of lignin. Lignin is a tough rigid material that makes up the wall of xylem vessels. The cells are connected to form xylem vessels. These vessels transport water and minerals from the root to the leaves and also support the plant in the form of wood. Figure 9.17 shows the structure of xylem vessels.

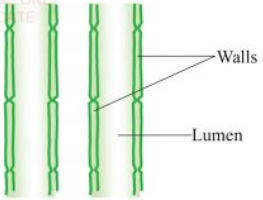


Figure 9.17: Xylem vessels

Palisade cells

Palisade cells found in plant leaves contain large amounts of chloroplasts. Chloroplasts are the sites for photosynthesis. They contain chlorophyll which traps sunlight energy during photosynthesis. Figure 9.18 shows the structure of a palisade cell.

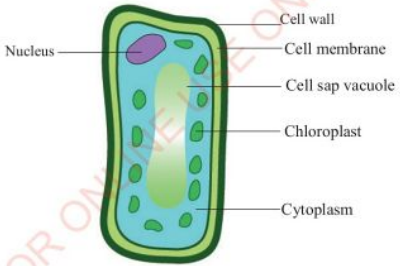


Figure 9.18: Palisade cell

Chapter summary

1. The cell is the basic functional unit of life.
2. There are two main types of cells, eukaryotic and prokaryotic.
3. Basically there are three main parts of a cell which are nucleus, cell membrane, and cytoplasm.
4. The structures that are found in plant cells but not in animal cells are:

(a) Cell wall.
(b) Chloroplasts.
(c) Cell sap vacuoles.

5. Cell differentiation refers to the way cells are specialised to perform specific functions.
6. A tissue is a group of cells that perform the same function.
7. An organ is made up of various tissues that work together to perform a function.
8. An organ system consists of organs that work together to perform a function.
9. Examples of specialized animal cells are white blood cells, red blood cells, and sperm cells.
10. Examples of specialized plant cells are guard cells, root hair cells, and palisade cells.

Revision exercise 9

1. A cell membrane is flexible and semi-permeable to _____.
   (a) liquids passing through it
   (b) small solids that pass through it
   (c) only certain substances passing through it
   (d) semi-liquids that pass through it

2. One of the following is not a characteristic of prokaryotic cells.
   (a) They have no nuclear membrane.
   (b) They reproduce by multiple fission.
   (c) They have flagella.
   (d) They have no nucleus.

3. An organism is made up of_____ which are the functional unit of life.
   (a) tissues
   (b) cells
   (c) organs
   (d) systems

4. Xylem is an example of_____.
   (a) organ
   (b) cell
   (c) tissue
   (d) organ system

5. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement in the space provided.
   (a) A tissue comprises of different organs that perform the same function._____
   (b) Chloroplasts and mitochondria perform similar functions._____
   (c) Palisade cell is one of the specialised cells in plants._____
   (d) A cell membrane is similar in function to a cell wall._____

6. The following terms are arranged in alphabetical order. Rearrange them into an appropriate biological sequence, starting with the lowest level.
   cell ⟶ organ ⟶ organism ⟶ system ⟶ tissue

7. Name the parts of the cell described in each of the following statements.
   (a) The semi-permeable membrane that encloses the cytoplasm of a cell.
   (b) A large cellular organelle that contains hereditary information.
   (c) The site of respiration in the cell.
   (d) A jelly-like mixture consisting mostly of water, located between the cell membrane and the nucleus.
   (e) A part that protects, support, and give shape to plant cells.

8. Distinguish between:
   (a) Prokaryotic and eukaryotic cells
   (b) An organ and tissue

9. Compare the structures of a plant and an animal cell as seen under the light microscope.

10. Explain what will happen if the following are removed from plant or animal cell.
    (a) Nucleus
    (b) Cell wall
    (c) Chloroplast
    (d) Mitochondria

11. Draw and label the following:
    (a) An animal cell as seen under the light microscope
    (b) A prokaryotic cell
12. Using examples of plant and animal cells, explain the meaning of cell differentiation.
13. Describe the functions of any three specialized cells in plants.
14. Study Figure 9.19 and answer the following questions.

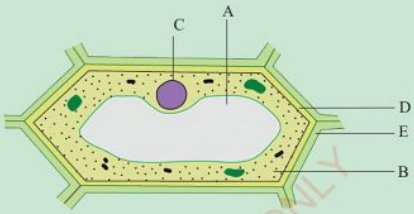


Figure 9.19

(a) Label the parts shown by letters A to E.
(b) State the functions of the parts labelled A to E.

Chapter Ten

Classification of living things

Introduction

There are different kinds of organisms in the world. Some organisms are too small to be seen by naked eyes and they are called microorganisms. Others can be seen by naked eyes and are called macro-organisms. Due to the existing diversity of organisms, it is difficult to clearly understand their characteristics. In this chapter, you will learn about the concept of classification, classification systems, ranks of classification, and binomial nomenclature. The competencies developed from this chapter will enable you to identify and classify new organisms by comparing their characteristics with the already classified organisms.

The concept of classification

The process of grouping organisms according to their similarities and differences is called classification. Organisms that are similar are placed in the same group. These similarities can be in terms of their evolutionary relationship or the way they carry out life processes such as feeding and reproduction. The field of biology that deals with classifying organisms is called **taxonomy**. Organisms such as snails, orange trees, crocodiles, birds, lions, and baobab trees as shown in Figure 10.1 belong to different groups.

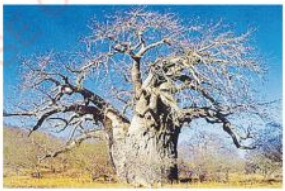
(a)

(b)

(c)

(d)

(e)



(f)

Figure 10.1: Variety of living things (a) snail (b) orange tree (c) crocodile (d) birds (e) lion (f) baobab tree

Activity 10.1: Grouping living organisms according to their similarities and differences

Materials: A variety of small plants, insects, and other animals

Procedure

1. Walk around the school compound and collect a variety of plants, insects, and other animals.
2. Group the collected organisms according to their similarities and differences.
3. Discuss with your classmates the similarities and differences of the grouped organisms.

Caution
Do not collect poisonous plants and stinging animals such as scorpions.

Questions

1. What did you learn from the activity?
2. Why do you think it is important to classify organisms?

The importance of classification

Classification is important in the study of living things because of the following reasons:

(a) There are millions of species of living things in the world. Grouping them makes it easier to study and identify them, because the members of the group have many characteristics in common.

(b) It makes communication among biologists in the world easier.

(c) It enables scientists to predict characteristics of an organism based on the characteristics of a group it belongs. When we know the characteristics of a group then we can predict the characteristics of an organism in that group. For example, an eagle and a chicken are both birds. If we know the structure of the heart of a chicken we can predict the structure of the heart of an eagle even if we have not seen it.

(d) It helps to understand how organisms are related in terms of their evolutionary history.

Classification systems

There are two main types of biological classification systems, namely artificial and natural classification.

Artificial system of classification

Artificial classification groups organisms according to a few observable features for example, the presence of legs or wings. Based on this, bees, birds, and bats would be grouped together because they have wings. Snakes, earthworms, and snails would also be grouped together because they do not have legs. Artificial classification also involves classifying organisms according to their size, how they move, where they live, or what they eat.

In the third century BC, Aristotle (a Greek philosopher) used artificial classification to classify plants. He grouped them according to their shape, size, and whether they were useful to human or not.

Activity 10.2: Classifying living things using artificial system of classification

Materials: A variety of living things or charts showing pictures of a bird, bat, bee, snake, snail, and earthworm

Procedure

1. Observe the organisms in Figure 10.2 and note as many observable features as you can.

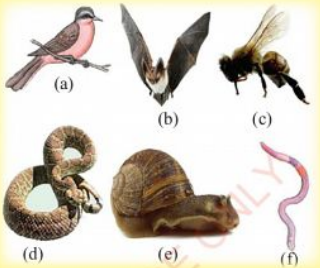


Figure 10.2: Variety of organisms (a) bird (b) bat (c) bee (d) snake (e) snail (f) earthworm

2. Classify the above living things based on the following features:
   (a) Size
   (b) How they move
   (c) Where they live
3. How many organisms did you get for each feature?
4. Share your answers with your classmates.

Advantages of artificial system of classification

(a) It is based on simple and easily observable features. Artificial classification is therefore straight forward and easy to use.

(b) It is simple to identify and classify organisms since newly discovered organisms with just a few known features can be easily fitted in.

(c) It is stable because it does not change with time or discovery of new organisms.
(d) It is less expensive because it uses few observable features to group the organism.
(e) It does not require special classification techniques or highly skilled personnel.

Disadvantages of artificial system of classification

(a) Some organisms that are unrelated in their internal make up can be grouped together because of the resemblances of their few external features for example bats and birds.
(b) Similar organisms may be placed in different groups because of the use of only few observable features for example bats and rats.
(c) It provides only limited information about each member. For example, organisms such as bacteria and some fungi are grouped as microorganisms because they are microscopic. This classification has ignored other features such as their modes of feeding, reproduction, and cell structure.
(d) It does not allow the prediction of information; hence it limits more advancement in taxonomy.
(e) It is less accurate because it uses only few observable characteristics for example mode of feeding, habitat, locomotion, or presence of wings.

Natural system of classification

In the natural system of classification organisms are grouped based on many features in common particularly those related to evolutionary relationship. In this system, characters that show **homology** or similarity of origin must be distinguished from those that exhibit **analogy** or similarity of use. For example, the arms of man, forelimbs of whales, and wings of birds and bats are homologous structures. In contrast, the wings of birds and insects performs similar functions but are different in origins hence they are **analogous**.

Advantages of natural system of classification

(a) It allows organisms which are genetically and evolutionally related to be grouped together.
(b) It is more accurate, since it involves scientific research to gather enough information before the actual placement of an organism into a particular group is decided.
(c) It enables placing of newly discovered organisms into groups they belong.
(d) It allows addition of new features when they are discovered.

Disadvantages of natural system of classification

(a) It is very expensive since it involves experiments, research, and high classification skills.

(b) It is tedious and time consuming since it uses many features in grouping organisms.
(c) It is not stable because it can change any time due to addition of newly discovered features or information.

Table 10.1 shows the differences between artificial and natural system of classification.

Table 10.1: Differences between artificial and natural system of classification

Artificial system of classification	Natural system of classification
Based on external features only	Considers both internal and external features
Requires simple skills	Requires advanced scientific skills
Based on an individual's interest	Based on international standards
It is usually fast and less expensive	Takes more time and expenses
Less accurate	More accurate

Activity 10.3: Classifying organisms using artificial and natural system of classification

Materials: A variety of living things or charts showing pictures

Procedures

1. Observe the external features of living things and note as many features as you can.
2. (a) Group the organisms based on artificial system of classification.
   (b) Group the organisms based on natural system of classification.
3. Discuss your answers with your classmates.

Major groups of living things

There are five major groups of organisms. These groups are:
(a) Monera for example bacteria.
(b) Protoctista for example amoeba, *Plasmodium* sp., and *Euglena* sp.
(c) Fungi for example mushroom and yeast.
(d) Plantae for example maize, bean, and banana plants.
(e) Animalia for example human beings, dogs, and rats.

Viruses however remain unclassified because they possess both features of living and non-living things. Examples of viruses include Corona virus, Ebola virus, and HIV.

Ranks of classification

In classification of living things, there are seven ranks or taxonomic units which are arranged hierarchically in a descending order from the highest to the lowest rank. Each unit is called a taxon (plural: taxa). These ranks are Kingdom, Phylum or Division, Class, Order, Family, Genus, and Species. The highest rank is Kingdom and the lowest is Species.

Initially all organisms were classified into two major kingdoms namely; kingdom Animalia and kingdom Plantae. Currently five kingdoms of living things are recognised namely kingdom Monera, Protoctista, Fungi, Plantae, and Animalia. Kingdom Animalia is subdivided into phyla (singular: phylum) and kingdom Plantae is subdivided into divisions. The phyla or divisions are further subdivided into classes. Each class is subdivided into orders. An order is subdivided into families and families are subdivided into genera (singular: genus). A genus is subdivided into species. A species is a group of closely related organisms that can interbreed under natural conditions and produce fertile offspring.

The flow chart in Figure 10.3 shows how kingdom Plantae and kingdom Animalia are subdivided.

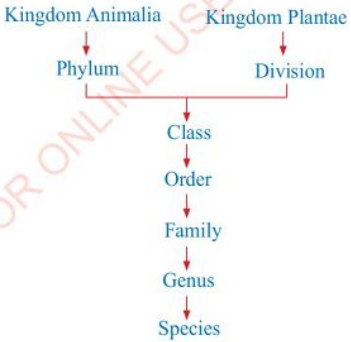


Figure 10.3 Taxonomic ranks of classification

Kingdoms have the greatest varieties of organisms. At kingdom level, organisms share few features in common. As you move down the ranks, each unit has less organisms and the members of each unit have many features in common.

At the species level, organisms share many features. Members of the same species can interbreed to produce fertile offspring, but organisms from different species do not interbreed. If they interbreed, they do not produce fertile offspring. This is because of differences in genetic make-up, behaviour, geographical location, and morphological features, such as variation in size of sexual organs. However, there are a few exceptions to this rule. For example a horse and a donkey can interbreed to produce a mule. Mules are usually but not always infertile. Dogs and wolves can interbreed to produce fertile offspring.

In Table 10.2, a few common organisms have been classified from kingdom to species level.

Table 10.2: Classification of some common organisms

Taxonomic unit	Human being	Cat	Maize plant
Kingdom	Animalia	Animalia	Plantae
Phylum/Division	Chordata	Chordata	Angiospermophyta
Class	Mammalia	Mammalia	Monocotyledoneae
Order	Primate	Carnivora	Graminales
Family	Hominidae	Felidae	Poales
Genus	*Homo*	*Felis*	*Zea*
Species	*Homo sapiens*	*Felis catus*	*Zea mays*

Binomial nomenclature

Binomial nomenclature is a scientific system of naming organisms using a two-part name. The first part of the name represents the genus. It is also called the generic name. The second part of the name represents specific **epithet**. The two parts form the name of a species or scientific name. This system was first introduced by Carl Linnaeus or Carolus Linnaeus, who is also referred to as the father of classification.

As an example, the scientific name of a human being is *Homo sapiens*. *'Homo'* is the generic name and *'sapiens'* is

the specific epithet. Scientific names of other common organisms are shown in Table 10.3.

Rules of binomial nomenclature

The following rules are observed when writing scientific names:

(a) All scientific names must be written in Latin language or if is in a different language, the name must be Latinised.

(b) The name should have two parts; the first part represents the genus and the second part represents the specific epithet.

(c) The generic name is written before the specific epithet.

(d) The generic name must start with a capital letter.

(e) The specific epithet begins with a small letter.

(f) In published documents such as books, scientific names should be written in italics, for example *Zea mays* and *Homo sapiens*. When handwritten, the names must be underlined separately for example Zea mays and Homo sapiens. Examples of how the scientific names are written in documents is shown in Table 10.3.

Table 10.3: Scientific names of common organisms

Common name	Scientific name
Common frog	*Rana temporaria*
Domestic cat	*Felis catus*
Coconut palm	*Cocos nucifera*
Mango tree	*Mangifera indica*
Garlic	*Allium sativum*
Onion	*Allium cepa*
Pea plant	*Pisum sativum*
Housefly	*Musca domestica*
Lion	*Panthera leo*
Leopard	*Panthera pardus*
Mimosa plant	*Mimosa pudica*

Chapter summary

1. Classification is the grouping of organisms based on their similarities and differences.
2. Classification is important because:
   (a) It makes easier to study the millions of organisms in the world.
   (b) Each organism (species) is referred to by the same name all over the world.
   (c) It is easier to study organisms when they are in groups.
   (d) It enables scientists to make predictions.
3. There are two types of classification systems:

(a) Artificial system of classification; based on few observable features of organisms.

(b) Natural system of classification; based on internal and external features of organisms.

4. In natural system of classification, organisms are divided into kingdoms, phyla or divisions, classes, orders, families, genera, and species. These units are called taxa (singular: taxon).
5. The members of a species are the most closely related. They can interbreed to produce a fertile offspring.
6. Currently five kingdoms are recognised: Monera, Protoctista, Fungi, Plantae, and Animalia.
7. Binomial nomenclature is the system of giving scientific names to organisms. A scientific name has two parts:
   (a) The first part is the generic name (Genus).
   (b) The second part is the specific epithet.

Revision exercise 10

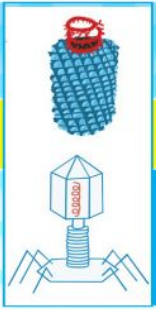
1. Match each item from **Column A** with its corresponding item in **Column B**.

List A	List B
(i) Kingdom	(a) Natural, artificial
(ii) Classification ranks	(b) *Panthera pardus*
(iii) Types of classification systems	(c) Division, genus, species
(iv) Scientific naming	(d) *Zea mays*
(v) Human being	(e) Monera, Animalia
(vi) Maize	(f) Binomial nomenclature
(vii) Leopard	(g) *Pisum sativum*
(viii) Established the practice of binomial nomenclature	(h) *Felis catus*
	(i) *Homo sapiens*
	(j) Aristotle
	(k) Carl Linnaeus

2. Explain the meaning of the following terms:
   (a) Classification
   (b) Taxonomy
   (c) Species
   (d) Binomial nomenclature

3. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement in the space provided against each question.
   (a) Artificial system of classification is based on few observable features. _____
   (b) The process of sorting living things into groups is called classification. _____
   (c) Organisms of the same species can interbreed to produce fertile offspring. _____
   (d) Organisms of different species do not usually interbreed. _____
   (e) Classification is based on similarities of organisms. _____

4. Why is classification important?
5. What are the differences between natural and artificial systems of classification?
6. Name the five kingdoms of living things.
7. List the ranks of classification starting with the highest to the lowest.
8. Explain why organisms belonging to different species do not interbreed to produce viable offspring.
9. Explain disadvantages of the artificial system of classification.
10. Mention six rules of binomial nomenclature.



Chapter Eleven

Viruses, kingdom Monera and kingdom Protoctista

Introduction

There are many species of living organisms in the world. These organisms are placed in groups based on their common or shared characteristics. Each group has its own features that make it distinct from others. In this chapter, you will learn about viruses and two kingdoms of organisms, namely Monera and Protoctista. The competencies developed from this chapter will enable you to distinguish members of these groups.

Viruses

A virus is an extremely small fragment of nucleic acid (DNA or RNA) surrounded by a protein coat. It is smaller than a living cell. A virus is not a cell. The study of viruses is called Virology. Examples of viruses are shown in Figure 11.1.

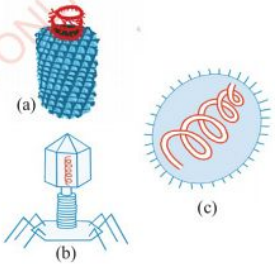


Figure 11.1: Different types of viruses (a) Tobacco mosaic virus (b) Bacteriophage virus (c) Influenza virus

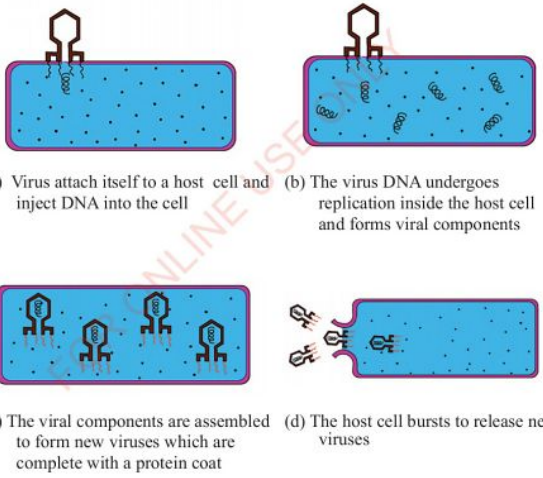
Characteristics of viruses

(a) They do not have a nucleus, cytoplasm, or cell organelles.

(b) They have a simple structure consisting of a small piece of nucleic acid (DNA or RNA) surrounded by a protein coat called a capsid. Some viruses have viral envelopes. These are membranes enclosing the capsids. The envelopes are made up of proteins from the host cell.

(c) They cannot reproduce on their own. They must attack a host cell and use the materials in that cell to reproduce. This is called obligate parasitism. The ability of a virus to reproduce inside the cell and crystallize in the absence of a living host places them between living and non-living things.

Figure 11.2 shows how some viruses attack and reproduce inside host cells.



(a) Virus attach itself to a host cell and inject DNA into the cell

(b) The virus DNA undergoes replication inside the host cell and forms viral components

(c) The viral components are assembled to form new viruses which are complete with a protein coat

(d) The host cell bursts to release new viruses

Figure 11.2: Viral reproduction

(d) When outside a host cell, they show no symptoms of life (do not grow, feed, excrete, or respire). They exist in a dormant state.

(e) They are host-specific. This means that a certain type of virus only attacks a specific host. For example, the rabies virus affects only mammals and HIV attacks only certain types of white blood cells in human beings.

(f) Most viruses are infectious: This means they can cause diseases to their hosts.

The structure of viruses

Viruses are composed of strands of genetic material (DNA or RNA) which forms the core. The core is enclosed by a protein coat called capsid as in bacteriophage. DNA or RNA are of various shapes and sizes according to the type of the virus. Examples of the structures of viruses are shown in Figure 11.3.

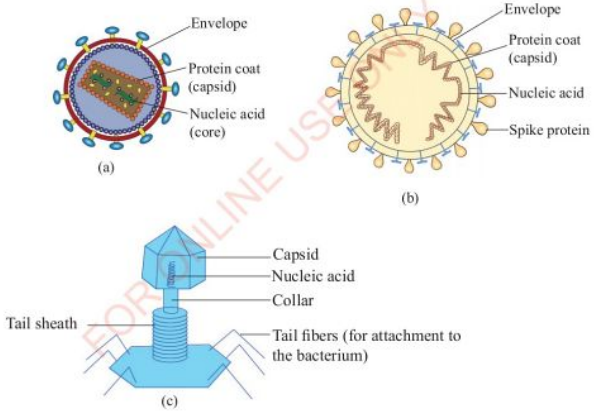


Figure 11.3: Structure of (a) Human Immunodeficiency Virus (b) Corona virus (c) Bacteriophage

Advantages of viruses

Although most viruses cause diseases, they also have the following advantages:

(a) Viruses are important in the study of cellular and molecular Biology. They are used by scientists to manipulate and investigate the functions of cells.
(b) Some viruses are used to make vaccines. For example, the first vaccine against smallpox was a small dose of the virus that causes cowpox, which is a mild infection. On recovering from cowpox, the body had antibodies that could resist both cowpox and smallpox.
(c) Bacteriophages are viruses that attack bacteria. They help in controlling bacterial infections and diseases.
(d) Some viruses are used in biological control to eradicate pests such as insects.

Disadvantages of viruses

(a) Most viruses are pathogenic. They cause diseases and infections such as tobacco mosaic disease, tomato spotted wilt disease, cassava mosaic disease, rabies, chickenpox, COVID-19, polio, and AIDS.
(b) Pathogenic viruses can reproduce very fast, leading to large-scale epidemics.
(c) Viruses can alter themselves often, and thus become difficult to cure viral infections. For example, there are many different types of viruses that can cause common cold and influenza. This makes it difficult to develop vaccines or cures for these infections.

Exercise 11.1

1. Explain why viruses are considered as both living and non-living things.
2. What are the two components of a virus?
3. Describe the structure of a bacteriophage.
4. Explain the economic importance of viruses.

Kingdom Monera

This kingdom consists of bacteria and blue-green algae. The scientific study of bacteria is called Bacteriology.

Characteristics of bacteria

(a) They are prokaryotic. Their cells lack a well-defined nucleus, since they have no nuclear membrane. They also lack other membrane bound organelles.
(b) They are small unicellular organisms. Some bacteria stick together to form chains or clusters called colonies.
(c) Some are free-living while others

are parasites or saprophytes. Free-living bacteria means that they exist on their own, for example in sewage or soil. These bacteria do not need to form relationship to other organisms in order to survive. Parasitic bacteria depend on other organisms known as hosts for their needs. Examples of hosts are human beings and other animals. Saprophytic bacteria get their food from dead organic matter.

(d) Free-living bacteria have flagella for movement.

(e) Bacteria have a slimy outer layer. This layer helps to protect them from parasites like viruses and predators such as protozoa.

(f) They reproduce asexually by binary fission or through spores.

(g) They occur in various shapes. There are five known shapes of bacteria. These are spherical or cocci (singular: coccus), rod or bacilli (singular: bacillus), spiral or spirilla (singular: spirillum), comma or vibrio (singular: vibrion) and corkscrew or spirochaetes (singular: spirochaete). Table 11.1 shows various shapes of bacteria.

Table 11.1: Various shapes of bacteria

Shape	Name	Examples
 Spherical-shaped bacteria	Cocci (Singular: Coccus)	*Diplococcus sp.* (found in pairs), for example bacteria that cause pneumonia and gonorrhoea *Staphylococcus* sp. (form clusters), for example bacteria that cause boils *Streptococcus* sp. (form chains), for example bacteria that cause sore throat

Shape	Name	Examples
 Rod-shaped bacteria	Bacilli (Singular: Bacillus)	*Mycobacterium tuberculosis* which causes tuberculosis, *Escherichia coli* which is found in the guts of human beings and can cause cramping, diarrhoea, and urinary tract infections *Salmonella typhi* which causes typhoid, and *Clostridium tetani* which causes tetanus
 Spiral-shaped bacteria	Spirilla (Singular: Spirillum)	*Treponema pallidum* which causes syphilis
 Comma-shaped bacteria	Vibrio (singular: vibrion)	*Vibrio cholerae* which causes cholera
 Corkscrew bacteria	Spirochaetes (singular: spirochaete)	*Borrelia* sp. which cause lyme disease and relapsing fever

Activity 11.1: Observation of features of bacteria

Materials: Microscope and prepared microscope slides of bacteria

Procedure

1. Observe prepared slides of bacteria using the microscope. What shapes of bacteria do you see?
2. Draw what you have observed.
3. Compare your drawings with diagrams of Figure 11.4.

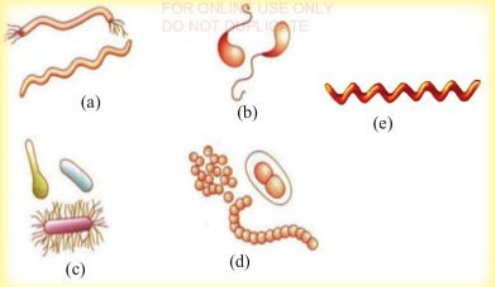


Figure 11.4: Structures and shapes of bacteria (a) spirilla (b) vibrio (c) bacilli (d) cocci and (e) spirochaete

Structure of bacteria

Bacteria have circular DNA suspended in the cytoplasm without being enclosed by the nuclear membrane. The cell wall encloses the cell membrane. Figure 11.5 shows a generalised structure of a bacterium.

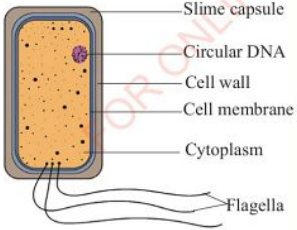


Figure 11.5: Generalised structure of a bacterium

Bacteria can be pathogenic or non-pathogenic.

Pathogenic bacteria

These are bacteria that can cause infections and diseases. Some of the diseases caused by bacteria are fire blight and crown gall in plants. In animals, bacteria cause diseases such as Tuberculosis (TB), typhoid fever, tetanus, cholera, syphilis, and gonorrhoea. Pathogenic bacteria have features that facilitate the spread of diseases and infections which include fimbriae or pili and flagella. They also produce toxins and perform invasion and colonization, transformation, and resistance.

Fimbriae or pili

Fimbriae are hair-like structures on the surface of some bacteria. The

hairs attach themselves to the host so that they cannot be removed easily. For example, *Escherichia coli* have fimbriae that attach themselves to the lining of the urinary tract or the intestines. Example of the structure of bacterium with fimbriae is shown in Figure 11.6.

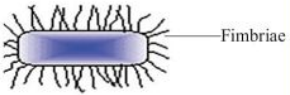


Figure 11.6: Bacterium with fimbriae

Flagella

These are long tail-like structures that help some pathogenic bacteria to move to a site where they can survive. An example of bacteria with flagella is shown in Figure 11.7.

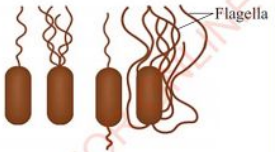


Figure 11.7: Bacteria with flagella

Toxins

Some bacteria produce toxic compounds that harm their hosts. Human body react to the produced toxins by inducing vomiting and diarrhoea in order to remove those toxins. For instance, toxins released by *Clostridium* sp. can lead to severe diarrhoea due to body reaction.

Invasion and colonization

Some bacteria attack cells and tissues and reproduce rapidly. For example, *Salmonella typhi* can destroy intestinal cells to feed on their contents. This causes severe diarrhoea.

Transformation

Bacteria can transform themselves and become resistant to modes of treatment. For example, the bacterium that causes tuberculosis has become resistant to many antibiotics by transforming itself.

Resistance

Some types of bacteria release a substance known as biofilm that protects them from harmful substances such as drugs.

Non-pathogenic bacteria

These are bacteria that are harmless even when they are in a plant's or animal's body. For example, *Rhizobium* sp. that are found in the root nodules of leguminous plants, help to convert atmospheric nitrogen to nitrates in the soil. Bacteria in the human gut manufacture vitamins K and B_{12} for example *Escherichia coli*.

Advantages of bacteria

(a) Some non-pathogenic bacteria feed on substances that are harmful to the environment, and in the process neutralize them. For example, they neutralize petroleum waste from petroleum industries, dyes and pesticides, thereby making the environment clean.

(b) Bacteria in the stomach of ruminant animals such as goats and cows secrete cellulase enzyme. Cellulase enzyme helps in the digestion of cellulose which forms a large part of the diet of ruminants.

(c) Nitrogen-fixing bacteria lives in the root nodules of leguminous plants. They convert free nitrogen in the air to nitrates in soil which can be used by plants to make proteins.

(d) Vitamins produced by bacteria are important for the health of animals, including human.

(e) Many bacteria are decomposers. They break down the dead bodies of plants and animals to release important elements such as nitrogen, carbon, and phosphorus which can be recycled.

(f) Some bacteria produce lactic acid as a result of fermentation of carbohydrates. This is important in the production of cheese, yoghurt, vinegar, and alcohol.

(g) Controlled fermentation is used in the curing of tea and tobacco and retting of flax. Curing helps to treat and preserve these products. Retting of flax is important in the production of linen.

(h) Some bacteria are used to produce antibiotics, which are used to treat bacterial infections.

(i) Bacteria are used in genetic engineering to produce hormones such as insulin and human growth hormone.

(j) Autotrophic bacteria undergo photosynthesis to release oxygen into the atmosphere. Oxygen is important for respiration.

(k) Bacteria in the human gut manufacture vitamins K and B_{12}, for example *Escherichia coli*.

Disadvantages of bacteria

(a) Some bacteria cause infections and diseases in animals. Some of the common bacterial diseases of animals are typhoid fever caused by *Salmonella typhi*, tuberculosis (TB) caused by *Mycobacterium tuberculosis* and gonorrhoea caused by *Neisseria gonorrhoeae*.

(b) Some bacteria cause diseases in crops. Examples of these diseases are fireblight on pea and apple caused by *Erwinia amylovora* and leaf spot in cotton caused by *Xanthomonas campestris*. Bacterial diseases in crops cause reduction in yield hence loss to farmers.

(c) Some bacteria cause food spoilage by decaying stored food and making it unsuitable for health.
(d) Sulphur bacteria produce sulphuric acid, which causes damage to buried metal pipes.
(e) Denitrifying bacteria convert soil nitrates into atmospheric nitrogen, therefore they reduce soil fertility.

Exercise 11.2

1. Mention three examples of beneficial bacteria.
2. Name three species of harmful bacteria.
3. Why are bacteria classified as kingdom Monera?
4. With the aid of a diagram, describe a generalised structure of a bacterium.

Kingdom Protoctista

Members of this kingdom include *Amoeba* sp., *Euglena* sp., *Plasmodium* sp., *Paramecium* sp., and *Trypanosoma* sp.

Characteristics of protoctists

(a) They are eukaryotic.
(b) Most are unicellular organisms, only a few are multicellular.
(c) Most live in or near water, or in moist places. Others are parasitic.
(d) Some are autotrophic (they manufacture their own food) while others are heterotrophic (obtain nutrients from other organisms).
(e) Some are mobile while others are sessile.
(f) Some reproduce sexually and others asexually. Others reproduce both sexually and assexually.
(g) Many protoctists have locomotory structures such as cilia, flagella or pseudopodia.

Phyla of kingdom Protoctista

Protoctists are subdivided into several phyla. Only five phyla of this kingdom will be described in this section. These phyla are Rhizopoda, example *Amoeba* sp., Apicomplexa, example *Plasmodium* sp., Euglenophyta, example *Euglena* sp., Ciliophora, example *Paramecium* sp. and Zoomastigina, example *Trypanosoma* sp.

Phylum Rhizopoda

An example of organisms found in the phylum Rhizopoda are *Amoeba* sp. which are free living or parasitic unicellular organisms. Parasitic amoeba include *Entamoeba histolytica* which feeds on cells of the human colon and cause amoebic dysentery. Free living amoeba are found in sea water, fresh water, and in the soil. They can also be found in muddy ponds and slow flowing streams containing decaying organic matter.

A generalised structure of amoeba as shown in Figure 11.8

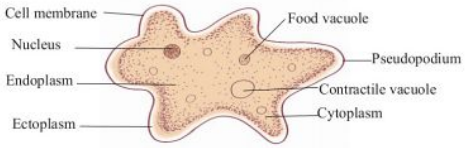


Figure 11.8: Generalised structure of amoeba

Characteristics of amoeba

(a) Amoeba have two layers of cytoplasm; a viscous outer layer called ectoplasm and a more fluid internal layer called endoplasm.
(b) Most of them are free living, feeding on plant and animal matter. Others are parasitic to animals such as human beings.
(c) They have pseudopodia (singular: pseudopodium), which are used for both locomotion and feeding as shown in Figure 11.9.

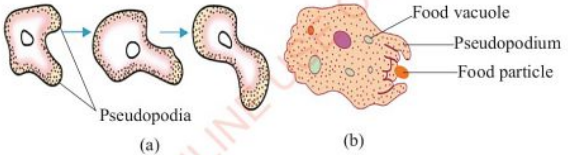


Figure 11.9: Amoeba using pseudopodia to (a) move and (b) feed

(d) They have contractile vacuoles which regulate the amount of water in the fresh water amoeba.
(e) They form temporary food vacuole to hold and digest food particles.
(f) Waste products such as urea and ammonia are excreted by simple diffusion. Diffusion is the movement of substances from a region of high concentration to a region of low concentration. When there is a high concentration of urea or ammonia in the amoeba, these substances flow out of the amoeba into the surrounding water.
(g) Oxygen and carbon dioxide gas are also exchanged by diffusion.
(h) They are unicellular organism.
(i) They reproduce asexually by binary fission as shown in Figure 11.10.

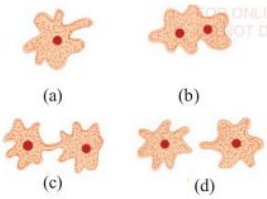


Figure 11.10: Binary fission in amoeba (a) mother cell (b) mother cell nucleus divides (c) mother cell cytoplasm divides (d) two new daughter cells

Advantage of amoeba

Amoeba are commonly used in laboratories to study cell structure and function.

Disadvantage of amoeba

Amoeba can cause diseases. For example, *Entamoeba histolytica* which cause amoebic dysentery in humans. *Entamoeba gingivalis* cause teeth and gum diseases.

Exercise 11.3

1. Write any three characteristics of the protoctists.
2. Mention five characteristics of amoeba?
3. Explain the economic importance of amoeba.

Phylum Euglenophyta

This phylum consists of unicellular aquatic organisms most of which live in freshwater and possess flagella. Example of organisms found in this phylum are *Euglena* sp. *Euglena* sp. cause green scum that often appears on stagnant water. Figure 11.11 shows the structure of *Euglena* sp.

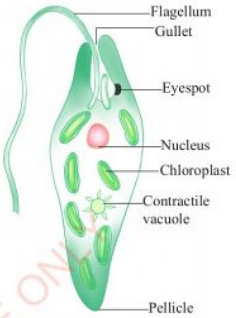


Figure 11.11: Structure of the *Euglena* sp.

Characteristics of *Euglena* sp.

(a) They are unicellular.
(b) They have chloroplasts which contain chlorophyll for photosynthesis.
(c) Most of them are found in fresh water; only a few are found in salt water.
(d) They are protected by pellicle, which surrounds the cytoplasm, since they lack cell wall. The pellicle allows the euglena to change shape.
(e) They have flagella for movement.
(f) They have eye spots for detection of light intensity.

(g) They are eukaryotic cells.
(h) They possess both plant and animal characteristics. The plant characteristic is the possession of chloroplasts which contain chlorophyll for photosynthesis. The animal characteristics includes ability to move using a flagellum, an eyespot for detection of light intensity, and gullet for ingesting food.

Advantages of *Euglena* sp.

(a) They are used to treat sewage because of their unique capacity to change from being autotrophic to heterotrophic.
(b) *Euglena* sp. are an important source of food to aquatic organisms such as fish.
(c) During photosynthesis, *Euglena* sp. produce oxygen gas. This oxygen is useful to aquatic organisms. It also helps to balance oxygen gas levels in sewage treatment plants.

Disadvantages of *Euglena* sp.

Euglena sp. blooms can be harmful to fish. The toxins produced by these large numbers of microorganisms can kill fish and other organisms in the water.

Phylum Apicomplexa

Organisms found in this phylum are unicellular and parasitic, for example *Plasmodium* sp. which cause malaria in humans.

Characteristics of *Plasmodium* sp.

1. They are unicellular.
2. They are parasites with a complex life cycles involving the host and the vector.
3. They reproduce sexually in the host and asexually by multiple fission in the vector and host.
4. When a plasmodium enters the human body, it attacks the red blood cells and liver cells.
5. They are eukaryotes.

Effects of *Plasmodium* sp.

Plasmodium parasites cause malaria. Malaria can lead to inflammation and rupture of the spleen, and miscarriages. It can also cause anaemia due to the destruction of red blood cells. Severe malaria can also cause death.

Phylum Ciliophora

Organisms found in this phylum are unicellular and are found in aquatic habitats, for example *Paramecium* sp. Figure 11.12 shows a structure of a *Paramecium* sp.

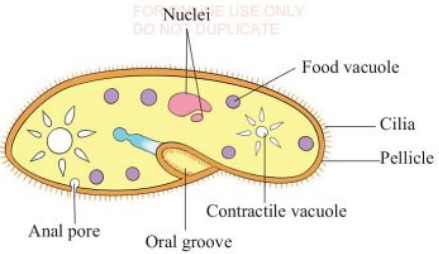


Figure 11.12: Structure of *Paramecium* sp.

Characteristics of *Paramecium* sp.

(a) They are unicellular and slipper-shaped.

(b) They are heterotrophic.

(c) They live in fresh water.

(d) The body is covered with short hairy structures called cilia.

(e) They use cilia to move and to create a feeding current.

(f) The body of the paramecium cell is enclosed by a stiff but elastic membrane, called the pellicle.

(g) Food enters the organism through an opening called the oral groove.

(h) They have food vacuoles which are formed to hold and digest food particles.

(i) *Paramecium* sp. feed on bacteria and other microorganisms.

(j) They have anal pores which are used for elimination of undigested food.

(k) *Paramecium* sp. can reproduce either asexually or sexually, depending on their environmental conditions. Asexual reproduction takes place when enough nutrients are available, while sexual reproduction takes place under conditions of starvation.

(l) Contractile vacuoles regulate the amount of water in the cytoplasm.

Advantages of *Paramecium* sp.

Paramecium sp. play important ecological role in the environment as they help to clean up small particles of debris in the water as well as feeding on small animals.

Disadvantages of *Paramecium* sp.

(a) Some *Ciliophora* such as *Balantidium coli* cause disease. They invade and destroy the lining of the intestine, causing a disease called balantidiasis.

(b) *Paramecium* sp. feed on bacteria which decompose sewage. This may delay the decomposition of sewage.

Exercise 11.4

1. In which ways are *Euglena* sp. similar to and yet different from *Paramecium* sp?
2. List two features showing that *Paramecium* sp. belong to kingdom protoctista.
3. Explain any three characteristics of *Paramecium* sp.

Phylum Zoomastigina

Organisms found in this phylum are unicellular flagellate protozoa. Generally they are found in the intestine, but can also be found in blood stream or in the heart, for example *Trypanosoma* sp. Figure 11.13 shows the structure of a *Trypanosoma* sp.

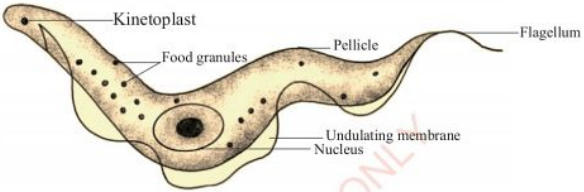


Figure 11.13: Structure of a *Trypanosoma* sp.

Characteristics of *Trypanosoma* sp.

(a) They are unicellular, slender, elongated, and dorsal ventrally flattened in shape.
(b) They are heterotrophic.
(c) They are parasites in wild animals, domesticated animals, and human beings.
(d) Have a mass of mitochondrial DNA located near the mitochondrion in a structure called kinetoplast.
(e) The body is covered with a thin, elastic, and firm pellicle.
(f) Most of them reproduce asexually by binary fission while inside the host.
(g) Some have an undulating membrane for locomotion.

Disadvantages of *Trypanosoma* sp.

Trypanosoma brucei is the causative agent of the disease called trypanosomiasis or sleeping sickness. The disease affects mostly African countries. It can be transmitted through bites of a vector called tsetse fly or through blood contact from an infected individual.

Activity 11.2: Observing different protoctists

Materials: Specimen bottles, microscope, microscope slides and cover slips, pond water, a notebook, and a pencil

Procedure

1. Go to a pond or any other place with stagnant water.
2. Fetch water from the pond using specimen bottles.
3. In the Biology laboratory, put a drop of the pond water on a microscope slide, add stain and cover it with a cover slip.
4. Observe the slide under the microscope. Can you identify any organisms? Name them.
5. Draw what you see under the microscope.

Chapter summary

1. A virus is an extremely small microscopic agent. It is not a cell.
2. Kingdom Monera consists of bacteria and blue-green algae.
3. Bacteria can be pathogenic or non-pathogenic.
4. Kingdom Protoctista includes *Amoeba* sp., *Plasmodium* sp., *Euglena* sp., *Paramecium* sp., and *Trypanosoma* sp.
5. *Amoeba* sp. are aquatic unicellular organisms that use pseudopodia for locomotion and engulfing food.
6. *Plasmodium* sp. are parasites that cause malaria. Their life cycle involves a host and a vector.
7. *Euglena* sp. are unicellular protoctists that use flagella for movement. Some euglena are autotrophic.
8. *Paramecium* sp. are slipper-shaped and complex cells that use cilia for movement.

Revision exercise 11

Write **TRUE** for a correct statement and **FALSE** for an incorrect statement in the space provided.

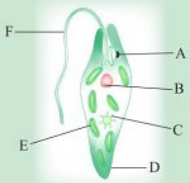
1. A virus is an extremely small organism. _____
2. Kingdom Monera includes *Amoeba* sp. _____
3. *Plasmodium* sp. is a parasite that cause sleeping sickness. _____
4. *Euglena sp.* are unicellular Protoctists. _____
5. *Paramecium* sp. use flagella for movement. _____

Write the term from the box that best matches each of the phrases in question 6-12.

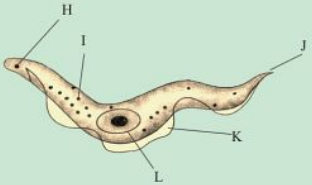
Flagellum	*Amoeba* sp.	*Plasmodium* sp.
Bacterium	Virus	Eukaryote
Monera	Cilia	

6. A protoctist that moves by means of temporary projections called pseudopodia._____
7. The only kingdom of prokaryotic organisms. _____
8. An organism that causes malaria. _____
9. The structures that a paramecium uses for movement. _____
10. A disease-causing particle that consists of nucleic acid and a protein coat. _____
11. The structure that *Euglena* sp. uses for movement. _____
12. An organism whose cells do not contain nucleus or membrane-bound organelles. _____
13. (a) List the different shapes of bacteria.
    (b) Draw the shapes you have named in 13 (a).
14. What are the economic importance of bacteria?
15. Outline the harmful effects of viruses.
16. Give the scientific names of the bacteria that cause the following diseases.
    (a) Tuberculosis (b) Tetanus (c) Cholera
17. Describe the characteristics of *Trypanosoma* sp.
18. Distinguish between Apicomplexa and other protoctists.
19. Draw a well labelled diagram of a *Paramecium* sp.
20. How are euglena beneficial to the environment?
21. How does an amoeba:
    (a) move? (b) feed? (c) reproduce?
22. Explain the effects of the following organisms to humans:
    (a) *Amoeba* sp.
    (b) *Plasmodium* sp.
    (c) *Trypanosoma* sp.

23. Study the diagrams below and answer the following questions



Organism X



Organism Y

(a) Give the common names for organisms X and Y.

(b) State the phyla in which organisms X and Y belong.

(c) Give two advantages of organism X.

(d) Name the parts labelled A-F in organism X and parts labelled H-L in organism Y.

Glossary

Active immunity
immunity acquired as a result of a person's immune system producing its own antibodies

Adolescence
transitional period between childhood and adulthood

Amoeba
aquatic unicellular organism that uses pseudopodia for locomotion and engulfing food

Analogous structure
structures with different origin but perform the same function

Analogy
similarity of use

Antibody
protein molecule produced by the body's immune system to fight an antigen

Antigen
material recognized by the body as foreign that can induce an immune response

Aquarium
place or container for keeping live marine or fresh water organisms

Artificial immunity
immunity as a result of a person's immune system being induced to produce a specific immune response

Binomial nomenclature
scientific system of naming organisms whereby every name is made up of two parts

Botany
study of plants

Capsid
protein shell that encloses genetic material in a virus

Cell
basic unit of life

Chlorophyll
green coloured pigment found in the leaves of green plants, and stems of some plants

Chloroplast
cell organelle with chlorophyll where photosynthesis occurs

Class
third taxonomic rank of classification

Delirium
disturbed state of mind marked by restlessness, illusion, and incoherent thought and speech

Disease
condition that interferes with the normal functioning or health of the body

Division
second taxonomic rank of classification in plants

Drooling
dropping saliva uncontrollably from the mouth

Ecology
branch of Biology that deals with the study of the relationship between living things and their natural environment

Environment
surroundings or the conditions in which an organism lives

Eukaryotic cells
cells whose nuclei are bound by nuclear membranes

Excretion
the process by which metabolic wastes are removed from the body of an organism

Fungi
the kingdom composed of saprophytic organisms that digest food externally and absorb the resulting soluble nutrients

Genus
sixth taxonomic rank of classification

Growth
permanent increase in size and mass of an organism

Health
a state of physical, mental, and social well-being

Helper T Cells
a type of white blood cells that are involved in immune responses, including killing infected host cells and activating other white blood cells to fight infection.

Homologous structures
structures with same origin. They may perform the same or different functions

Homology
similarities of origin

Hunchback
A condition in which spine of the upper back has an excessive curvature.

Hygiene
the practice of keeping the body, belongings, and surroundings clean in order to maintain good health

Immunity
the ability of the body to resist infections and diseases.

Incinerate
to burn something until it is completely destroyed

Infection
invasion of pathogens into the body

Irritability
ability of living things to detect and respond to changes in their environment

Kingdom
first taxonomic rank of classification.

Laboratory
a room specialized to conduct scientific experiments

Locomotion
type of movement whereby the whole body moves

Metabolism
chemical processes that take place inside living cells

Microorganisms
very small living things such as bacteria and protozoans that cannot be seen by naked eyes.

Microscope
an instrument that is used in scientific studies to enlarge very small things, such as microorganisms so that they can be easily seen and examined

Monera
kingdom consisting of bacteria and blue-green bacteria

Multicellular organisms
many celled organisms

Muscle cramps
sudden, involuntary, and painful

contractions of a single muscle or a group of muscles

Natural immunity
immunity that is inborn or exists even before the body is exposed to an antigen

Nutrition
the process by which living things take in food for growth, metabolism, and repair.

Opportunistic infection
an infection due to a weakened immune system that may manifest into a disease.

Order
fourth taxonomic rank of classification

Organ
a group of tissues that carry out the same function

Organelles
small structures found inside the cell having a specialized function, for example mitochondria, chloroplasts, and vacuoles

Paramecium sp.
slipper-shaped and complex unicellular organism that uses cilia for movement

Passive immunity
immunity acquired by transfer of antibodies from another source

Pathogen
a disease-causing organism

Photosynthesis
the process by which plants make their own food using carbon dioxide, water, and energy from the sun

Phylum
second rank of classification in animals

Plasmodium sp.
the parasite that causes malaria in human beings

Prokaryotic cell
cell that does not have a true nucleus or membrane-bound organelles

Proteins
organic compounds made of amino acids

Protoctista
kingdom that includes amoeba, plasmodia, euglena, and paramecia

Pseudopodia
cell extensions in amoeba used for either locomotion or engulfing food particles

Puberty
the stage at which a child begin to mature biologically, psychologically, and socially and become capable of reproduction.

Recycle
to turn waste into useful products e.g. turning used newspaper into envelopes or paper bags.

Reproduction
the process by which living organisms produce new offspring of their kind

Respiration
the process by which food substances are metabolised to produce energy

Root hair
extension of an epidermal cell of a root that helps to absorb water and minerals from the soil

Scientific method
a set of steps used in science to prove a hypothesis.

Secondary sexual characteristics
behavioural or physical changes that occur during puberty and which create differences between males and females

Sense organs
groups of tissues that enable us to observe things by looking, smelling, hearing, tasting, and touching them.

Sensitivity
ability to detect and respond to stimuli

Skin
the organ forming the outermost covering of the body of vertebrates.

Specialized cell
a cell that performs a specific function

Specimen
an organism, part of a body of an organism, or any object used for scientific study

Stigmatisation
to treat people unfairly because of their state of health, social group, or physical disorders

Stimuli
anything or condition that causes change in the internal or external environment of an organism

Sting
piercing needle-like structure found in bees, hornets, and wasps

Stomata
tiny pores in the epidermis of leaves that allow gaseous exchange and transpiration to occur in plants

Taxon
a group of organisms sharing common characteristics in varying degrees, for example phylum, order, family, genus, species

Taxonomy
the field of biology that deals with classifying organisms

Temperature
the degree of hotness or coldness of an object or environment

Tissue
a group of cells working together to perform a specific function

Transfusion
the transfer of blood from one individual (the donor) to another (the recipient) through blood vessels

Tuberculosis (TB)
an infectious bacterial disease that spreads by droplets when an infected person coughs or sneezes

Unicellular organisms
single-celled organisms

Vaccination
the act of introducing a vaccine into the body to produce immunity to a specific disease

Virology
the study of viruses

Vitamin
complex organic micronutrients essential for the body wellbeing and protection against diseases

Xylem
tissue made up of vessels and tracheid that transport water and minerals in vascular plants

Zoology
the study of animals.

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Index

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