Science and Technology

Standard Six

Pupil's Book



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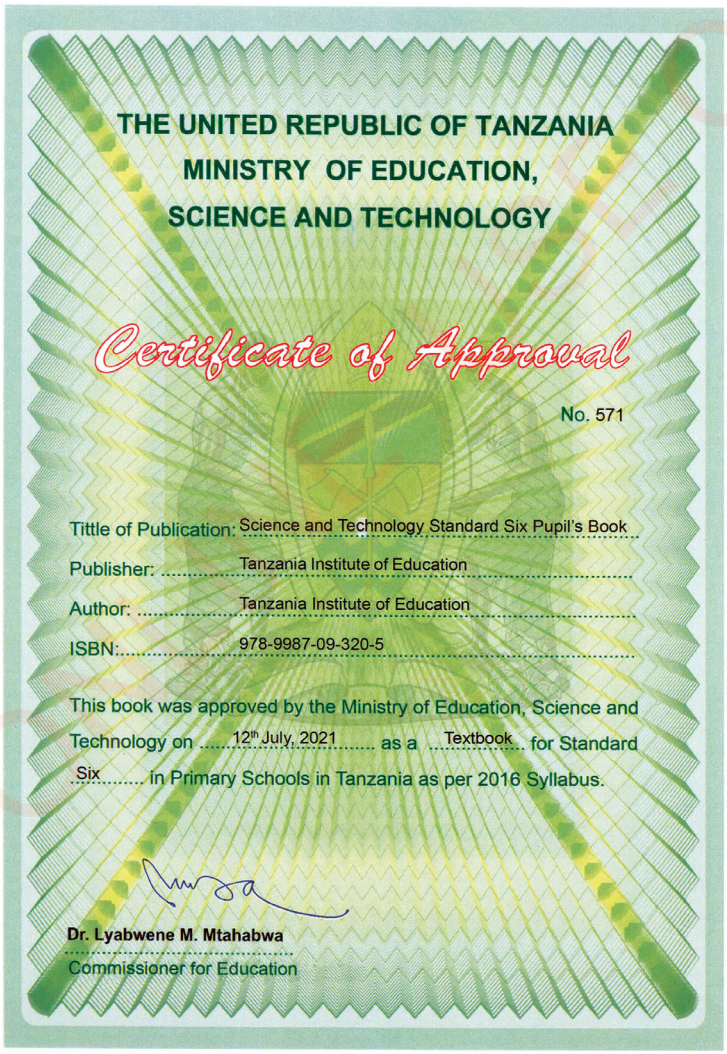

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Commissioner for Education

Tanzania Institute of Education

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Introduction

This is the fourth book in a series of five textbooks on Science and Technology for Primary Schools. The book is prepared according to the 2016 Science and Technology Syllabus for Primary Schools, issued by the Ministry of Education, Science and Technology. This book consists of 18 chapters, which are: Air, Growth in plants, Photosynthesis, Soil, Electric energy, Renewable energy, Work and machines, Osmosis and diffusion, Spreadsheet program and Internet. Others are Environmental Cleanliness, First aid, Sexually Transmitted Diseases (STDs), HIV and AIDS, Hereditary diseases, Health services, Blood circulatory system, Puberty, and Reproductive system. The book includes explanations, illustrations, practical activities, exercises and experiments that enhance learning. You are encouraged to do all activities, experiments and exercises. This will enable you to develop the intended competencies.

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Chapter One

Air

Introduction

In Standard Five, you learnt about the main characteristics of living things including breathing. You learnt that plants and animals need air for their survival. Animals use oxygen for respiration and give out carbon dioxide. During photosynthesis, plants use carbon dioxide and give out oxygen. In this chapter, you will learn the concept of air and characteristics of gases that compose air. You will also learn about the use of air in daily life. The knowledge and skills acquired through this chapter will help you to conserve the environment and hence increase fresh air and also reduce production of dangerous gases.

Meaning of air

Air is a mixture of different gases found in the atmosphere. These gases include oxygen, carbon dioxide, and nitrogen. A human being can feel air.



Discuss with your fellow pupils

1. Can you see air?
2. Can you touch air?
3. Can you feel air?

Characteristics of air

Air has the following characteristics:

(a) It is invisible.

(b) It occupies space.

(c) It is in a gaseous state.

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(d) It has neither smell nor colour.

(e) It has weight.

Activity 1: *Study the characteristics of air*

Requirements: balloons, electronic balance, and cotton string

Procedure

1. Weigh the empty balloon and the piece of cotton string and record the weight.
2. Fill the balloon with air by blowing using your mouth.
3. Tie the balloon full of air with a piece of cotton string. Weigh the balloon with air using an electronic balance and record the weight.

Questions

1. What is the shape of the balloon after filling it with air and tying it? Study Figure 1.
2. Is there any difference in the weight of the balloon between step 1 and step 3?

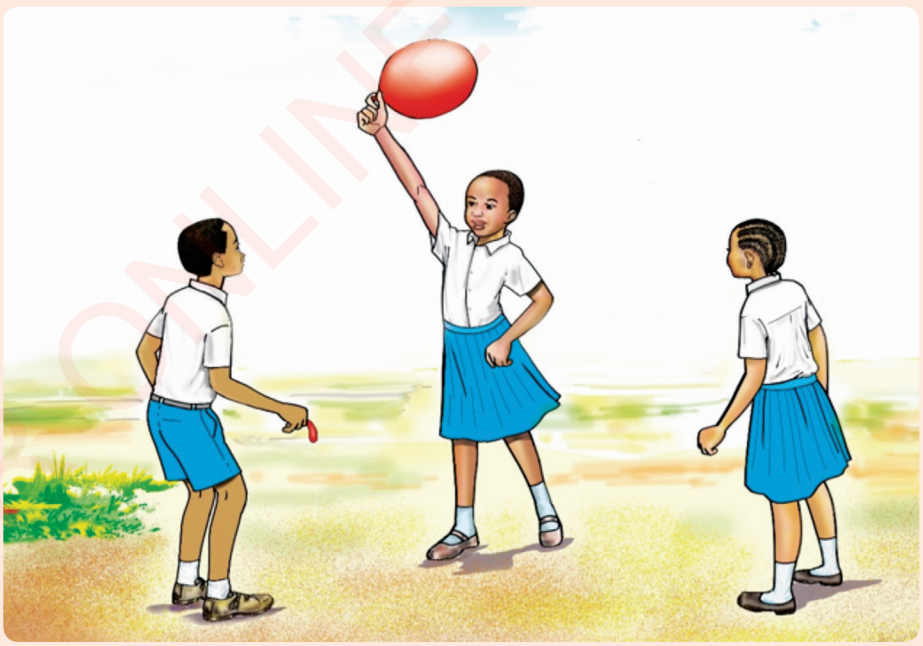

Figure 1: *Pupils demonstrating the characteristics of air*

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Importance of air

Air is of great importance to the environment and living things. The importance of air is seen in the life of living things, burning of things, and pollination. Air is also important in the production of electricity, drying of materials and transfer of sound waves. Other areas in which air is important include rising and floating of things, and inflating of tyres and balloons. Likewise, air is important in changing atmospheric vapour into rain and balancing of heat on the earth.

Life for living things: All living things, including plants and animals, depend on oxygen for their life. A germinating seed uses oxygen to break down the stored food resulting into the production of energy. This energy is necessary for germination and growth of the plant. Plants also use carbon dioxide to manufacture their food. Similarly, in animals, oxygen is transferred through the blood to the cells. In the cells, oxygen helps to convert food into energy required by the body.

Burning of things: In order for fire to start, there must be oxygen gas. This gas allows the burning of different things such as firewood, charcoal, and paper. Fuel machine engines use oxygen for burning the fuel in order to produce energy. This energy enables the engines to work. In charcoal making, oxygen is restricted from entering the charcoal furnace. This is done to avoid the complete burning of charcoal to ash.

Pollination: The moving air in the atmosphere is called wind. This wind transfers pollen from the male part to the female part of the flower. This is done within the same plant or between one plant and another. Flowers produce a smell that is transferred by air from one place to another. The smell is sensed by living things such as insects and birds. The smell attracts insects and birds that are searching for food. In getting the nectar, they carry pollen and cause pollination in the flowers.

Production of electricity: There are different sources of electricity including hydroelectric power and solar energy. Electricity can also be produced by wind. Special power plants for the production of wind electricity are installed in strong wind places (See Figure 2). The produced electricity is used in homes, schools, offices and factories.

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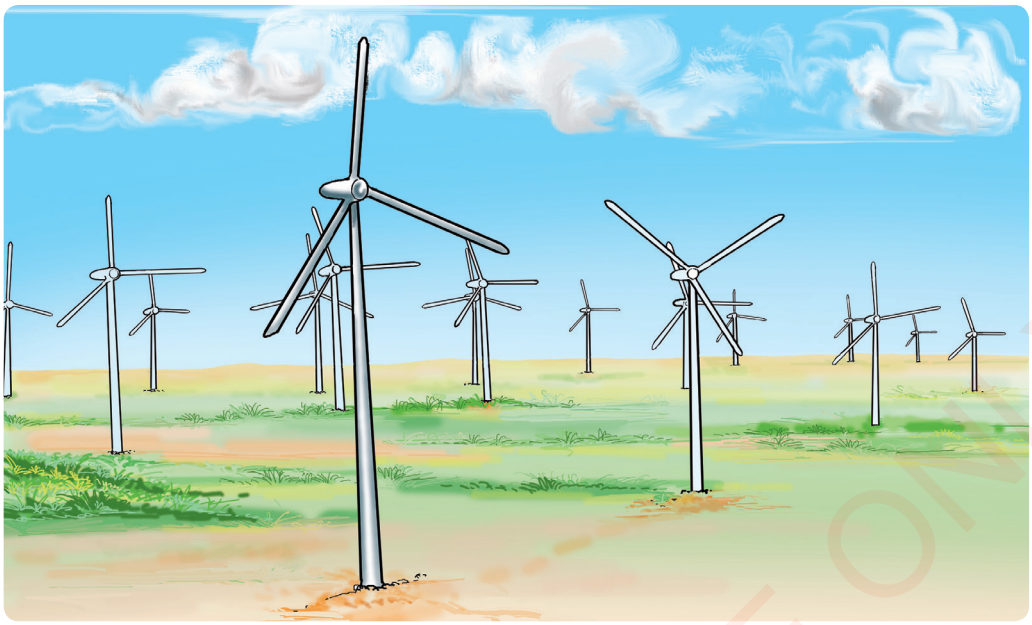

Figure 2: *Wind farm for producing electricity*

Drying of things: Circulating air absorbs water vapour (moisture) from different things such as crops and soil. Exposure of wet clothes at open places allows air to absorb the moisture. In this case, air causes drying of the clothes. Cereal crops are spread at open places so that the circulating air can take away the moisture for proper drying of the crops. Examples of cereals that can be dried by air are maize, millet, sorghum and beans (See Figure 3).

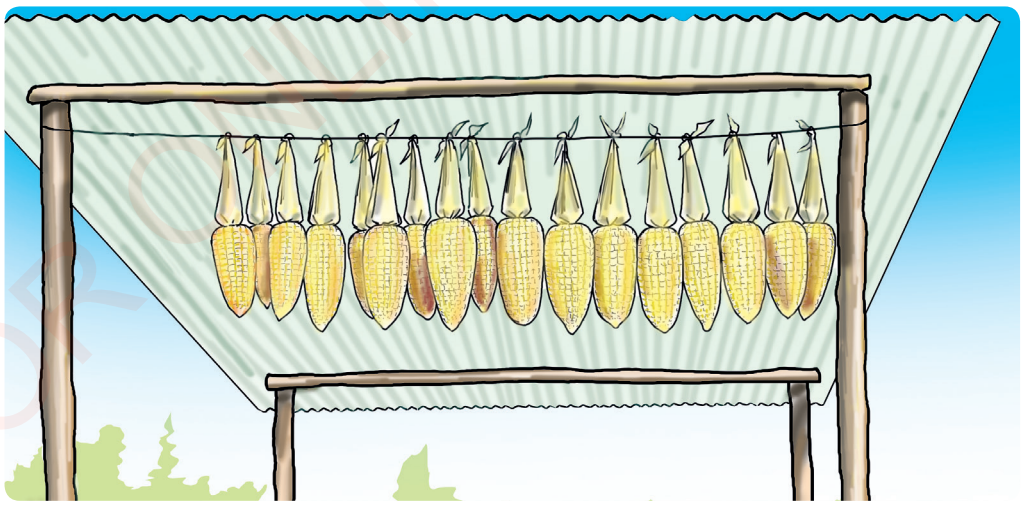

Figure 3: *Maize dried in air*

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Transfer of sound waves: Presence of air enables one to hear voices from human beings, birds, animals and different things such as bells. Sound waves travel from the points of their production to other places through air. For example, a radio receives different sound waves from broadcasting stations. Without air, you could not hear the voices you always hear in your environment.

Rising and floating of things: Birds and different insects move from one place to another by flying.

Things that fly have special features that enable them float in the sky. Parachutes and balloons are inflated with air for them to float in the sky (See Figure 4).

Likewise, some of the objects that float on water such as buoys contain air that makes them float.

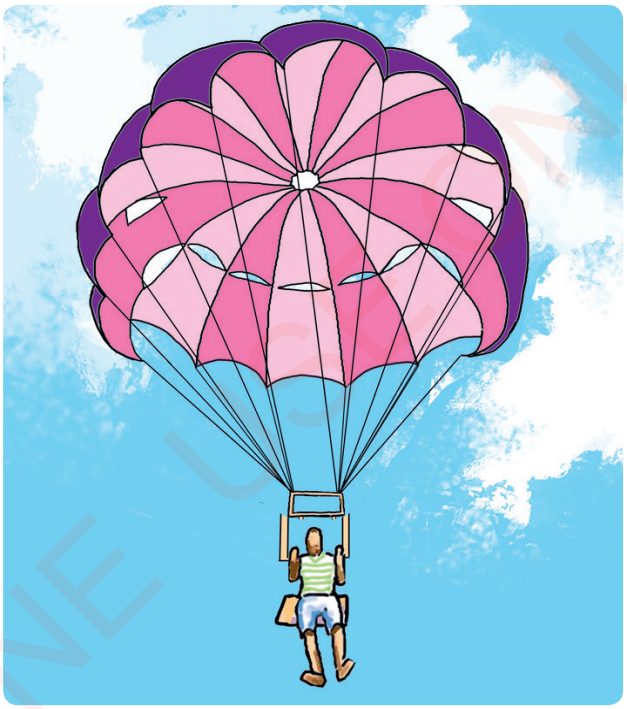

Figure 4: *A parachute floating in the sky*

Filling of tyres with air: Transport facilities such as bicycles, motorcycles, and vehicles use tyres to move from one place to another. Tyres fixed on wheels are filled with air to enable transport facilities to withstand heavy loads. Air filled tyres also reduce friction against the road.

Change of atmospheric vapour into rain: When water from different bodies gains heat, it changes into vapour that rises into the atmosphere. In the atmosphere, water vapour cools and condenses into clouds. When the clouds become heavy they fall as droplets which are called rain. The whole cycle of forming rain mainly depends on air.

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Temperature regulation on the earth surface: Air circulates on the earth's surface and on water bodies such as rivers, lakes, seas and oceans. When sun rays hit some parts of the earth, especially during the dry season, the temperature rises. At the same time, water gains heat slowly hence it becomes relatively cooler than the land. Wind blows from water bodies to the land. Air from water bodies cools the air on the land. Air circulation between water bodies and the land regulates the temperature of the earth.

Exercise 1

Answer the following questions in your exercise book.

1. What is air?
2. Mention five characteristics of air.
3. Mention five uses of air.

Composition of air

Air is a mixture of different gases. The composition of gases in the air is shown in the table.

Table: *Composition of air*

Gas	Per cent
(a) Nitrogen	78
(b) Oxygen	20.9
(c) Argon	0.90
(d) Carbon dioxide	0.03
(e) Other gases	0.17

Air contains mainly nitrogen, oxygen, argon and carbon dioxide. Other gases such as hydrogen, neon, helium, krypton and xenon are present in very small quantities. Water vapour is also a gas that forms part of air. The amount of water vapour in the air differs from one place to another.

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This depends on the quantity of the vapour produced and the weather conditions of the places concerned.

Oxygen

Oxygen occupies 20.9 per cent of the air. This gas is produced by plants during photosynthesis as indicated by the equation,

$$\text{Carbon dioxide + Water} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{Carbohydrate + Oxygen}$$

Oxygen can also be prepared in the laboratory starting from different compounds. For example, it can be prepared using potassium chlorate as shown in the equation,

$$\text{Potassium chlorate} \xrightarrow[\text{Heat}]{\text{Manganese dioxide}} \text{Potassium chloride + Oxygen}$$

The importance of oxygen gas: Oxygen gas is important to the environment and living organisms in general. This gas is used in gaseous exchange, hospitals and welding. It is also important in transportation facilities, and in water treatment and purification.

Gaseous exchange: Oxygen gas is used by different living organisms such as human beings and other animals. When oxygen is inhaled into the lungs, it is captured in the blood and transferred to body cells. In the body, the gas helps in the breakdown of food to produce energy. The gas is also used by small organisms. Oxygen gas is absorbed through the skin of small organisms such as worms to the cells.

During the night, plants use oxygen gas to produce energy. That is why it is advised not to put plants in sleeping rooms with insufficient air supply.

Astronomers, divers, and mountain climbers carry with them oxygen gas in cylinders for their use (See Figure 5). Oxygen gas is also pumped into underground mines to ensure miners have sufficient supply of it.

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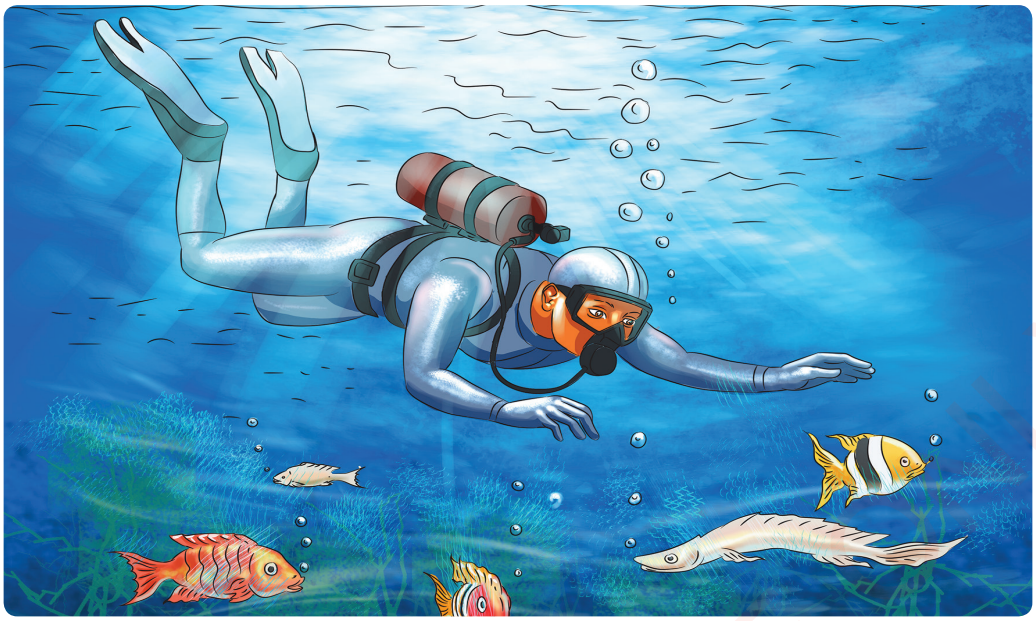

Figure 5: *A diver using oxygen gas in deep water*

Hospitals: Oxygen is stored in special cylinders for use by patients in hospitals. For example, premature babies have breathing problems. They fail to use their lungs for gaseous exchange. Therefore, they use oxygen from a special machine that enables them breath. Likewise, patients with breathing problems especially those in critical condition, use special oxygen generating machines (See Figure 6).

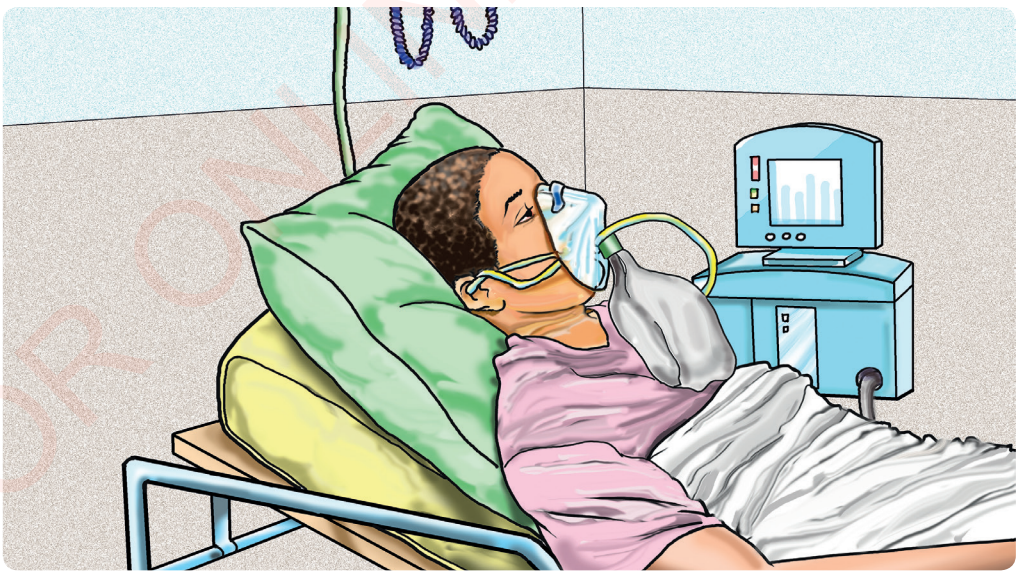

Figure 6: *A patient using oxygen from a special machine*

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Welding: Oxygen gas is used in welding. The gas facilitates the burning and softening of metals to be joined together.

Transport: Many transport facilities on land, water and air use fuel. The fuel is burnt so as to produce energy. The energy enables these facilities to move on the ground, and float in the air and on water. Oxygen is used to burn the fuels used in these facilities.

Wastewater treatment and purification: Wastewater from residential areas, industries, business areas and from hospitals can be purified and reused. This is done using microorganisms such as bacteria found in the water. In order for the microorganisms to survive in the water, oxygen gas is blown into the water. Air blowing depends on the types and amount of chemicals present in the water. Thus, water must be investigated to find out the types and amount of chemicals present during treatment.

Exercise 2

Answer the following questions in your exercise book.

1. The percentage of oxygen gas in the air is _____.
2. Oxygen contained in gas cylinders is also found in hospitals. What is it used for?
3. Mention five daily uses of oxygen.

Carbon dioxide

Carbon dioxide gas is present in the air at 0.03 per cent. Carbon dioxide is made up of two elements, which are carbon and oxygen. This gas has neither smell nor colour. In breathing, living things exhale carbon dioxide. Activities such as fermentation, burning and rotting of things produce carbon dioxide. Likewise, in the laboratory, carbon dioxide is prepared by reacting carbonates and acids as shown in the following chemical equation:

Calcium carbonate + Hydrochloric acid ⟶ Calcium chloride + Water + Carbon dioxide

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Importance of carbon dioxide gas

Plants use carbon dioxide and give out oxygen in the process of manufacturing their food (See Figure 7).

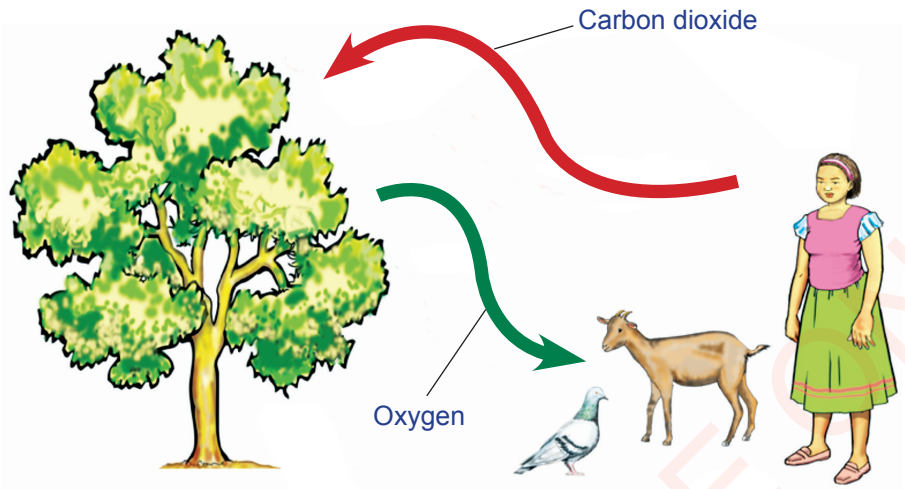

Figure 7: *Sources and uses of carbon dioxide and oxygen*

Carbon dioxide helps in keeping things fresh in the refrigerator. It is also filled in cylinders for extinguishing fire. See Figure 8.



Figure 8: *Carbon dioxide fire extinguisher*

Carbon dioxide is also used in the manufacturing of chemical fertilisers. Carbon dioxide from yeast action is used to raise the bread dough in bakeries and homes. Moreover, the gas is used in preserving drinks such as soda and juice.

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Harmful effects of carbon dioxide gas

Currently, there is an increased production of carbon dioxide from industrial and human activities. When carbon dioxide gas is produced in a large amount, it may cause environmental problems. Plants help to reduce the amount of carbon dioxide gas in the environment. It is important to plant many trees and avoid unnecessary cutting of the trees. Carbon dioxide gas forms a layer in the atmosphere that prevents heat loss from the earth. This leads to temperature increase on the earth's surface and climate change. The increased temperature leads to melting of ice that results into an increase in ocean water level.

Exercise 3

Answer the following questions in your exercise book.

1. Name the elements that form carbon dioxide gas.
2. Mention three sources of carbon dioxide gas.
3. Explain four uses of carbon dioxide gas.
4. Explain two human activities that result into the production of carbon dioxide gas in your environment.

Nitrogen

Compared to other gases, nitrogen gas occupies the largest part of the air. It forms 78 per cent of all the gases in the air. This gas is produced through geological activities, agricultural activities and animal husbandry. Also, urban waste produces this gas. Nitrogen gas is important in the production of proteins in plants and animals. In the soil, the gas is converted by bacteria into an element or compounds. The element or compounds are then absorbed together with water through plant roots as nutrients to the plants. Lack of nitrogen in the soil slows and retards plant growth, and plant leaves become yellow. Growth retardation and yellowing of leaves lowers crop production and yields.

Uses of nitrogen

Nitrogen gas is useful in making industrial fertilisers such as urea, Double Ammonium Phosphate (DAP), Nitrogen, Phosphorus and Potassium (NPK),

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Suphate of Ammonia (SA), and Calcium, Ammonia and Nitrogen (CAN). Nitrogen is used in producing nitric acid, different dyes, and nylon. The gas is also used in hospitals to preserve different things. Examples of these things are male and female gametes, cells, nerves and blood. It is also used to preserve things at specific temperatures.

Exercise 4

Answer the following questions in your exercise book.

1. What kind of food is nitrogen used to make in plants and animals?
2. Mention five types of fertilisers made using nitrogen.
3. Apart from agriculture, mention three other uses of nitrogen.

Argon

This is an inert gas found in the air. Argon makes 0.90 per cent of the air. Argon is an inert gas because it cannot react with other elements to form compounds. It is ordourless and colourless. The gas is used in electric bulbs and fluorescent tubes. Argon is also used in metal cutting and welding.

Water vapour

Water exists in three states, which are solid, liquid and gas. Water vapour exists in the air in different amounts depending on the area. The vapour comes from water bodies such as oceans, lakes, rivers, and other sources. Plants lose water to the atmosphere in the form of vapour. In the atmosphere, the vapour cools and condenses into droplets that fall as rain. Animals also lose water in the form of vapour through sweating and breathing.

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Activity 2: *Investigation of the presence of water vapour in the air*

Requirements: table, a piece of cotton cloth, freezer, watch, 1 litre of water, two 1-litre empty bottles with their tops

Procedure

1. Pour $\frac{1}{2}$ a litre of water into each of the two bottles and close with a lid.
2. Mark one bottle A and the other B.
3. Place bottle A containing water in the freezer for 20 minutes.
4. Place bottle B containing water on the table.
5. Take bottle A from the freezer, dry it using a piece of cotton cloth and place it on the table.
6. Leave bottle A on the table for 5 minutes.
7. Observe what happens to bottles A and B (See Figure 9).



Bottle with water droplets on the surface

Bottle without water droplets

Figure 9: *Demonstration on the presence of water vapour in the air*

Questions

1. What did you observe?
2. Did you observe the same changes in the two bottles?
3. What do you think is the reason for the changes you observed?

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Exercise 5

Answer the following questions in your exercise book.

Section A

1. Fill in the following table by providing the right answer.

Gas type	Percentage composition
(a) _____	78
(b) Oxygen	_____
(c) Argon	_____
(d) _____	0.03
(e) Other gases	_____

2. Choose the correct answer in the following questions:

(i) The gas used by plants to manufacture their food is_____.

(a) oxygen
(b) carbon dioxide
(c) nitrogen
(d) argon

(ii) What gas is required for a fire to start?

(a) Carbon dioxide
(b) Argon
(c) Oxygen
(d) Nitrogen

(iii) One of the following gases is used in industrial preservation of drinks:

(a) Nitrogen
(b) Argon
(c) Carbon dioxide
(d) Oxygen

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Section B

3. Write **TRUE** for a true statement and **FALSE** for an incorrect statement.
   (a) Plants depend on oxygen from animals. _____
   (b) Air is colourless and odourless. _____
   (c) There are only four gases that compose air. _____
   (d) Carbon dioxide gas is used to extinguish fire. _____
   (e) Water vapour comes from oceans and plants only. _____

Section C

Answer the following questions:

4. Explain the importance of air in the environment.
5. Explain how mountain climbers and divers get oxygen gas.
6. Mention five uses of carbon dioxide gas.
7. Explain the importance of nitrogen gas.
8. Why is argon called an inert gas?
9. Explain why air is matter.
10. Explain two negative effects caused by an excessive amount of carbon dioxide gas in the environment.
11. Explain two uses of argon gas.

Vocabulary

Atmosphere	a layer of gases above the earth's surface
Exhale	to breathe out or emit air from the lungs through the mouth or nose
Geology	the study of the earth, the materials from which it is made, the structure of those materials, and the processes acting upon them
Inhale	to breathe in or to draw air into the lungs through the mouth or nose

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Chapter Two

Growth in plants

Introduction

In Standard Five, you learnt about the characteristics of living things and reproduction in plants. Moreover, you conducted experiments to demonstrate the role of light and water in plant growth. You learnt that through reproduction, plants increase in number. After plants have reproduced, they continue to grow and increase in height and size. In this chapter, you will learn the essential needs for plant growth, how plants obtain them and effects of their deficiency in plant growth. The knowledge and skills gained will enable you to grow and care for plants in order to conserve the environment.

Essential needs for plant growth



Think

Why do plants such as trees and grass grow?

Growth is one of the characteristics of living things. It is an increase in plant's height, weight and cell size. Growth in living things occurs at different rates in their lifespan. Usually all living things grow rapidly during their early stages until they are about to mature. The growth rate after maturity starts to decrease and stop at a certain period. The organism will eventually die. Plants grow well when all essential needs for growth are available. The following illustration shows all essential needs for plant growth.

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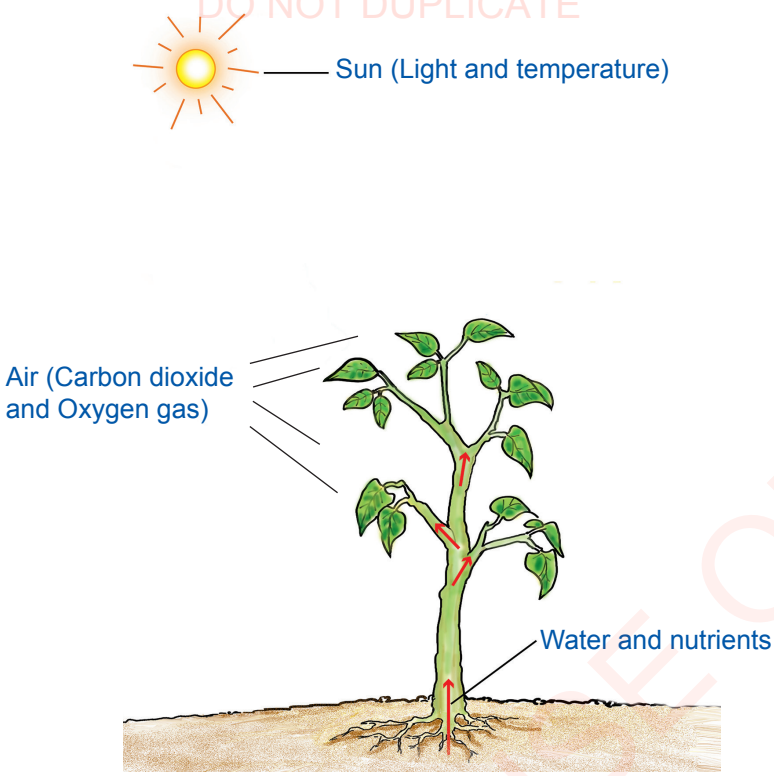

Figure: *Essential needs for plant growth*

The figure indicates that plants require five essential needs for its proper growth. These essential needs are sunlight, air, water, nutrients and temperature. In order for plants to grow well all the five essential needs must be available. If some of the essential needs are available while others are in short supply or missing, plant growth is affected. For example, if sunlight is available to the plant but water or nutrients are not available, plant growth will be affected. The details for each of the five essential needs are given in the following sections:

Sunlight

Sunlight is an essential need for plant growth. The sun provides heat and light energy which are necessary for plant growth. Plants make their food using sunlight energy. Plant leaves have chlorophyll which absorbs sunlight energy to enable plants to make their food. The ability of the plant to make its own food using sunlight energy is called photosynthesis. As the intensity of sunlight increases, the rate of photosynthesis also increases. However, if the intensity of sunlight is too high, the chlorophyll is destroyed. This leads to a decrease in the rate of photosynthesis. Hence, if the intensity of sunlight keeps increasing, photosynthesis will eventually stop.

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In the absence of sunlight, plant stems become slender, elongated and the leaves turn yellowish. Lack of enough sunlight reduces the ability of the plants to make their own food and therefore affect plant growth. High intensity of sunlight causes loss of soil moisture, drying of leaves and plants, and eventually the entire plant dies.

Air

Air is essential for plant growth because plants use carbon dioxide from the air to make their food by photosynthesis. The gas enters the plant through stomata pores in the leaves. The stomata pores open to absorb carbon dioxide gas which is required in the process of photosynthesis. Although plants use carbon dioxide for photosynthesis, the concentration of this gas in the atmosphere is relatively constant. This is maintained by the process of respiration in living things which releases carbon dioxide to the atmosphere. This gas is also produced through decomposition of plants and animal remains, combustion of fuel from vehicles, machines and volcanic eruptions.

The increase of carbon dioxide concentration in the atmosphere affects growth in plants. Recently, the concentration of carbon dioxide in the atmosphere has increased due to various human activities. Examples of these activities include burning of coal and other types of fossil fuel, industrial activities and deforestation. The increase of carbon dioxide in the atmosphere decreases the rate of opening and closing of stomata in plants. If the level of carbon dioxide is high in the atmosphere, stomata open for a short period and just enough of this gas is obtained. Reduction of time for stomata opening affects the amount of water absorbed from the soil by the plant for photosynthesis. On the other hand, low levels of carbon dioxide in the atmosphere limit the ability of plants to synthesize their food. Plants also need oxygen for their growth. Oxygen supports the process of breaking down food to release energy during respiration.

Water

Water is one of the essential needs for plant growth. Water is also one of the necessary raw materials for photosynthesis. Plants absorb water from the soil through their roots. The roots have small hairs which absorb water by osmosis. Water is transported through the root hairs to the main root, stem and finally to the leaves. The tissue which conducts water in plants is called xylem and it is located in the central part of the plant stem and root.

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Water is important for plant growth in the following ways:

1. Water dissolves nutrients in the soil and makes it easy for plants to absorb them. Roots absorb water containing nutrients from the soil. The nutrients from the soil or other media in which the plant is growing are then transported through the stem to the leaves. These nutrients are used by the plants for growth.
2. It transports carbohydrates and other nutrients from the leaves to other parts of the plant.
3. It regulates the temperature of plants, mainly through transpiration.
4. When plant cells are filled with water they become turgid and provide mechanical support to the plant.
5. It is a raw material that enable plants to make their own food through photosynthesis.

A large proportion of plant cells is occupied by water. Different plants have different water requirements for their growth. For example, a rice plant requires large amounts of water while a sorghum plant requires relatively a small amount of water for growth. Plants require the right amount of water for their proper growth and better yield. When the soil is saturated with water, the air space in the soil is replaced with water. Therefore, the roots may decay due to lack of oxygen in the soil. This condition may affect plant growth and eventually lead to death of the plant. When the amount of water available to plants is low, the required nutrients cannot be absorbed from the soil to the plants. In addition, when the amount of water available to plants is low the rate of photosynthesis decreases. This causes the plant to be weak and wither before it dies.

Nutrients

Plants need various nutrients for their proper growth. Plants get nutrients by absorbing them from the soil or other media where they are grown. It should be remembered that some plants can grow in water in the absence of soil. The absorption is by osmosis and is done by the root hairs located near the root tip. Once the nutrients are absorbed in the root hairs, they are transported through the xylem tissue to the main root and enters the stem. These nutrients are finally transported to the leaves.

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Nutrients can be categorised into two main groups which are macro-nutrients and micro-nutrients. Macro-nutrients are required by plants in large amounts and are very important for growth. There are three macro-nutrients namely nitrogen, phosphorus and potassium. Macro-nutrients are available in the soil. Their availability to plants can be increased by the addition of mineral fertilisers in the soil. Micro-nutrients are essential elements needed by plants in a very small or trace amount. They are also known as trace elements. Micro-nutrients include calcium, magnesium, sulphur, chlorine, iron, manganese, zinc, copper, boron, molybdenum, nickel, oxygen, carbon and hydrogen.

Functions of macro-nutrients in plant growth

Each type of plant requires a certain amount of nutrients for its proper growth. If the required amount of nutrients is low or high, it affects the growth of the plant. Therefore, the right amount of nutrients is essential for plant growth. The following table shows the functions and effects of deficiency of macro-nutrients which are nitrogen, phosphorus and potassium.

Table: *Functions and effects of deficiency of nitrogen, phosphorus and potassium in plant growth*

Types of a nutrient	Functions of the nutrient	Effects of deficiency of the nutrient	Sources of the nutrient
Nitrogen	(i) It facilitates growth of leaves. (ii) Used in protein synthesis. (iii) It is responsible for the formation of chlorophyll in the leaves therefore it is required for photosynthesis. (iv) Promotes stem growth.	(i) Stunted growth. (ii) Leaves lose their green colour and turn yellow. This results into death and fall of leaves. (iii) A decrease in the amount of protein. (iv) Reduced number of flowers. (v) Plant pre-maturity, poor quality and low yield of crops.	(i) Soil. (ii) Fertilisers containing nitrogen. (iii) Bacteria with ability to fix nitrogen from the atmosphere to produce nutrients containing nitrogen.

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Types of a nutrient	Functions of the nutrient	Effects of deficiency of the nutrient	Sources of the nutrient
Phosphorus	(i) It promotes photosynthesis. (ii) It promotes root growth. It is required in large amounts in young plants especially in the buds of roots. (iii) It promotes flowering and fruit development. (iv) Prevents various diseases to plants. (v) Improves the quality of crops.	(i) Causes slow growth in plants, weakens plants and causes stunted growth. (ii) Results into plants taking a long time to mature. (iii) Leads to plants producing poor and few fruits.	Soil, fertiliser containing phosphorus.
Potassium	(i) It is required for root growth. (ii) It helps in maintaining water balance in plants during photosynthesis by controlling the action of opening and closing of the stomata. (iii) It helps in the distribution of carbohydrates produced during photosynthesis. The carbohydrates are either used by plants for growth or stored for future use. (iv) It increases plant ability to fight against diseases. (v) Increases the quality, size and number of fruits, leaves, cereals and seeds.	(i) Plant leaves lose their chlorophyll colour and turn yellow. (ii) Plants take a long time to mature and growth becomes stunted. (iii) Plant stem becomes weak and at high risk of attack by diseases. (iv) A decrease in size, quality, and number of fruits, leaves, cereals and seeds.	Soil, fertilisers containing potassium and ash.

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Temperature

Plants require optimum temperature for proper growth. Suitable temperature is necessary during seed germination, photosynthesis and respiration. When the temperature is excessively high, plants dry off. In addition, very low temperatures lead to failure of plants to make their own food and may die. When seeds are not stored at suitable temperature or not sown in the soil with optimum temperature, their germination will be affected.

Exercise

Answer the following questions in your exercise book.

Section A

Fill in the blanks with correct answers.

1. The nutrient called _____ promotes development of flowers.
2. The nutrient called _____ promotes growth of roots.
3. The nutrient that promotes the development of leaves is called _____.
4. The transportation of water and nutrients from the roots to leaves occurs through _____.

Section B

Answer the following questions:

5. What is the meaning of growth in plants?
6. List five essential needs for plant growth.
7. Which tissue is used to transport water and nutrients from the roots to stem and leaves?
8. List down the macro-nutrients that are required for plant growth.
9. Which effects are likely to occur in the growth of a plant if it lacks sufficient amounts of carbon dioxide gas?
10. What will happen to a maize plant if it lacks potassium?
11. Explain four effects of lack of water in plant growth.
12. Briefly explain the effects of lack of nitrogen in plants.

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Vocabulary

Osmosis	the process by which water molecules move from a region of low concentration to a region of high concentration of solute through a semi-permeable membrane
Photosynthesis	a process by which a plant makes its own food using sunlight, carbon dioxide gas and water
Tissue	a collection of similar cells working together to perform the same function
Xylem	a tissue that is used for transportation of water and nutrients from the roots to other parts of the plant

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Chapter Three

Photosynthesis

Introduction

In Standard Five, you learnt about the part of the plant involved in photosynthesis. You also learnt how plants use carbon dioxide, water and sunlight energy to make their food. In this chapter, you will perform experiments to investigate the roles of chlorophyll and sunlight in photosynthesis. In addition, you will conduct an experiment to test the presence of starch in the leaves after photosynthesis. The knowledge and skills acquired in this chapter will enable you to develop practical skills in conducting experiments in plants. You will also be able to analyse and interpret data for scientific investigations related to plants.

Necessary requirements for photosynthesis

The following requirements are necessary for photosynthesis to take place in plants:

(i) Carbon dioxide gas

(ii) Water

(iii) Chlorophyll

(iv) Sunlight

Photosynthesis occurs when carbon dioxide reacts with water in the presence of chlorophyll and sunlight. The combination of water and carbon dioxide produces carbohydrate and oxygen. Part of the carbohydrate produced during photosynthesis is used by the plant to produce energy which is used in various ways by the plant. The excess carbohydrates are stored in different plant parts in form of starch. Therefore, when animals feed on leaves, roots, fruits and seeds from plants they obtain starch which was produced during

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photosynthesis. Oxygen gas produced during photosynthesis is released to the atmosphere and is used by animals including human beings for respiration. The photosynthesis process is summarised in the following equation:

$$\text{Carbon dioxide + Water} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{Carbohydrate + Oxygen}$$

The following experiments can be conducted to verify the role of necessary requirements for photosynthesis and the products obtained:

Experiment 1: *To investigate the role of chlorophyll in photosynthesis*

Aim: To show that chlorophyll is necessary for photosynthesis.

Requirements: variegated leaf, spirit, water, two beakers, test tube, iodine solution, white tile or saucer, kerosene stove and wire mesh

Procedure

1. Take a plant with variegated leaf or leaves and put it in a dark place for six hours.
2. Transfer the plant from the dark and place it in the sunlight for about four hours.
3. Detach one variegated leaf from 2 above as shown in Figure 1(a) then dip it in boiling water as shown in Figure 1(b) and leave it for five minutes.
4. Remove the leaf and dip it into a test tube containing spirit.
5. Put the test tube containing the leaf and spirit into the beaker with boiling water as shown in Figure 1(c) for a while until the green colour of the leaf disappears.
6. Remove the leaf from the test tube and dip it into warm water to soften it as shown in Figure 1(d).
7. Remove the leaf from the warm water and spread it on a white tile.
8. Put three drops of iodine on the leaf using a dropper as shown in Figure 1(e).

Caution: Spirit is highly flammable. It must be kept away from any direct flame.

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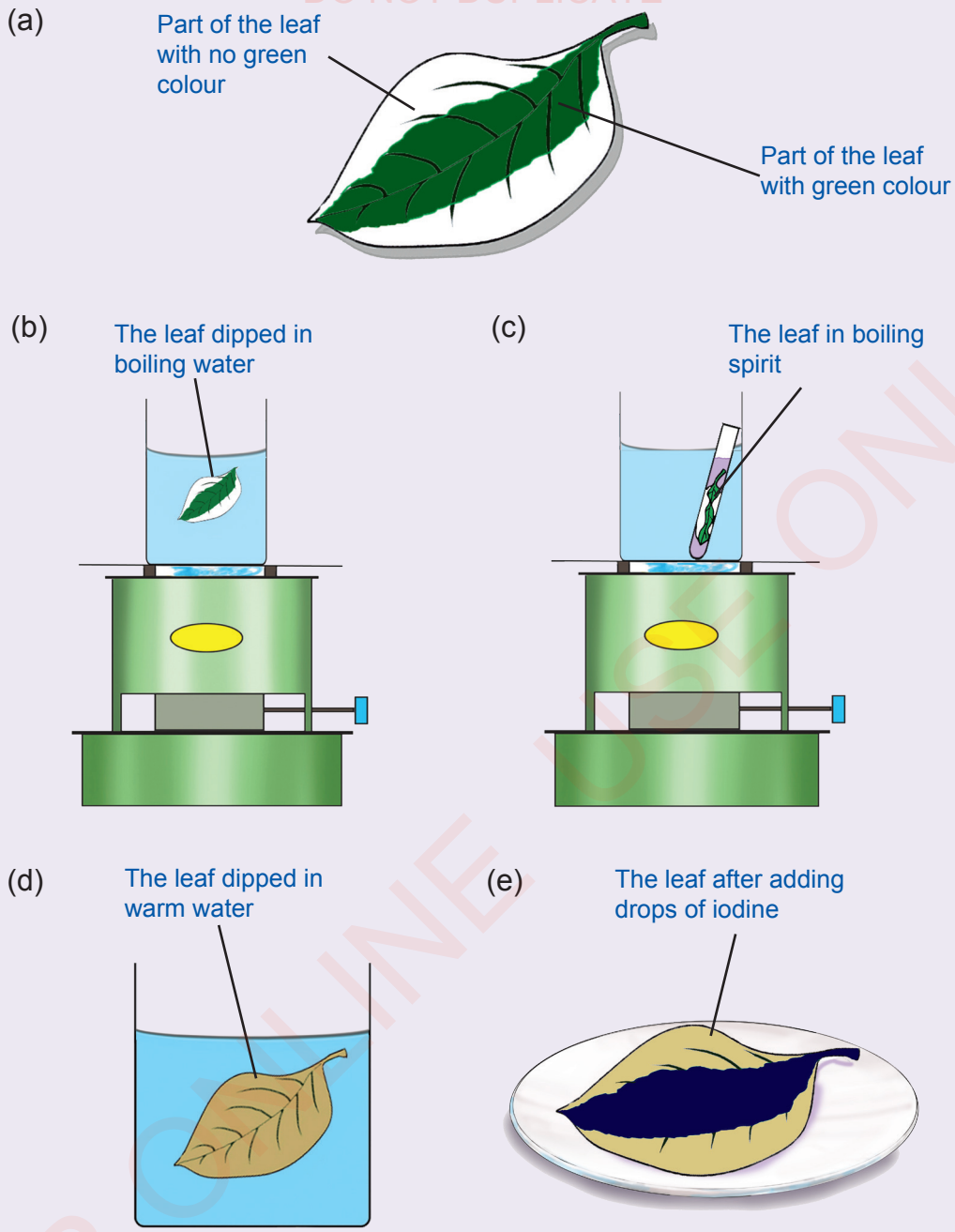

Figure 1: *To investigate the necessity of chlorophyll in photosynthesis*

Results: 1. Why was the leaf boiled in water?

2. Which part of the leaf changed its colour? Why?

Conclusion: Write the conclusion of the experiment you have performed.

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Experiment 2: *To investigate the role of sunlight in photosynthesis*

Aim: To show the necessity of light in photosynthesis.

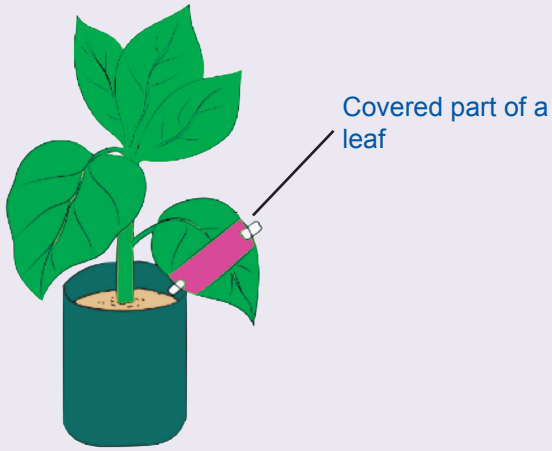
Requirements: potted plant, manila card, clips, spirit, water, two beakers, test tube, iodine solution, white tile or saucer, wire mesh and kerosene stove

Procedure

1. Take a potted plant and cover part of one leaf using a piece of manila card fastened by clips, as shown in Figure 2(a).
2. Transfer the plant to the sunlight and leave it exposed for four to six hours.
3. Detach the covered leaf from the plant.
4. Remove the manila card covering the leaf.
5. Dip the leaf into boiling water as shown in Figure 2(b) and leave it for five minutes.
6. Remove the leaf from the water and dip it into a test tube containing spirit.
7. Put the test tube with the leaf into the beaker with boiling water as seen in Figure 2(c). Leave it until the green colour disappears.
8. Remove the leaf from the spirit then dip it into warm water as shown in Figure 2(d) to soften it.
9. Remove the leaf from the warm water and spread it on a white tile.
10. Put three drops of iodine solution on the leaf as shown in Figure 2(e).

Caution: Spirit is highly flammable. It must be kept away from any direct flame.

(a)



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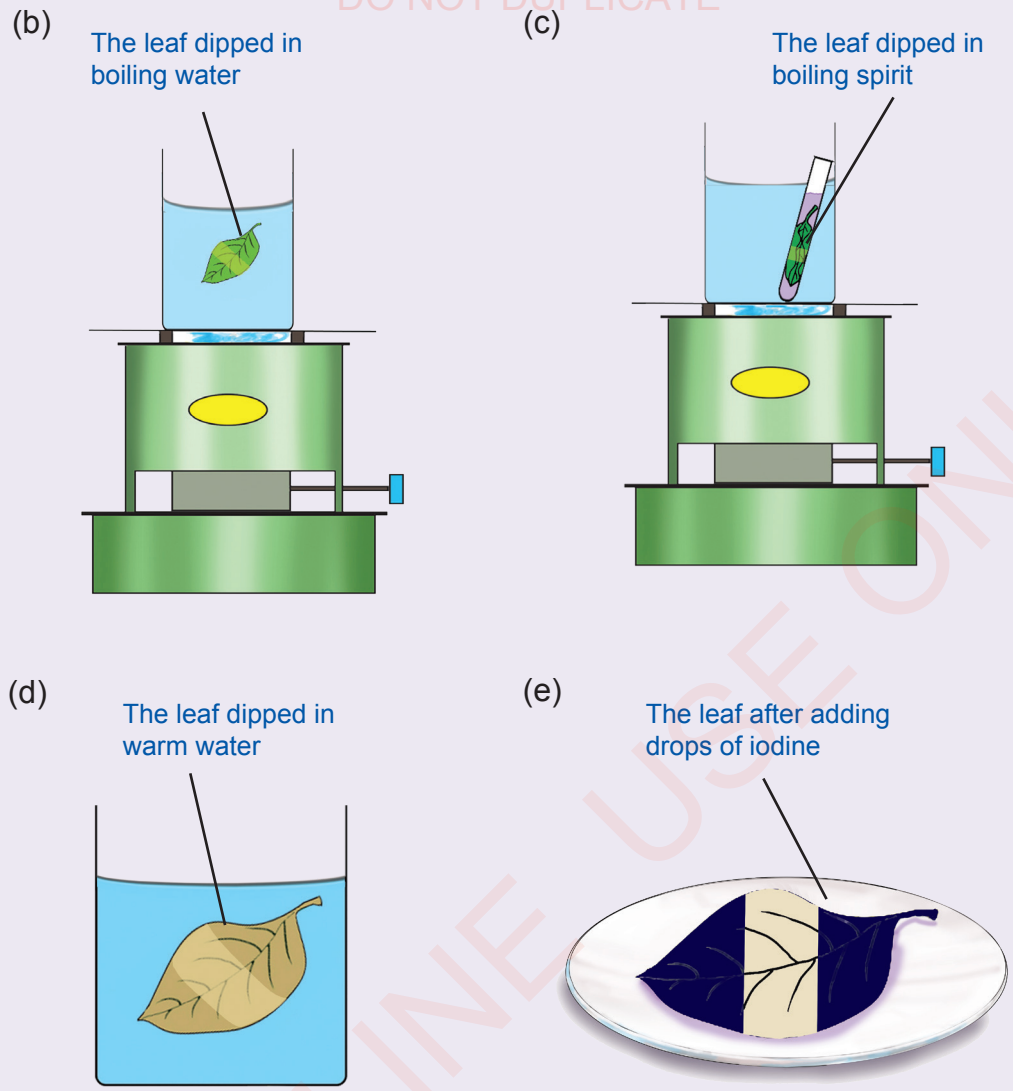

Figure 2: *To investigate the importance of sunlight in photosynthesis*

Results:

1. What differences have you observed between the covered and exposed parts of the leaf after adding iodine?
2. Which part of the leaf had no starch?
3. Why do you think the leaf part mentioned in (2) had no starch?

Conclusion: Write a conclusion of the experiment you have performed.

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Experiment 3: *To investigate the presence of starch in a leaf*

Aim: To demonstrate that starch is produced during photosynthesis.

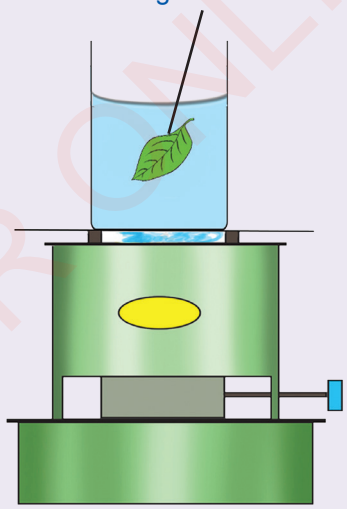
Requirements: potted plant bearing green leaves, water, spirit, two beakers, test tubes, iodine solution, white tile or saucer and kerosene stove

Procedure

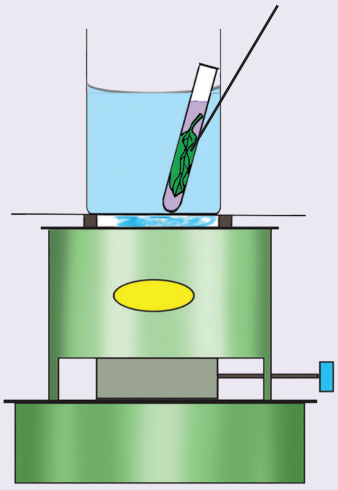
1. Detach one green leaf from the potted plant which has been exposed to sunlight for about four hours or more.
2. Dip the leaf into boiling water as shown in Figure 3(a) and leave it for five minutes.
3. Remove the leaf from the boiling water then dip it into a test tube containing spirit.
4. Place the test tube with the leaf into a beaker containing boiling water as shown in Figure 3(b) until the green colour disappears.
5. Remove the leaf from the spirit and dip it into warm water as shown in Figure 3(c), to soften it.
6. Remove the leaf from the warm water and spread it on a white tile.
7. Put three drops of iodine on the leaf as indicated in Figure 3(d).

Caution: Spirit is highly flammable. It must be kept away from any direct flame.

(a) A leaf dipped in boiling water



(b) The leaf dipped in a test tube containing boiling spirit



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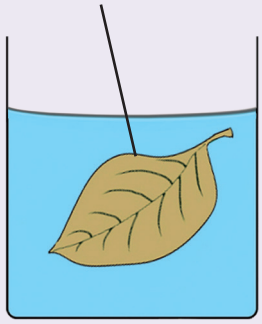
(c) The leaf dipped in warm water



(d) The leaf after adding drops of iodine

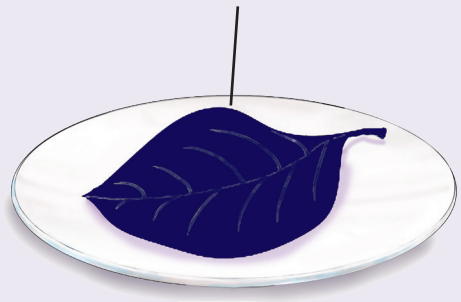


Figure 3: *To investigate presence of starch in the leaf*

Results: 1. What colour change did you observe on the leaf when the iodine solution was added?

2. What does the change of colour on the leaf imply?

Conclusion: Write a conclusion of the experiment you have performed.

Exercise

Answer the following questions in your exercise book.

1. What is photosynthesis?
2. Complete the following equation:

$$\text{Carbon dioxide} + \text{Water} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{X} + \text{Y}$$

X represents _____

Y represents _____

3. State the function of chlorophyll in plants?
4. Why were the leaves placed in boiling water in experiments 2 and 3?
5. Why were the leaves in experiments 1 and 2 placed in boiling spirit?
6. What is the function of iodine in the experiment?
7. What is the function of warm water in the leaf boiled in the spirit?

Vocabulary

Variegated leaf a leaf with multiple colours

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Chapter Four

Soil

Introduction

In Standard Four, you learnt about how environmental pollution degrades soil. In this chapter, you will learn about the meaning, importance, characteristics and types of soil. You will also learn about the activities that lead to soil degradation, and how to conserve the soil. The knowledge and skills obtained from this chapter will enable you to utilise the soil in your surroundings properly. Proper use of soil is important for present and future generations.

The meaning of soil

Soil is the top layer of the earth's surface. This is the upper layer of the rock that makes the earth's crust. Soil is a mixture of small rock particles and weathered minerals. It is also made up of the decayed remains of living things such as plants and animals. The decayed remains of living things are collectively known as organic matter. Soil is composed of 5% organic matter, 25% water, 25% air, and 45% minerals. Organisms such as insects and worms live in the soil. The spaces between the soil particles are occupied by air and water. The ratio between air space and water in the soil varies depending on weather conditions. These variations depend on the temperature and water content at a particular area. The water in the soil increases as a result of rainfall and percolation from rivers.

Importance of soil

Soil is important for various uses as follows:

1. Soil provides support to plants.
2. It preserves water to be used by plants and other living organisms.
3. It preserves air for gaseous exchange by plant roots and other organisms.

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4. It preserves different types of nutrients to be used by plants and other organisms.
5. It is used for making household appliances such as pots, jars, charcoal stoves, cups and ornaments.
6. It is used for building houses and other structures.
7. It also provides shelter for living organisms.

Characteristics of soil

Soil has various characteristics that lead to its different uses. These characteristics include colour, texture, structure, fertility and penetration of water and air. Soil colour indicates the types and amount of minerals present in the soil. For example, a red soil indicates the presence of a large amount of iron minerals. Soil fertility is the ability of the soil to nourish plants. It depends on the minerals and the amount of manure present in the soil. Soil structure is the arrangement and organisation of soil particles. The arrangement enables the clumping or fragmentation of the soil. Water and air penetration depends on the type of soil, and the amount and size of air spaces available between soil particles.

Types of soil

The knowledge on soil types helps to utilise the soil properly. There are three main types of soil: clay, loam and sandy.

Clay soil: Clay soil is formed by very small particles of soil. It is formed after weathering of rocks for many years. In Tanzania, this type of soil is mainly found in Kigoma and Mwanza regions. Particles of this soil have a tendency to stick together. This property limits the penetration of water and air within its particles. During the rainy season, this situation causes water logging while in the dry season the soil becomes very hard. This makes it difficult for the clay soil to be utilised for agricultural activities. Clay soil is used for making various things such as pots, jars, cups, charcoal stoves, and ornaments.

Loam soil: Loam soil is formed by a proper ratio of sand, clay and decayed organic matter. In Tanzania, loam soil is mainly found in Arusha, Kilimanjaro,

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Mbeya, Iringa, Njombe, and Ruvuma regions. Loam soil enables plants to grow easily, therefore, it is suitable for agriculture. This is because loam soil has the ability to preserve many nutrients, air and moisture.

Sandy soil: Sandy soil is formed by relatively large soil particles. This soil is formed from disintegrated and weathered rocks such as limestone, granite, white shining stones, and sedimentary rocks. In Tanzania, this type of soil is mainly found in the coastal zone. It is mainly found in Dar es Salaam, Tanga and Pwani regions. Sandy soil allows quick passage of water through it. Therefore, it causes lack of water for plants especially during the dry season. In this type of soil, agricultural activities usually depend on irrigation and use of fertilisers. Sandy soil is also suitable for building activities such as making building blocks.

Experiment: *Investigation of water holding and penetration capacity of different types of soils*

Aim: To show the ability of different types of soil to retain water and allow penetration of water.

Requirements: loam soil, clay soil, sandy soil, water, spade, three 1-litre beakers or three plastic bottles or tins

Procedure

1. Take three beakers then label them A, B, and C. You can also use plastic bottles or tins.
2. Fill three quarters of each beaker with a different type of soil, as follows:
   (a) In beaker A, put sandy soil.
   (b) In beaker B, put loam soil.
   (c) In beaker C, put clay soil.
3. Pour the same amount of water in each of the three beakers at the same time.
4. Carefully, observe and record what you see after pouring water into each beaker.

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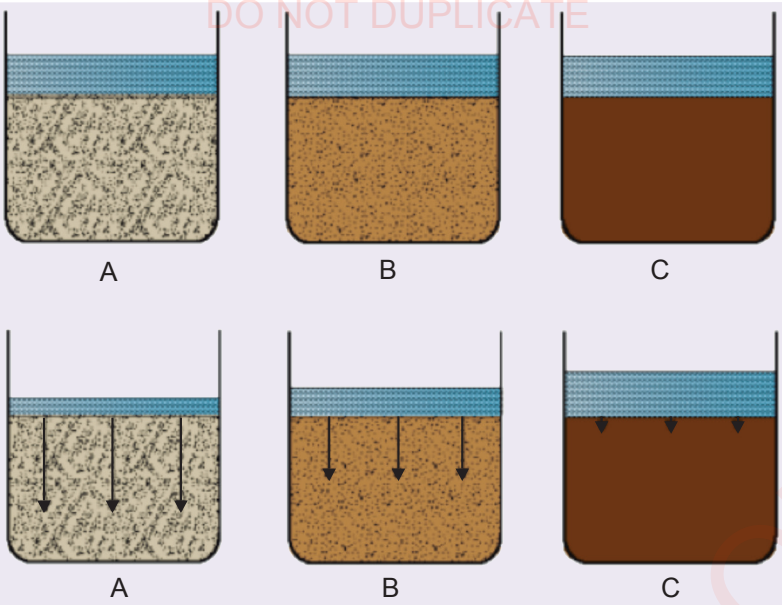

Figure 1: *Water penetration in three types of soil*

Results

Discuss the differences in water holding and penetration ability of soils in beakers A, B and C.

Conclusion: Write a conclusion for the experiment you have done.

Exercise 1

Answer the following questions in your exercise book.

1. (a) What is soil?
   (b) What is the composition of soil?
2. Mention five characteristics of soil.
3. (a) List three types of soil you have learnt.
   (b) Explain the uses of each type of soil you have mentioned in (a).
4. (a) What is the main type of soil found in your school environment?
   (b) Explain the characteristics of soil you have mentioned in (a).

Activities which affect the soil

Activities performed on the land surface or below the surface can affect the soil. There are many human and non-human activities that affect the soil. Some of the human activities that affect the soil are poor agricultural practices

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and overgrazing. Other practices which may affect the soil are deforestation and burning of vegetation cover. Mining activities, development of cities and business growth, natural disasters, and improper waste disposal may also affect the soil.

Poor agricultural practices: Agriculture is an activity that provides us with crops for food and business. For sustainable agriculture, the soil should be fertile and should have structure which allows proper growth of crops. Poor agricultural practices affect soil composition. These practices include cultivating on slopes without taking measures for controlling soil erosion. For example, cultivating without use of terraces, over-tilling and improper use of fertilisers and pesticides. Chemical fertilisers and pesticides affect the soil structure and kill living organisms in it. This happens when they are used without advice from agricultural experts.

Overgrazing: Overgrazing affects the soil. Grazing of many animals in one area for a long period of time causes grass depletion resulting into bare land. Movement of large groups of animals in one area from time to time can also destroy the soil structure. This causes soil erosion.

Deforestation: Trees are important to the ecosystem and human activities. Trees also give shade to the soil. Decaying of parts of trees such as leaves, stems and roots improves soil fertility. High rates of deforestation affect the soil. This results to bare land leading to soil erosion by water or wind (See Figure 2).



Figure 2: *Deforestation*

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Burning of forests: Burning of forests is a result of human activities such as honey harvesting, hunting, building and agriculture. In rare cases, fire can be caused by natural sources like volcanic eruption. Fire affects living organisms on the land surface or underground which are important for soil formation. In addition, fire destroys minerals in the soil therefore decreasing its fertility and destroying its structure (See Figure 3).



Figure 3: *Burning of forest*

Mining activities: Mining activities transform the structure of the soil (See Figure 4). In the preparation of a mining site, usually deforestation occurs and part of the soil is displaced. These activities cause the destruction of the soil structure and loss of water, nutrients and moisture. In the mining activities, water and various chemicals are used. Usually water is contaminated with chemicals during the cleaning of minerals. The contaminated water penetrates into the soil. This kind of soil can no longer support the growth of plants.

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Figure 4: *Mining activities*

Growth of cities and business: Due to increase in population, many forest areas have been cleared in order to build human settlements. In human settlements and business areas, many activities are performed which affect the soil. Activities such as construction, transportation, industrial manufacturing of goods, and business may affect the soil. Poor storage and disposal of chemical waste from factories may have serious effects on the soil. Therefore, the affected soil is no longer suitable for agricultural activities.

Natural disasters: These are phenomena which have severe effects on soil, such as flooding, earthquakes and volcanic eruption. Flooding causes water retention in an area for a long time. This leads to loss of various nutrients in the soil and death of important organisms due to lack of air. Earthquakes are often accompanied by ruptures of the upper layer of the land. This damages the soil structure. In some parts of the world, there are volcanic eruptions that spill lava that affects the soil.

Improper disposal of waste: Various activities conducted at home, school, factories, and in institutions produce waste. Other activities that produce waste are transportation and agricultural activities. The waste can be solid as shown in Figure 5. Other types of waste can be in the form of liquid or gas. Solid waste such as plastics do not decay, hence, they affect soil

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formation. Liquid waste can have a mixture of water and chemicals from human settlements, factories, hospitals or dispensaries. The chemicals kill organisms that live in the soil. The organisms are important in the formation of compost manure which increases nutrients in the soil.



Figure 5: *Solid waste*

Consequences of soil degradation

Degraded soil loses some of its characteristics rendering it unsuitable for use; for example, loss of soil fertility, soil erosion and death of organisms which live in it. The degraded soil is unable to support plant growth.

Soil erosion: Soil erosion is the transfer of the upper layer of the land from one place to another. This happens when the soil is left bare. Bare land is caused by deforestation and burning of the forest. Soil erosion is also caused by poor agricultural practices and overgrazing. Likewise, unplanned building of infrastructure and improper mining practices cause soil erosion.

Retardation of plant growth: Plants grow well on different types of soil depending on nutrient requirements. Plants which are grown in infertile soils become retarded in growth and may die. Lack of plant nutrients leads to retardation of plant growth, poor production of seeds and poor development of generations. This may lead to the extinction of some plant species.

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Decrease or loss of living things: There are different types of living things in the soil. The affected soil may affect these organisms due to lack of some important requirements. This affects the ability of some organisms to reproduce and others may die.

Exercise 2

Answer the following questions in your exercise book.

1. Mention five activities that affect the soil.
2. Explain three effects of degraded soil.
3. Explain three effects of soil erosion.

Soil conservation

Soil has many advantages including production of food crops, therefore, it must be conserved. Everybody in the community should be responsible for soil conservation for the benefit of the present and future generations. Activities involved in soil conservation include proper agricultural practices, control of soil erosion, proper livestock keeping practices, use of organic fertilisers and proper waste disposal.

Proper agricultural practices: Agriculture is a major occupation to many people in our country and other parts of the world. For valuable agriculture, the soil used must be well conserved. Agricultural activities may cause soil erosion or addition of different chemicals to the soil. In order to conserve the soil there must be proper agricultural practices including seasonal crop rotation. In crop rotation, leguminous crops are seasonally exchanged with cereal crops. While cereal crops reduce soil fertility, leguminous crops increase soil fertility. Fallowing of the land and proper use of chemicals such as pesticides and artificial fertilisers are also important for soil conservation.

Controlling soil erosion: Soil erosion occurs when the soil is exposed to wind and water. In order to avoid soil erosion, water and wind must be controlled. Ways to control soil erosion include terracing and mulching. Contour farming and strip farming are also important on steep lands. Other methods include planting of trees and crops that cover the soil.

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Cultivation by terracing: A terrace is a raised soil bed as seen in Figure 6 (a). Terraces help in reducing the speed of running water.

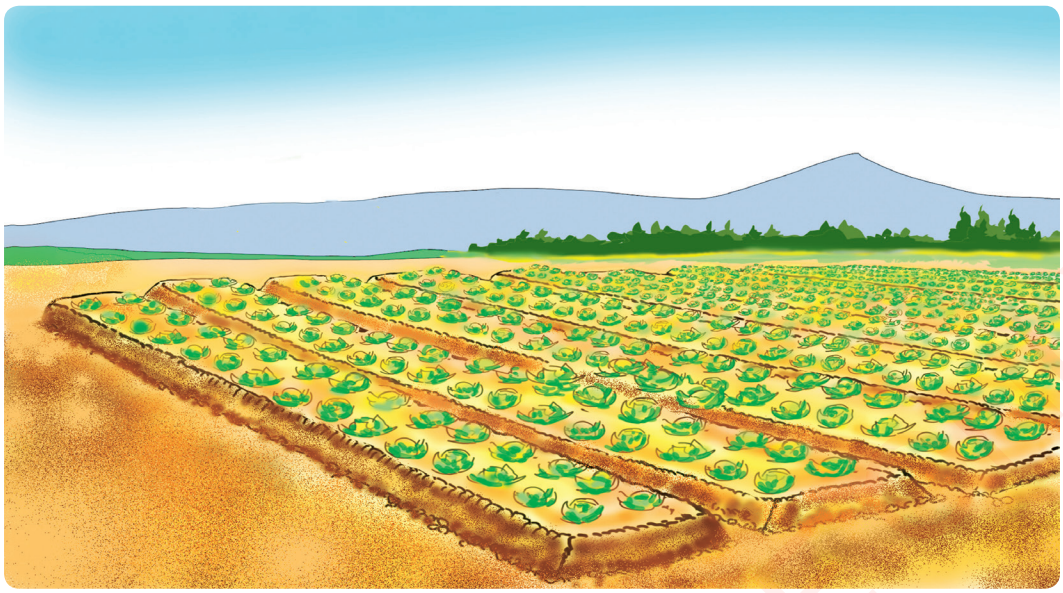

Figure 6 (a): *Cultivation by terracing*

Contour farming: Contour farming involves cultivating from one side of the steep land to another around the hill as seen in Figure 6 (b). Cultivating downslope leads to soil erosion.

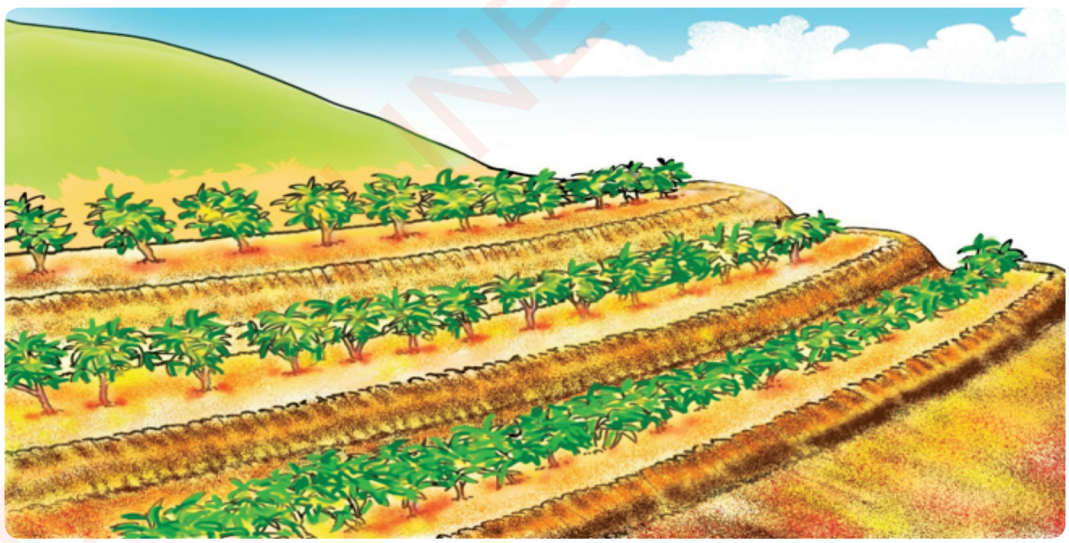

Figure 6 (b): *Contour farming*

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Strip farming: In strip farming, a hilly portion is cut to form steps as seen in Figure 6 (c). On the flat area of the steps, crops are planted. Strip farming minimises soil erosion.



Figure 6 (c): *Strip farming*

Activity 1: *Planting of trees and grass on an eroded land*

Requirements: a hoe, tree seedlings, grass, water, farmyard manure, compost manure and dry grass

Procedure

1. Find areas in the school that are affected by soil erosion.
2. Dig holes of 1.5 feet deep or more.
3. Put in some amount of manure and mix it with the soil.
4. Take the seedlings and remove them from their vessels without separating the roots from their soil.
5. Place the seedlings upright into the holes and carefully fill them with soil.
6. Carefully, water the planted seedlings.
7. Cover the areas around the seedlings' stems with dry grass.
8. Continue watering the seedlings everyday in the morning and evening until they flourish.

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Questions

1. Why were the seedlings removed from their vessels before placing them into the holes?
2. Explain the importance of placing dry grass around the stems of the seedlings.
3. Why do we plant trees on the eroded land?



Figure 7: *Pupils planting trees and grass around the school environment*

Proper harvesting practices: Matured crops are harvested and stored. Harvesting practices differ from person to person and between one society and another. In order to conserve soil, crop remains such as leaves, stems and roots should be spread in the farm. This replenishes soil fertility. Removal or burning of crop remains after harvesting exposes the soil to erosion.

Use of manure: Manure is made from plant remains or animal faeces. Manure is good in conserving the soil, since it does not have negative effects to the soil structure or organisms living in it. Manure originating from plants and food remains is called compost manure and manure originating from animal faeces is called farmyard manure.

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Activity 2: *Making compost manure*

Requirements: a hoe, spade, tape measure, trolley, maize or sorghum stalks, grasses, leguminous green leaves, farmyard manure, ash, water and 1or 2-metre-long pole

Procedure

1. Dig a 1 m or 2 m deep and 1 m or 2 m wide hole. Wet it with water or smear its walls and angles with mud then put in the stalks. Wet this layer with some water. Maize or sorghum stalks together with sticks and small branches of trees in the hole make a layer of 15 to 25 cm thick. This layer ensures good air circulation in the heap.
2. Place dry tree leaves or dry grass on the primary layer to make the first layer. The layer should be 20 to 25 cm thick, then wet it with water.
3. Put in leguminous green leaves to make the second layer of 20 to 25 cm thick. Do not wet this layer.
4. Put in farmyard manure or remains from compost manure to make a third layer. This layer should be 2 cm thick, then wet it.
5. Put a 2 cm to 3 cm thick soil to make the fourth layer.
6. Spread a little amount of ash on top of the fourth layer to speed up rotting.
7. Repeat steps 2 to 6 of the arrangement from the first layer. Do it until the hole is filled to the surface.
8. Insert a long narrow ended pole of at least 2 cm thickness into the heap for checking temperature. A bamboo pole is preferred due to its ability to allow air in and out the heap.
9. Cover the heap with leaves for some days in order to get compost manure.

Proper livestock keeping practices: Livestock keeping is important to human daily life because livestock has many benefits. The benefits include meat, milk, fertiliser and raw materials of different kinds. Despite the benefits obtained from livestock, the raised livestock should not exceed the available feeds. Large numbers of livestock such as cows and goats may result into depletion of grass and plants. This may leave the soil bare. Thus, there must be a proper ratio of the livestock to the available feeds.

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Proper waste disposal: Increase in human population, industries and business development leads to high rates of waste production. Waste like metal remains and chemicals from factories and hospitals are hazardous to the soil. A lot of waste has been improperly disposed or misplaced hence, affecting the soil. Education about proper waste disposal and enforcement of by-laws are required. There should be penalties to those who break rules and regulations. Education about proper waste disposal should include ways to reuse and recycle waste to other usable materials. Additionally, education should focus on minimising the use of goods that produce harmful waste. For example, plastics and nylon materials produce harmful waste. Figure 8 shows proper waste disposal.



Figure 8: *Proper waste disposal*

Exercise 3

Answer the following questions in your exercise book.

1. Mention five practices that help soil conservation.
2. What measures are required to prevent improper waste disposal?
3. Mention four reasons of using manure.

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Importance of soil conservation

It is difficult to regain the original characteristics of affected soil. Thus, it is important to conserve soil so as to increase productivity and maintain natural vegetation. Likewise, soil conservation stabilises the ecosystem, air circulation and water availability in the soil.

Increasing crop productivity: Soil conservation helps the soil to retain its characteristics, including fertility. Fertile soil enables crops to grow and reproduce. Thus, fertile soil enables the farmer to get higher yields.

Maintenance of natural vegetation: Phenomena such as soil erosion, overgrazing, and poor agricultural practices affect the soil. Affected soil may lead to death of some plants and may allow germination of intruder plants. Lack of soil conservation may lead to complete extinction of some trees and grass species in the world. Soil conservation therefore, allows the growth of plants and prevents the destruction of trees, grasses, and other plants.

Stabilisation of the ecosystem: Many organisms, both visible and invisible, live in the soil. Some of the organisms found in the soil are ants, worms, snakes, bacteria and fungi. Some of these organisms decompose remains from other living organisms. This adds humus and different nutrients to the soil. Some of the organisms found in the soil are food for other living organisms. Therefore, soil conservation supports the ecosystem of the organisms living in or on the soil.

Air and water penetration in the soil: Water and air are found in the pores between soil particles. Soil with enough fertility has better water and air penetration that allows their circulation within it. Air allows the survival of living things in the soil. Water allows plants to absorb different nutrients from the soil. Principally, lack of water and air in the soil affects the survival of the living things in it.

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Exercise 4

Answer the following questions in your exercise book.

Section A

1. Match the statements in **Part A** with correct words from **Part B**.

Part A	Part B
(i) Is fertile and suitable for agriculture	(a) Soil erosion
(ii) Mixed with cement for building	(b) Soil
(iii) Transfer of the soil from one area to another	(c) Water
(iv) Natural fertiliser	(d) Loam soil
(v) Most of the plants grow in	(e) Clay soil
	(f) Farmyard manure
	(g) Urea
	(h) Sandy soil

Section B

2. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.
   (a) Only leaders are responsible for soil conservation. _____
   (b) Farmyard manure is better than artificial fertilisers. _____
   (c) Water and wind are main soil erosion agents. _____
   (d) It is good to burn plant remains after harvesting. _____
   (e) Education and legal penalties will help to minimise improper waste disposal. _____

Section C

Answer the following questions:

3. In which regions of our country is sandy soil mainly found?
4. Explain the differences in the following activities:
   (a) Crop rotation and fallow farming
   (b) Contour cropping and terracing
5. Explain five practices that affect the soil and ways of avoiding the effects.

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6. Why do agricultural activities mainly depend on the soil type of a particular area?
7. Explain how the soil is affected by human activities at home and at your school.

Vocabulary

Afforestation	the process of planting trees in barren land in order to create a forest
Deforestation	clearing wide areas of trees where the land becomes bare
Extinction	loss, disappearance or elimination of some plants or organisms in the world due to some reasons such as over-exploitation, poor reproduction
Granite	a very hard crystalline stone often used for building
Percolation	filter gradually through a porous substance, for example, passage of water through the soil
Terrace	a raised, open, flat area on the land made to minimise soil erosion

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Chapter Five

Electric energy

Introduction

In Standard Five, you learnt about series and parallel circuits. You also learnt about the application of series and parallel circuits. Furthermore, you learnt how an electric current and voltage are measured. In this chapter, you will learn how Ohm's Law can be verified. You will also learn how to protect circuits and buildings from the effects of large currents. The knowledge and skills acquired will enable you to use electricity and electric appliances appropriately. They will also give you the ability to reduce or eliminate accidents caused by electric currents.

Verification of Ohm's Law

A simple electric circuit will be used to verify Ohm's Law. A simple electric circuit is made up of a dry cell, a switch, a bulb used as a resistor and a wire connecting them as shown in Figure 1.

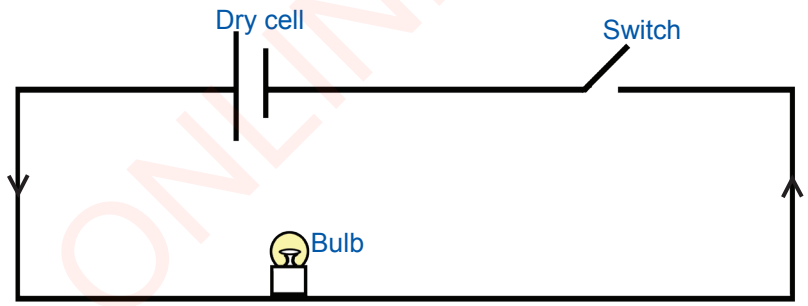

Figure 1: *Simple electric circuit*

In verifying Ohm's Law, it is important to understand a simple electric circuit and how it works. The dry cell as a source of electric current produces an electromotive force (e.m.f) which is also known as voltage (V). The voltage across a resistor is the potential difference between its two ends. The electric current flows from the source as indicated by the arrows, through a resistor

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and switch in a closed circuit (see Figure 1). The resistor in a circuit produces resistance to flow of electric current. An ammeter measures electric current in amperes (A) and a voltmeter measures potential difference in volts (V).

Ohm's Law

The voltage (V), electric current (I) and resistance (R) in an electric circuit have the following relationships:

(a) When the resistance in a circuit is constant, increase in voltage increases the current and when the voltage decreases the current also decreases.

(b) When the voltage in a circuit is kept constant, decrease in resistance increases the current and when the resistance increases, the current decreases.

Ohm's Law states that, the current through a resistor is directly proportional to the voltage across its two ends.

If a conductor has a resistance (R), and current (I) flowing through it, then the voltage (V) across the conductor is given by:

$$\text{Voltage (V)} = \text{Current (I)} \times \text{Resistance (R)}$$

$$V = I \times R$$

or

$$\text{Current (I)} = \frac{\text{Voltage (V)}}{\text{Resistance (R)}}$$

$$I = \frac{V}{R}$$

and

$$\text{Resistance (R)} = \frac{\text{Voltage (V)}}{\text{Current (I)}}$$

$$R = \frac{V}{I}$$

Exercise 1

Fill in the blanks by writing the correct answer.

1. When voltage increases in a circuit, the current _____.
2. Electromotive force is also called _____.
3. When resistance in a circuit decreases _____ increases.

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Measuring electric current

Electric current is measured by an ammeter. The following are some of the rules that must be observed when measuring electric current:

(a) The ammeter and other electric components in the circuit must be connected in series.

(b) Ensure the wires are connected correctly in their respective positions.

(c) Electric current should be recorded at equal voltage intervals.

Measuring voltage

Voltage is measured by an instrument called a voltmeter. The voltmeter is always connected in parallel with a resistor.

Experiment: *Investigation of variation of current and voltage in an electric circuit*

Aim: Verification of Ohm's Law

Requirements: three dry cells of 1.5 volts each, switch, wires, ammeter, bulb (used as resistor) and voltmeter

Procedure

1. Connect a circuit as shown in Figure 2, using one dry cell, ammeter, bulb, voltmeter and switch.
2. Put the switch on and observe carefully what happens to the bulb.
3. Use the given table to record the electric current in amperes and potential difference in volts.
4. Repeat step 1 up to 3 by adding a dry cell in series in each step.
5. Observe how the recorded values of current and voltage in the table vary.
6. Calculate the value of resistance for each set of potential difference (V) and electric current (I) using $R = \frac{V}{I}$.

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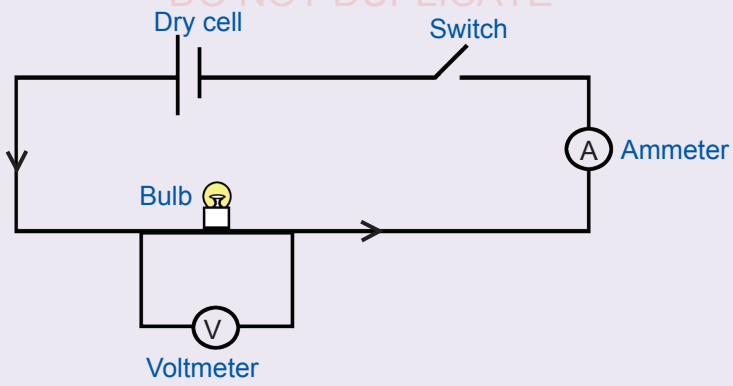

Figure 2: *Circuit for verifying Ohm's Law*

Table: *Potential difference (V) and current (I)*

No.	Potential difference (Volts)	Electric current (Amperes)	$\frac{V}{I}$ $\frac{\text{(Volts)}}{\text{(Amperes)}}$
1.			
2.			
3.			

Results

What is the relationship between voltage (V) and electric current (I)?

Conclusion

Write the conclusion of your experiment.

Exercise 2

Write **TRUE** for correct statements and **FALSE** for incorrect statements.

1. When a bulb lights, it indicates that a current is flowing in the circuit. _____
2. A voltmeter is used for measuring electric current in a circuit. _____
3. An ammeter and a voltmeter are some of the components used in an electric circuit. _____

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Application of Ohm's Law

Ohm's Law provides a relationship between voltage, electric current and resistance. It is also used to calculate the values of current, voltage or resistance, if two of the three values are known.

Ohms law is also used in designing and manufacturing electric appliances such as mobile phones, computers, televisions, electric irons and electric kettles.

Electric current

Example

What is the amount of current flowing through a wire of resistance 10 ohms, if the voltage across is 2 volts?

Solution

Given:
V = 2 volts
R = 10 ohm
Required: Current (I) flowing through the resistor

Formula: $I = \frac{V}{R}$

$I = \frac{2 \text{ volts}}{10 \text{ ohms}}$

I = 0.2 amperes

The current that will flow through the wire will be **0.2 amperes**.

Voltage

Example

A current of 0.6 amperes is flowing through a wire of resistance 20 ohms. Find the value of potential difference across the wire?

Solution

Given:
I = 0.6 amperes
R = 20 ohms
Required: Potential difference (V) across the wire

Formula: V = I × R

V = 0.6 amperes x 20 ohms

V = 12 volts

The potential difference is **12 volts.**

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Example

The potential difference across the two ends of a wire is 12 volts. The amount of current passing through the wire is 0.4 amperes. What is the resistance of the wire?

Solution

Given:

V = 12 volts

I = 0.4 amperes

Required: Resistance (R) of the wire

Formula: $R = \frac{V}{I}$

$$R = \frac{12 \text{ volts}}{0.4 \text{ amperes}}$$

$$R = 30 \text{ ohms}$$

The resistance of the wire is **30 ohms.**

Exercise 3

Answer the following questions in your exercise book.

1. A source of current has 28 volts. What amount of current will flow in a wire of resistance 7 ohms connected to this source?
2. A wire has a resistance of 15 ohms. A current of 0.3 amperes is flowing through it. Find the potential difference across the wire.
3. A wire has resistance of 2.5 ohms. The potential difference across the wire in the circuit is 12.5 volts. Find the amount of current flowing through the wire.
4. The potential difference across a conductor is 12 volts. The amount of electric current flowing through it is 3 amperes. Find the resistance of that conductor.

Electric faults in circuits and buildings

Electric energy is used in homes and industries to perform various activities. For example, electricity in homes is used for lighting, cooking, charging mobile phones, and ironing clothes. When converted into mechanical energy, it can be used to operate machines such as milling machines. The amount of electricity consumed in homes varies depending on the uses. Thus, the

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amount of electricity used in homes may increase or decrease, depending on circumstances. Unexpected increase or decrease of current is called electricity fluctuation. Such fluctuations can produce electric faults in electric appliances or cause fire in buildings.

Increase of electric current: There is a maximum limit of current which can safely flow through circuits of electric devices or buildings. Increase of electric current is said to occur when it exceeds the limit specified for a circuit or building. Increase of electric current occurs due to an abrupt increase in source voltage or improper connections of circuits. Similar increase of electric current in electric devices can occur when there is short circuit. Increase of electric current may cause destructions such as burning of buildings and electric devices including refrigerators, electric irons, electric cookers, radios and television sets. Increase of electric current may also cause burning of electric wires in buildings and transformers. It may also cause injury and death to human beings. Thus, the electric circuit in a building gets damaged when electric current increases above a specific limit.

Decrease of electric current: Decrease of electric current is said to occur when it is below the limit specified for a circuit or building. Decrease of electric current in homes and industries may be caused by overloading of electric networks, decreased electric supply voltage or defective transformers. Decrease of electric current may also be caused by incorrect connections or overloading of an electric circuit which occurs when too many electric devices or appliances are connected to a single circuit. Decrease of electric current in homes lowers performance of appliances, for example dimming of the lighting system. Similarly, decrease of electric current may make appliances such as electric cookers, refrigerators or motors fail to operate. It can also damage electric stabilisers.

Exercise 4

Answer the following questions in your exercise book.

1. Explain what is meant by increase of electric current.
2. Mention the problems which can be caused by:
   (a) increase of electric current.
   (b) decrease of electric current.

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Devices used to protect electric circuits and buildings against current fluctuations



Think

Have you asked yourself why electric circuits of appliances and buildings are protected against over current?

Protection of electric circuits of appliances and buildings against increase of electric current prevents electric appliances and buildings from being damaged. Electric devices fail to function or get damaged when there is a decrease or increase of electric current. There are special devices used for protecting electric devices and buildings from the effects of increase or decrease of electric current. The devices that perform this function include a fuse and a circuit breaker. Earth wire protects the user against the effects of faulty wiring of metallic electric devices such as an electric iron or refrigerator. These devices have the potential to conduct leakage current. Earth wire protects the user of electric appliances from getting electric shock from leakage current. It is also used to protect electric circuits, electric devices and electric users from the effects of increase in current. Often, electric devices such as a computer, radio, television set and refrigerator are connected to devices that protect them from the effects of increase and decrease of electric current. Such devices are called electric stabilisers. It is therefore advisable to use electric appliances approved by the Tanzania Bureau of Standards (TBS).

Exercise 5

Answer the following questions in your exercise book.

1. Mention the electric devices used to protect electric circuits of appliances and buildings against increase of electric current.
2. Explain the importance of protecting electric circuits of appliances and buildings against increase of electric current.

Fuse: Normally, the current flowing through a circuit has a specified limit, depending on the type of wire that forms the circuit. Electric faults occur when there is short circuit or current exceeding the specified limit. These effects may damage electric devices connected to such circuit. Therefore, to

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prevent such effects, fuses such as shown in Figure 3 (a) and 3 (b), are used to protect electric devices.

A fuse is a device consisting of a thin electric conductor which allows only a specified amount of electric current to flow through it. Therefore, the type of fuse used depends on the amount of current required by the appliance. Whenever the current passing through the fuse exceeds the rated value for normal operation of the appliance, the fuse wire melts and breaks the circuit. Therefore, fuses are made to allow specified amounts of current to flow to devices they are protecting. For example, there are fuses which allow flow of electric current not exceeding 3, 5, 10, 15 or 30 amperes. Melting and breaking of a fuse wire (see Figure 3 (a)) prevent flow of electric current in the circuit, thereby protecting the devices from being damaged. The damaged fuse is replaced by a new fuse or by connecting another fuse wire with specifications similar to the one that melted.

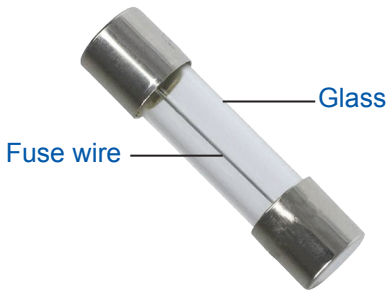

Figure 3 (a): *Example of a fuse*

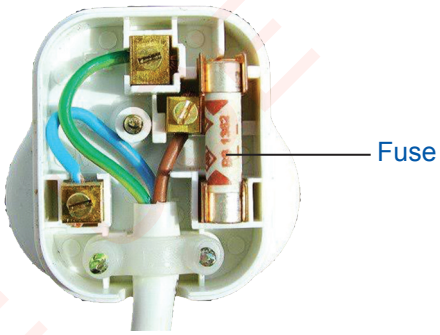

Figure 3 (b): *A fuse mounted in an electric plug*

Circuit breaker: Electricity is an essential source of energy in our daily life, used in homes and industries. Its safe utilisation requires that the amount of electricity needed in homes and industries should be specified. This information is used to minimise electrical damage that could be caused by abrupt increase in current or short circuit. Several devices have been made for regulating the amount of electric current flowing through circuits. Among those devices is the circuit breaker.

A circuit breaker is used for protecting electric appliances or devices connected to a circuit from being damaged. A circuit breaker receives electric current from the electric meter. It has a tripping switch. When the flowing current does not exceed the specified value, the circuit breaker remains at the “ON” position. When there is an abrupt increase of current or short circuit, the circuit breaker

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trips to the “OFF” position as shown in Figure 4.

The OFF position creates an open circuit which stops flow of current through the circuit. This prevents flow of electricity to appliances located in different parts of a house or building. Examples include light circuit, electric cooker and refrigerator. It is advisable to resolve the fault which made the circuit breaker to trip, before it is reset to resume its normal operation.

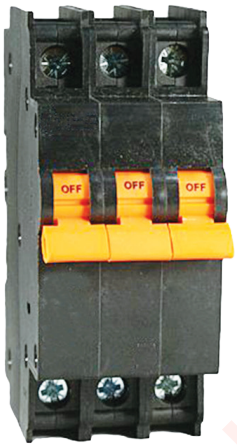

Figure 4: *Circuit breaker in OFF position*

Earth cable: The earth cable is used to prevent users from getting electric shock when an appliance develops an electric fault. The cable has a wire with one end connected to the metallic casing of the appliance. The other end is connected to a copper rod buried into the earth as shown in Figure 5. Without this cable, when there is an electric fault, touching the metallic casing of appliances can cause electric shock. If the casing is earthed, the current prefers to pass from the metal casing through the cable to the earth than through the body of the user of the appliance. The ground has a property which makes it possible to receive very high current without inducing harm to users of electricity.

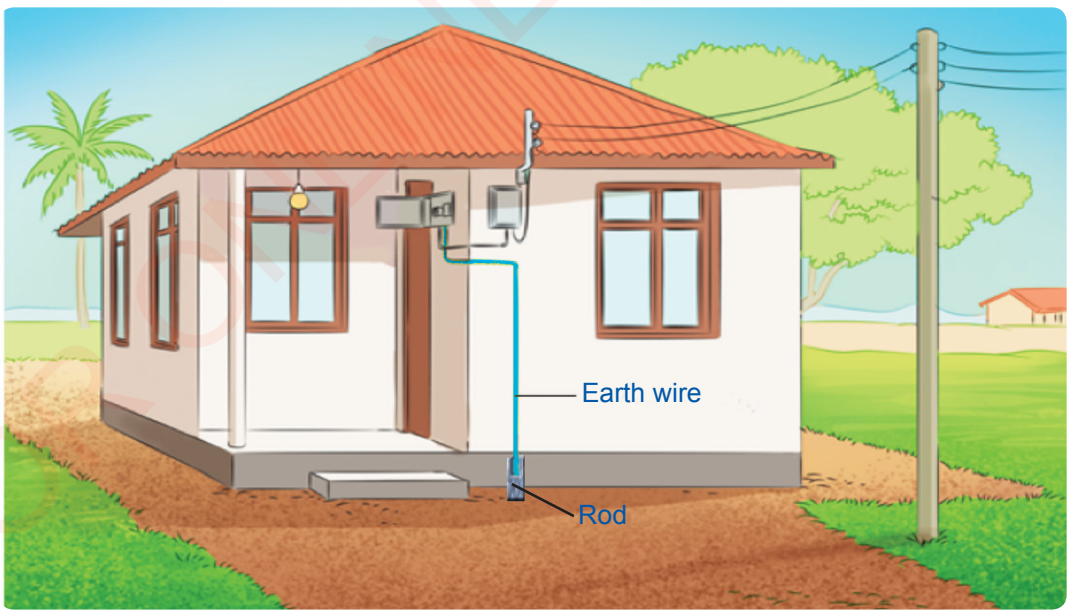

Figure 5: *A building with earth wire*

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Protection of buildings from lightning

Lightning is a large natural electric discharge between a cloud and the ground or earth. When an object is struck by lightning it is either burnt or damaged. When lightning strikes living organisms they are injured or killed. Lightning tends to strike roof tops with sharp metallic parts especially those of tall buildings. For this reason, buildings are required to have special devices to protect them from lighting. This device is called a lightning conductor. This conductor is made up of a long thick copper rod, or any other metal rod, with a pointed end, mounted vertically on top of the roof of a tall building as shown in Figure 6. The other end of the rod is connected to the ground by an earth cable connected to an earth rod. A lightning conductor allows charges from the surrounding clouds to flow to the ground thereby preventing lightning from striking the building. This method prevents accidents associated with lightning.



Figure 6: *Lightning conductor mounted from the top of a tall building to the ground*

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Exercise 6

Answer the following questions in your exercise book.

Section A

Choose the correct answer.

1. Which among the following devices protects computers from increase of electric current?
   (a) Resistor
   (b) Circuit breaker
   (c) Stabiliser
   (d) Lightning conductor

2. When a current is flowing in a circuit, the electric current is directly proportional to _____.
   (a) resistance
   (b) ampere
   (c) ohm
   (d) voltage

3. Ohm's Law is given by _____.
   (a) Voltage = Electric current x Resistance
   (b) Voltage = Electric current ÷ Resistance
   (c) Electric current = Voltage x Resistance
   (d) Resistance = Voltage x Electric current

Section B

Fill in the blanks.

4. A simple electric circuit comprises of a source of current, _____ and _____.
5. Electromotive force is also called _____ or _____.
6. When the resistance of a resistor increases, the voltage _____.
7. A voltmeter is used for measuring _____.
8. An ammeter is used for measuring _____.
9. When the switch of a simple circuit is disconnected, the bulb _____.

Section C

Answer the following questions:

10. Explain the differences between a fuse and a circuit breaker.

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11. Which device will you use to protect a building from being struck by lightning?
12. Write the formula for calculating the value of the electric current in a circuit, if the values of voltage and resistance are known.
13. If the source of current in a circuit has an e.m.f of 12 volts and the circuit resistance is 2 ohms, find the amount of electric current.
14. A machine with a load resistance of 8 ohms requires an electric current of 9 amperes to operate. Calculate the value of voltage needed for this machine.
15. The potential difference across a wire is 15 volts. If an electric current of 3 amperes is flowing through the wire, find the value of resistance of the wire.
16. Which device is connected to the main switch to protect circuits and buildings?

Vocabulary

Circuit breaker	an automatic electric switch designed to protect an electric circuit from damage caused by increase or decrease of current
Conductor	material which allows electricity to pass through
Fuse	a device containing a thin metal wire which melts and breaks to create an open circuit when the amount of current through it exceeds the specified value
Leakage current	an electric current flowing through an unwanted conductive path
Lightning conductor	a metal rod mounted on a tall building and connected to the ground to protect the building from the effects of lightning
Potential difference	measure of work done by a source of electricity in moving electric charge through a circuit between two points
Short circuit	a low resistance connection between two points in an electric circuit through which the current prefers to flow instead of the intended path

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Chapter Six

Renewable energy

Introduction

In Standard Four, you learnt about electric energy and how water, sunlight, wind, and fuel can be used to produce electricity. In this chapter, you will learn about renewable energy: its sources, characteristics and applications. You will learn how electricity can be produced from biogas. The knowledge and skills acquired will enable you to appreciate and use renewable energy.

Concept of renewable energy

The world is progressively experiencing shortage of energy due to rapidly diminishing fuel resources such as coal, oil and natural gas. This shortage is getting worse with the increasing costs of energy production. Use of these energy sources increases production of carbon dioxide which threatens the life of living organisms. This is another challenge related to the use of fuel resources. Increased use of renewable energy is currently seen as an alternative solution to these challenges.

Renewable energy is alternative energy with little or no harmful effects to living organisms and the environment during production and consumption. Renewable energy is produced from natural resources that are continuously self-replenishing. Some natural energy resources can be converted to electric energy. For example, sunlight, waterfalls, biogas and wind are some of the natural resources that can be converted into electric energy. Sometimes renewable energy is also called alternative energy or sustainable energy. This is because the resources are continuously being replenished by natural processes. Therefore, renewable energy can be available for use by present and future generations without running out.

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Renewable energy resources

Renewable energy originates from natural resources such as sunlight, wind, water waves, waterfalls, biogas and geothermal power. Tanzania has several waterfalls including those of Kidatu, Mtera and Nyumba ya Mungu dams. Wind energy resources are found in areas with strong winds such as Kititimo in Singida and Makambako in Njombe. Most areas in our country receive sunlight almost throughout the year and therefore, Tanzania has high potential for solar power.

Characteristics of renewable energy

Renewable energy has insignificant harmful effects to the environment and living organisms, in particular human beings, animals and plants. Renewable energy involves permanent resources which do not pollute the environment. Renewable energy can also be replenished because its sources are continuously being produced. Moreover, the investment costs of exploiting renewable energy are initially high. But after construction, the running costs are low because the energy resources are free.

Uses of renewable energy

Renewable energy has various uses in homes, offices and industries. Some of the uses include:

(a) Cooking, boiling water and drying various products such as crops and clothes.

(b) Running machines and electric appliances such as refrigerators.

(c) Running electronic gadgets such as calculators, clocks, traffic lights and mobile phone chargers.

(d) Running generators for producing electricity.

Exercise 1

Answer the following questions in your exercise book.

1. Explain the meaning of renewable energy.
2. List three characteristics of renewable energy.
3. List five uses of renewable energy.
4. Why is renewable energy also called sustainable energy?

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Biogas energy

Biogas can be produced from human faeces, animal dung, food and plant remains. Biogas is a mixture consisting of a large proportion of methane and a small proportion of carbon dioxide. It also has traces of water vapour, hydrogen sulphide, ammonia and hydrogen. Biogas is produced by a special plant called a digester, as shown in Figure 1. This plant is comprised of the following parts:

(a) Inlet pipe: A pipe through which the raw materials that feed the digester pass.

(b) Digester tank: This is a tank in which raw materials decompose to produce biogas.

(c) Cover: It is gas-to-air seal used to cover the entrance through which water is poured and mixed with raw materials in the digester tank by stirring.

(d) Outlet pipe: A pipe which is used to remove residue of the materials used to produce biogas.

(e) Gas tube: This carries the biogas generated in the digester tank to the places where it is consumed. The tube has a gas valve which opens to allow or closes to prevent flow of gas to or from the digester tank.

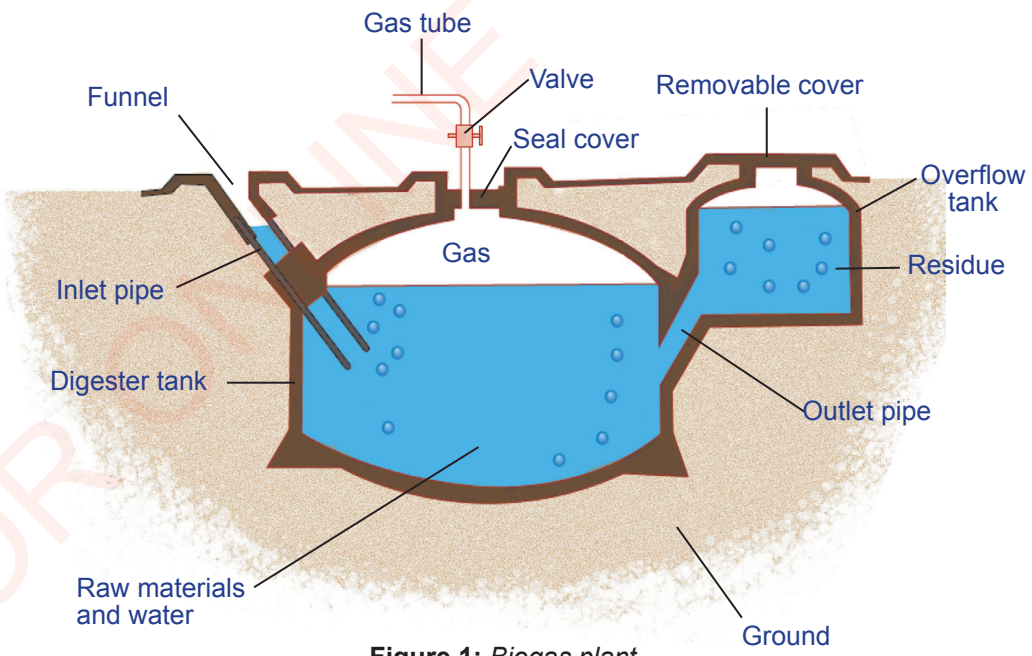

Figure 1: *Biogas plant*

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The size of biogas plants or digesters differs depending on intended gas uses. Small digesters produce biogas for domestic use such as cooking. Large digesters produce biogas for industrial use including running turbines which generate electricity.

Production of biogas

Production of biogas is done at temperatures ranging from 35°C to 55°C. This temperature range is favourable for decomposing raw materials by bacteria. Materials used to generate biogas such as faeces, animal dung, food remains and crop residue are mixed with water. This mixture is then placed inside the digester tank which is tightly sealed to prevent entrance of air. The raw materials are digested by bacteria to produce gas. The biogas produced is collected and transferred to different parts for various uses using pipes connected to the gas tube. When the raw materials are exhausted or no longer produce gas, they are pushed out via an outlet pipe. New raw materials and water are then added to the digester tank through the inlet pipe. The exhausted raw materials, also called residues, are used as manure in gardens or farms.

Activity: *Production of biogas*

Materials: large and small plastic buckets with covers, funnel, gas pipe, gas valve, animal dung, water, two pieces of pipe, wire, small piece of iron sheet, hoe, spade and match box

Procedure

1. Drill two holes in the small bucket, one at the bottom and the other on the top cover. Insert a gas pipe in the top hole.
2. Drill a small hole in the cover of the large bucket.
3. Place the small bucket on the top of the large bucket in such a way that the lower hole of the small bucket is exactly over the upper hole of the large bucket.
4. Drill other two holes on the side of the large bucket, one close to the cover and the other close to the base as shown in Figure 2.
5. Insert a piece of pipe carrying a funnel in the hole closer to the bucket cover. Place the second piece of pipe in the hole closer to the base.
6. Make a pit in the ground for emptying residue from the large bucket.

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7. Take animal dung and mix it with water and stir thoroughly. Pour sufficient amounts of the mixture into the large bucket through the funnel until it is three quarters full.
8. Close the gas and residue pipes for seven days.
9. Open the gas pipe slowly to check if some gas has been produced. What is the colour of the gas? Light a match and place it on the gas pipe. Did the gas produce a flame such as shown in Figure 2?

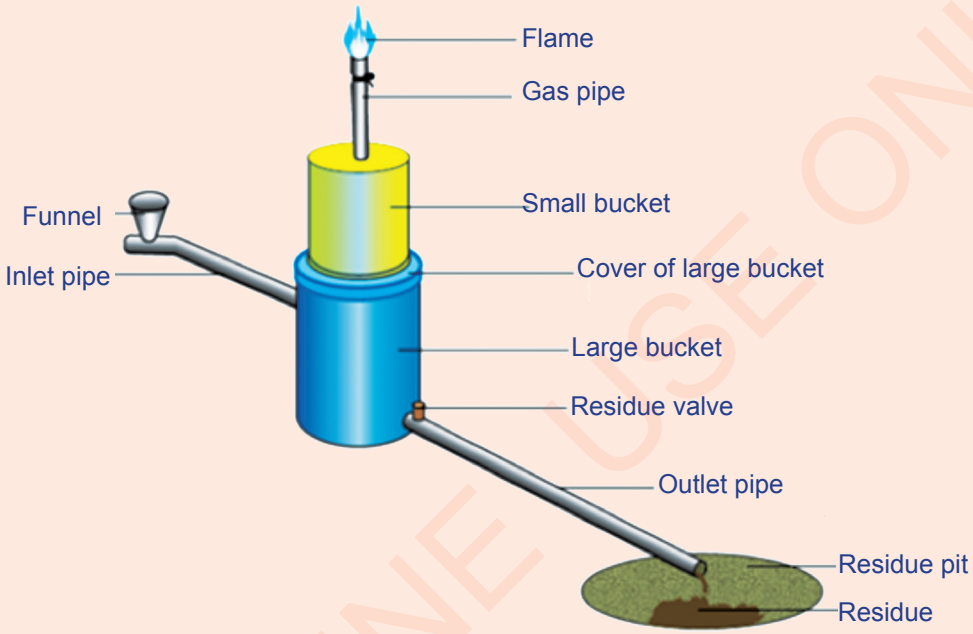

Figure 2: *Biogas plant model*

Production of electricity using biogas

Biogas from a digester is purified using a special filter containing different chemicals. This process removes the gases which do not have properties of biogas as fuel. Such gases include carbon dioxide and hydrogen sulphide. Carbon dioxide is removed to purify the methane in biogas before it is used for cooking or production of electricity. Hydrogen sulphide gas is also removed to prevent corrosion of the biogas plant. If these gases are not removed, they lower the ability of biogas to produce energy.

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Biogas has chemical energy which can be converted into heat and electric energy. For example, the power plant used to produce electricity in the sisal estate in Hale Limited in Tanga Region uses biogas. Electricity produced from biogas can be used in homes and industries. While biogas as fuel is useful, methane and carbon dioxide are greenhouse gases which increase the temperature of the atmosphere.

Exercise 2

Answer the following questions in your exercise book.

Section A

Choose the correct answer for each of the following questions.

1. Sources of renewable energy are_____.
   (a) wind, sunlight, waterfalls, fuel and biogas
   (b) wind, geothermal power, waterfalls and fuel
   (c) wind, sunlight, geothermal power, waterfalls, and biogas
   (d) wind, sunlight, geothermal power, fuel and biogas
2. Which among the following decompose wastes in a biogas plant?
   (a) Viruses and bacteria
   (b) Worms, flies and bacteria
   (c) Bacteria
   (d) Flies and worms
3. Which gas makes the largest proportion of biogas?
   (a) Carbon dioxide
   (b) Hydrogen sulphide
   (c) Hydrogen
   (d) Methane

Section B

Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.

4. Renewable energy is derived from resources which cannot be replenished. _____
5. Biogas is composed of a mixture of methane, hydrogen and carbon dioxide. _____

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6. The residue created from faeces during biogas production is used as manure. _____

Section C

Answer the following questions:

7. Mention the type of gas which forms the largest proportion of biogas.
8. List three sources of renewable energy.
9. Mention the effects of producing methane and carbon dioxide in the atmosphere.
10. Explain the functions of the following parts of a biogas plant or digester:
    (a) Cover
    (b) Digester tank
    (c) Gas pipe
11. Why are carbon dioxide and hydrogen sulphide gases removed during production of electricity from biogas?

Vocabulary

Decompose	break down or cause to break down into simpler parts
Fuel	materials such as coal, natural gas and oil that can be burned to produce heat energy
Replenish	restore (a stock or supply) to a former level or condition
Sustainable energy	energy that meets the needs of the present generation without putting the needs of future generations at risk

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Chapter Seven

Machines and work

Introduction

In Standard Five, you learnt about different types of simple machines. You also learnt about three classes of levers and their application in doing work. In this chapter, you will learn about the meaning, types and uses of pulley systems and complex machines. You will also learn about work in science and its use. The knowledge and skills gained will enable you to make and use machines to simplify work. The ability to construct good machines increases performance of work in different areas thereby, increasing production.

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Pulley systems

In the rural areas and some parts in the urban areas with limited water supply, people get water from deep wells. Most of these wells are so deep that it is not possible to use a mug or jug to draw water from them. For this reason, people use containers such as buckets attached to pulleys to draw water easily from deep wells. A fixed pulley is a simple machine used to lower or raise heavy objects.

A pulley is a wheel with a grove on its outer edge and it can rotate freely on an axle or pin fixed on a frame. A load is tied at one end of a smooth rope which passes over the grove. The other end of the rope is used to lower or lift the load. There are two types of pulleys, namely, fixed and movable pulleys.

Fixed pulley: In this pulley, the wheel remains at one location when a load is lowered or raised by the rope as illustrated in Figure 1.

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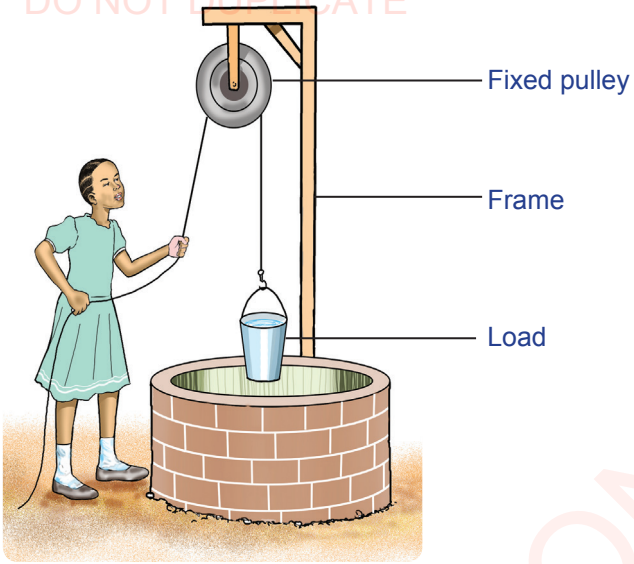

Figure 1: *Raising a load using a fixed pulley*

Movable pulley: This type of pulley moves when the load is being raised or lowered as shown in Figure 2. The combined use of fixed and movable pulleys reduces the effort for lowering or raising the load.

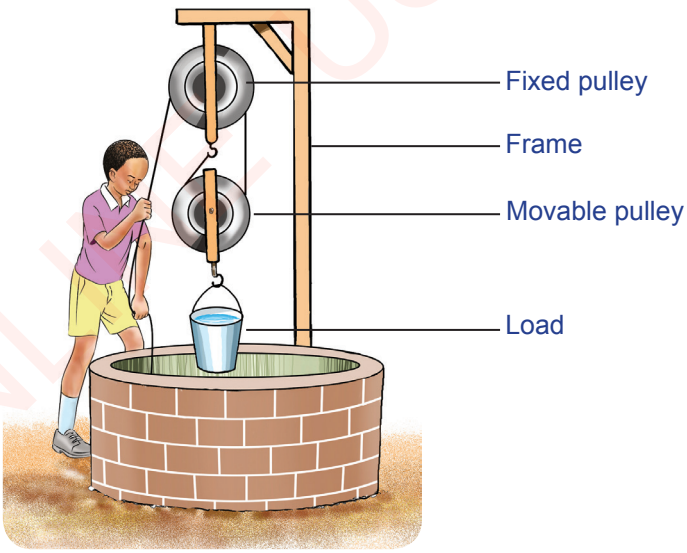

Figure 2: *Raising a load using a combination of fixed and movable pulleys*

Uses of pulleys

Pulleys are used to raise or lower loads. For example, to raise and lower flags. Another example is the raising of bricks and concrete to the upper levels during construction.

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Activity 1: *Using pulleys to simplify work*

Requirements: two empty bottles with lids and of volumes 0.5 and 1.5 litres, knife, reel, a 20 cm long stick and a string

Procedure

1. Take the two empty bottles with lids of volumes 0.5 and 1.5 litres as shown in Figure 3 and cut them to remove the top parts.

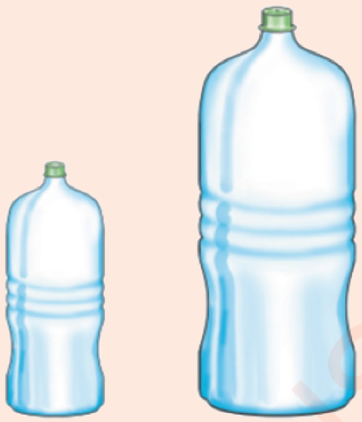

Figure 3: *Empty bottles*

2. Take the top part of the smaller bottle with a lid and drill two holes facing each other close to the open end for attaching the string.
3. Take the lower part of the larger bottle and drill two holes facing each other for supporting the stick carrying the reel as shown in Figure 4.
4. Take the small bottle described in step 2 and tie a string to the holes, then insert it in the larger bottle (see Figure 4).
5. Insert the stick in the first hole of the large bottle, then insert the reel on the stick.
6. Insert the other end of the stick carrying the reel in the second hole of the large bottle.
7. Tie another string at the middle of the string tied to the smaller bottle and place it on top of the reel.
8. Fill two thirds of the larger bottle with water, and fetch the water using the smaller bottle.
9. Pull the string as shown in Figure 4. What do you observe?

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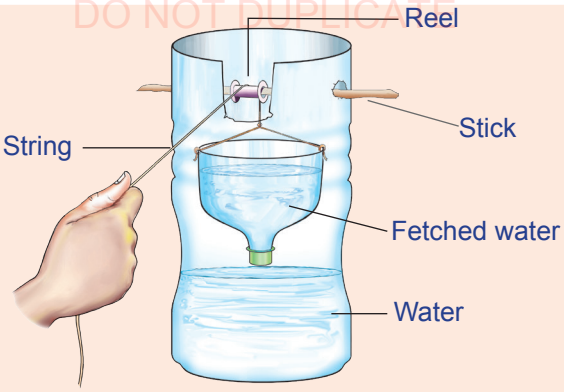

Figure 4: *Lifting a load using a fixed pulley*

Mechanical advantage, velocity ratio, and efficiency of simple pulleys

Mechanical advantage

Mechanical advantage is the ratio of the weight of a load to the effort used to lift or move the load. High value of mechanical advantage shows that a little effort has been used to lift or move a large load. Also, it shows by how much the machine used has simplified the work done. Mechanical advantage has no units since the unit of load is the same as the unit of effort.

Formula

$$\text{Mechanical advantage} = \frac{\text{Load}}{\text{Effort}}$$

Velocity ratio

Velocity ratio is the ratio of distance moved by the effort to the distance moved by the load when doing work with pulleys.

Formula

$$\text{Velocity ratio} = \frac{\text{Distance moved by effort}}{\text{Distance moved by load}}$$

Efficiency

Efficiency of a machine is a measure of its ability to perform a lot of work, in the shortest possible time, using little effort or energy. Efficiency is expressed

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as a percentage obtained by dividing the mechanical advantage by the velocity ratio.

Formula

$$\text{Efficiency} = \frac{\text{Mechanical advantage}}{\text{Velocity ratio}} \times 100\%$$

Mechanical advantage, velocity ratio and efficiency of a fixed pulley

While using a fixed pulley to lift a load, the tension along the entire rope between the effort and the load is the same. Therefore, the weight of the load and the effort needed to lift it are the same. If the load is lifted through a distance of 2 metres, the effort used to lift the load will move down a distance of 2 metres. In this case, the fixed pulley has mechanical advantage and velocity ratio equal to one.

Example

While using a fixed pulley, a 60 kg load was lifted up through 1 m and the effort moved 1 m down.

(a) What is the effort in kilograms?

(b) Calculate the mechanical advantage.

(c) Calculate the velocity ratio.

(d) Calculate the efficiency of the fixed pulley.

Solution

Given:

Load = 60 kilograms

Distance moved by the load = 1 metre

Distance moved by the effort = 1 metre

Required: To determine the effort, velocity ratio, mechanical advantage and efficiency.

(a) Calculation of the effort

Formula: Effort = Load

Effort = 60 kilograms

Therefore, effort is equal to **60 kilograms.**

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(b) Calculation of mechanical advantage

Formula: $\text{Mechanical advantage} = \frac{\text{Load}}{\text{Effort}}$

$\text{Mechanical advantage} = \frac{60 \text{ kilograms}}{60 \text{ kilograms}}$

$\text{Mechanical advantage} = 1$

The mechanical advantage of the fixed **pulley is 1.**

(c) Calculation of velocity ratio

Formula: $\text{Velocity ratio} = \frac{\text{Distance moved by effort}}{\text{Distance moved by load}}$

$\text{Velocity ratio} = \frac{1 \text{ metre}}{1 \text{ metre}}$

$\text{Velocity ratio} = 1$

The velocity ratio of the fixed **pulley is 1**.

(d) Calculation of efficiency

Formula: $\text{Efficiency} = \frac{\text{Mechanical advantage}}{\text{Velocity ratio}} \times 100\%$

$\text{Efficiency} = \frac{1}{1} \times 100\%$

$\text{Efficiency} = 100\%$

Therefore, for a fixed pulley, mechanical advantage is 1 and velocity ratio is also 1. In this case the efficiency for fixed pulleys is 100%. However, due to friction between the rope and the wheel of the fixed pulley, the efficiency is less than the calculated value. For this reason, efficiency of fixed pulleys is always less than 100%.

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Mechanical advantage, velocity ratio and efficiency of a movable pulley

Two pulleys are needed when using a movable pulley to lift a load as shown in Figure 5. The tension in all parts of the ropes are the same. Thus, the effort needed to lift the load in part A of the rope is equal to the effort needed to lift the load in part B of the rope. Both efforts combine to lift the load.

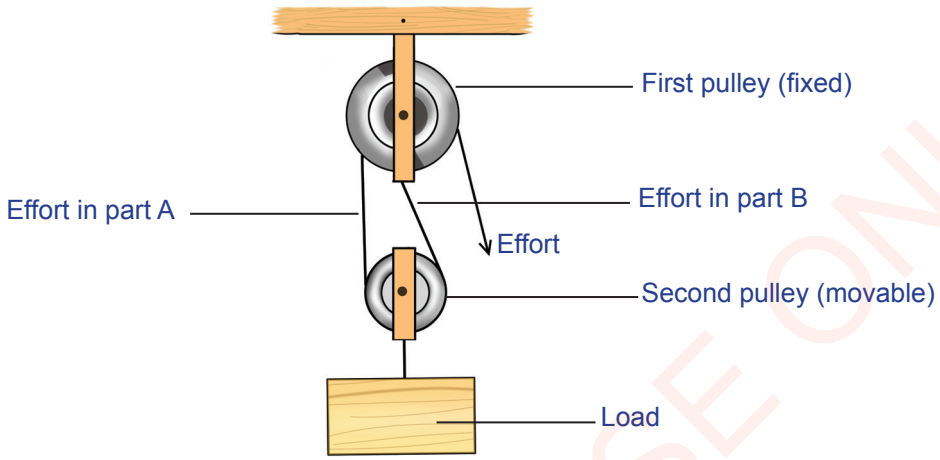

Figure 5: *A two - pulley system*

$$\text{Effort in part A} + \text{Effort in part B} = \text{Load}$$

$$\text{Effort} + \text{Effort} = \text{Load}$$

$$2 \times \text{Effort} = \text{Load}$$

$$\text{Effort} = \frac{1}{2} \times \text{Load}$$

Therefore, the effort needed to lift the load is half the load. As the number of movable pulleys in a system increases, the effort to lift the load decreases. Therefore, the mechanical advantage of the movable pulley in Figure 5 is 2. Similarly, the distance moved by the load is half the distance moved by the effort when lifting the load.

$$\text{Distance moved by load} = \frac{1}{2} \times \text{Distance moved by effort}$$

Thus,

$$\text{Distance moved by effort} = 2 \times \text{Distance moved by load}$$

Therefore, velocity ratio of the movable pulley is 2.

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Example 1

Calculate the effort needed to lift 800 kilograms load using a movable pulley.

Solution

Given:
Load = 800 kilograms
Required: Effort

Formula: $\text{Effort} = \frac{1}{2} \times \text{Load}$

$\text{Effort} = \frac{1}{2} \times 800 \text{ kilograms}$

$\text{Effort} = 400 \text{ kilograms}$

Therefore, the effort is **400 kilograms.**

Example 2

Calculate the load when the effort used to lift the load using a movable pulley is 350 kilograms.

Solution

Given:
Effort = 350 kilograms
Required: load in kilograms

Formula: $\text{Effort} = \frac{1}{2} \times \text{Load}$

$\text{Load} = 2 \times \text{Effort}$

$\text{Load} = 2 \times 350 \text{ kilograms}$

$\text{Load} = 700 \text{ kilograms}$

Therefore, the weight of the load is **700 kilograms.**

Example 3

Calculate the distance moved by the load when the distance moved by the effort while lifting the load is 2 metres.

Solution

Given:
Distance moved by the effort = 2 metres
Required: Distance moved by the load.

Formula: $\text{Distance moved by the load} = \frac{1}{2} \times \text{Distance moved by the effort}$

$\text{Distance moved by the load} = \frac{1}{2} \times 2 \text{ metres}$

$\text{Distance moved by the load} = 1 \text{ metre}$

Therefore, the distance moved by the load is **1 metre.**

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Example 4

Use the first example to find the mechanical advantage. Using also example 3 find the velocity ratio of movable pulleys.

From example 1

Solution

Given:
Load = 800 kilograms
Effort = 400 kilograms
Required: Mechanical advantage.

Formula: $\text{Mechanical advantage} = \frac{\text{Load}}{\text{Effort}}$

$$\text{Mechanical advantage} = \frac{800 \text{ kilograms}}{400 \text{ kilograms}}$$

$$\text{Mechanical advantage} = 2$$

Thus, the mechanical advantage of the movable pulley is **2.**

From example 3

Solution

Given:
Distance moved by the effort = 2 metres
Distance moved by the load = 1 metre
Required: Velocity ratio of the movable pulley.

Formula: $\text{Velocity ratio} = \frac{\text{Distance moved by effort}}{\text{Distance moved by load}}$

$$\text{Velocity ratio} = \frac{2 \text{ m}}{1 \text{ m}}$$

Thus, the velocity ratio is **2.**

Therefore, for a movable pulley the mechanical advantage is 2 and the velocity ratio is also 2. This shows that the efficiency of this pulley system is 100%. In practice, the mechanical advantage is less than the velocity ratio. As a result, the efficiency of the pulley system is always less than 100% due to friction between the rope and the pulley.

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Pulley systems

Pulley systems, such as those shown in Figure 6, consisting of one or multiple pulleys, have velocity ratio equal to the number of pulleys used in each system. Pulley systems with one, two, three or more pulleys are used to simplify work. The effort of a pulley system decreases as the number of pulleys increases. For example, the effort for a system with two pulleys is half the load being lifted.

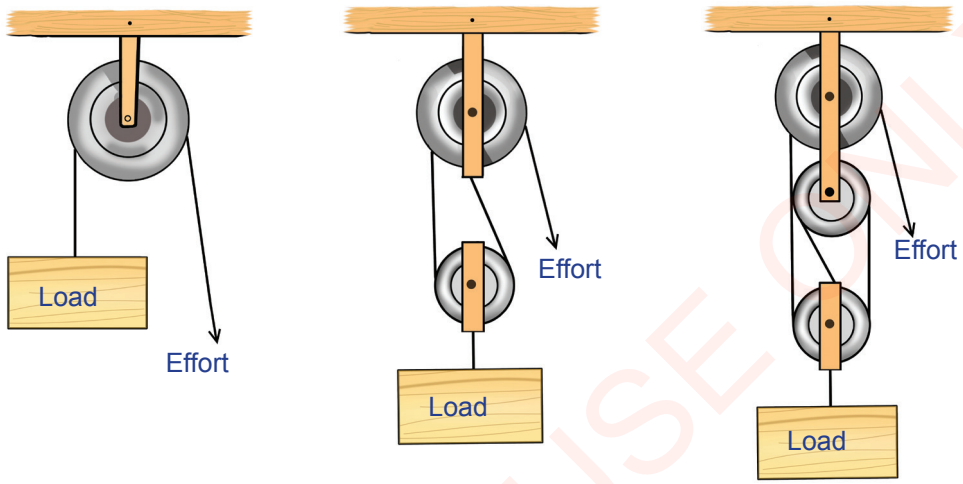

Figure 6: *System of pulleys*

If efficiency is 100%, mechanical advantage will be equal to the number of pulleys used. If efficiency is less than 100%, the mechanical advantage is still given by the formula:

$$\text{Mechanical advantage} = \frac{\text{Load}}{\text{Effort}}$$

Calculations associated with systems with multiple pulleys

Example 1

Find the mechanical advantage of a system consisting of five pulleys, if an effort of 12 kilograms is used to lift 48 kilograms of load. Also, find the efficiency of the pulley system.

Solution

Given:

Load = 48 kilograms

Effort = 12 kilograms

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Velocity ratio = number of pulleys = 5

Required: Mechanical advantage and efficiency.

Mechanical advantage

Formula: $\text{Mechanical advantage} = \frac{\text{Load}}{\text{Effort}}$

$$\text{Mechanical advantage} = \frac{48 \text{ kilograms}}{12 \text{ kilograms}}$$

$$\text{Mechanical advantage} = 4$$

Thus, the mechanical advantage of the pulley system is **4**.

Efficiency

Formula: $\text{Efficiency} = \frac{\text{Mechanical advantage}}{\text{Velocity ratio}} \times 100\%$

$$\text{Efficiency} = \frac{4}{5} \times 100\%$$

$$\text{Efficiency} = 80\%$$

Therefore, the efficiency is **80%**.

Example 2

Effort of 25 kilograms was able to lift 75 kilograms load through 3 metres. In this process, the effort moved a distance of 12 metres. Use this information to find:

(a) Mechanical advantage.

(b) Velocity ratio.

(c) Efficiency.

Solution

Given:

Load = 75 kilograms

Effort = 25 kilograms

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Distance moved by the load = 3 metres
Distance moved by effort = 12 metres

Required:

(a) Mechanical advantage

(b) Velocity ratio

(c) Efficiency

(a) Mechanical advantage

Formula: $\text{Mechanical advantage} = \frac{\text{Load}}{\text{Effort}}$

$$\text{Mechanical advantage} = \frac{75 \text{ kilograms}}{25 \text{ kilograms}}$$

$$\text{Mechanical advantage} = 3$$

Thus, the mechanical advantage is **3**.

(b) Velocity ratio

Formula: $\text{Velocity ratio} = \frac{\text{Distance moved by the effort}}{\text{Distance moved by the load}}$

$$\text{Velocity ratio} = \frac{12 \text{ metres}}{3 \text{ metres}}$$

$$\text{Velocity ratio} = 4$$

Thus, the velocity ratio is **4**.

(c) Efficiency

Formula: $\text{Efficiency} = \frac{\text{Mechanical advantage}}{\text{Velocity ratio}} \times 100\%$

$$\text{Efficiency} = \frac{3}{4} \times 100\%$$

$$\text{Efficiency} = 75\%$$

Thus, the efficiency is **75%.**

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Complex machines

Complex machines are made up of two or more simple machines. Complex machines simplify work by increasing the speed and effort needed to complete the work in the shortest possible time. Therefore, two or more simple machines which form a complex machine are designed to work together. Examples of complex machines are mortice locks, sewing machines, blenders, and machines for hulling and grinding cereals. Other examples are motorcycles and bicycles as shown in Figure 7.

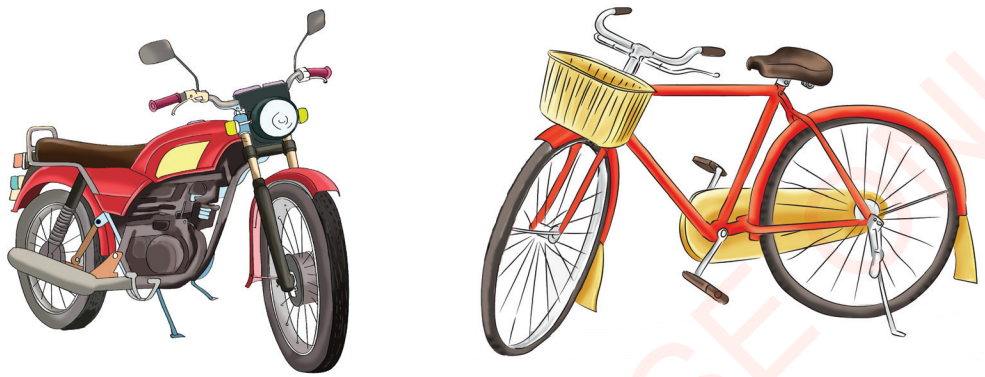

Figure 7: *Examples of complex machines*

Importance of complex machines

Devices or gadgets used to perform different activities in agriculture, transportation and industry, are made of complex machines. These machines include devices used for transportation, production in industry and agriculture, lifting and loading or offloading cargo.

Exercise 1

Answer the following questions in your exercise book.

1. (a) What is a pulley?
   (b) Draw a diagram of a pulley system consisting of a fixed and a movable pulley.
2. Calculate the load, if the effort needed to lift it using a movable pulley is 500 kilograms.
3. Mention two properties of complex machines.
4. Calculate the velocity ratio of a pulley with 80% efficiency and mechanical advantage of 2.

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5. Effort of 80 kilograms moved a distance of 20 metres. Through what distance did this effort move a load of 35 kilograms, if the velocity ratio is 4?
6. What is the mechanical advantage of a movable pulley if its efficiency is 100%?
7. Calculate the effort, if the mechanical advantage is 5 and the load is 45 kilograms.
8. Examine a bicycle and list the names of simple machines used in its construction.

Work

Work is done when a force pushes or pulls a load through a certain distance. For work to be done, it is necessary for a force to cause movement in its direction. For example, a person will be considered to have done work if the person uses a force to move a load through some distance. Thus, work is the outcome of a force lifting or moving a load through some distance. Therefore, work is the product of force and the distance moved in the direction of the applied force.

$$\text{Work} = \text{Force} \times \text{Distance}$$

For example, work is done when you lift a chair and put it on your head. But, if someone else lifts the chair and puts it on your head, you are not doing any work. The work is being done by the person who is lifting the chair and putting it on your head. Similarly, if you push a wall with great force, you will have done no work because the applied force does not move the wall.

Exercise 2

Answer the following questions in your exercise book.

1. Give the meaning of work.
2. Work is a product of _____ and _____.
3. Why is a person who pushes a wall for three hours continuously considered to have done no work?

Unit of work

If a force of 1 newton pushes or pulls something through a distance of one 1 metre, the work done is 1 newton metre. The unit of work is called joule. 1 joule is the amount of work done when a force of 1 newton pulls or pushes something through a distance of 1 metre.

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Activity 2: *Measuring work done when force is used to pull an object*

Requirements: a metre ruler, table, spring balance, wooden block, nail, ruler, string and hammer

Procedure

1. Mark position A on the table. Use the metre ruler to mark point B 70 cm from point A as shown in Figure 8.
2. Fix the nail into the wooden block using a hammer.
3. Tie one end of the string to the nail and the other on the hook of a spring balance.
4. Place the wooden block on the table in such a way that its vertical side on the left aligns with point A. Pull the spring balance slowly horizontally. What do you observe about the wooden block?
5. Continue pulling and reading the amount of force registered by the spring balance. Take the reading when the value of force indicated by the spring balance while pulling is constant. Continue pulling until the wooden block moves a distance of 70 centimeters.
6. Record the distance moved and the force used to move the wooden block. Use them to calculate the work done by the force.

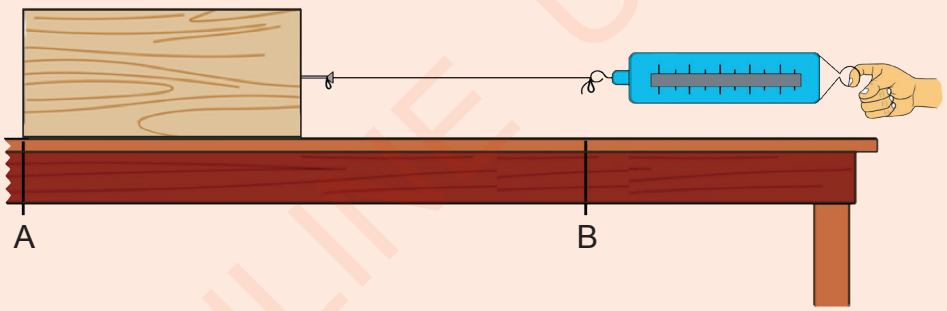

Figure 8: *Determination of work done*

Work is a product of force and the distance moved by the force in its direction.

$$\text{Work} = \text{Force} \times \text{Distance}$$

$$\text{Force} = \frac{\text{Work}}{\text{Distance}}$$

$$\text{Distance} = \frac{\text{Work}}{\text{Force}}$$

The unit of force is newton, abbreviated by N. The unit of work is joule, abbreviated by J.

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Calculation of work done

Example 1

A person pushes a barrel through a distance of 6 metres using 10 newtons. How much work is done by the person?

Solution

Given:
Force = 10 newtons
Distance = 6 metres
Required: Work done

Formula: Work done = Force $\times$ Distance

Work = 10 N $\times$ 6 m

Work = 60 Nm = 60 J

Therefore, the amount of work performed by the person is **60 joules**.

Example 2

A mechanic used a force of 50 N to lift a car component thereby doing 75 J work. What was the distance moved by the car component?

Solution

Given:
Force = 50 N
Work = 75 J

Required: Distance moved by the force

Formula: $\text{Distance} = \frac{\text{Work}}{\text{Force}}$

$\text{Distance} = \frac{75\ \text{J}}{50\ \text{N}}$

Distance = 1.5 m

Therefore, the mechanic lifted the car component through a distance of **1.5 metres.**

Example 3

Suppose the work done by wind to move an empty tin through a distance of 20 m in its direction is 100 J. Find the force of the wind?

Solution

Given:
Work = 100 J
Distance = 20 m

Required: Force

Formula: $\text{Force} = \frac{\text{Work}}{\text{Distance}}$

$\text{Force} = \frac{100\ \text{J}}{20\ \text{m}}$

Force = 5 N

Therefore, the force exerted on the empty tin by the wind is **5 newtons.**

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Exercise 3

Answer the following questions in your exercise book.

Section A

Choose the correct answer for each of the following questions.

1. Complex machines are made up of _____.
   (a) only simple machines
   (b) two or more simple machines
   (c) only two simple machines
   (d) machines which collectively work together

2. Which of the following is a complex machine? _____
   (a) Wedge
   (b) Lever
   (c) Sewing machine
   (d) Inclined plane

3. Two or more simple machines which form complex machines are designed to work _____.
   (a) together to simplify work
   (b) independently
   (c) in parallel for an extended period
   (d) differently for a long period

Section B

Fill the following table:

4. Use the mark (✓) to identify types of machines in the following table.

No.	Machine	Simple machine	Complex machine
(a)	Pair of scissors		
(b)	Bicycle		
(c)	Hoe		
(d)	Sawing machine		
(e)	Bottle opener		
(f)	Tractor		

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Section C

Answer the following questions:

5. Give the meaning of a machine.
6. What are the types of pulleys?
7. Effort of 200 kilograms was used to lift a load of 400 kilograms. Calculate the mechanical advantage.
8. Effort moved a distance of 2 metres to move a load through a distance of 1 meter. Calculate the velocity ratio.
9. A fixed pulley was used to lift a 150 kilogram load. Calculate the effort used to lift the load.
10. A machine for processing meat had mechanical advantage of 0.75 and velocity ratio of 5. Calculate the efficiency of the machine.
11. In a tag of war, each team pulled the rope with a force of 1000 newtons. If there was no winner, how much work was done by each team?
12. A force of 100 newtons was used to move a sack of rice through a distance of 2 metres. How much work was done?
13. A work of 300 joules was done by moving an object 6 metres in the direction of the applied force. Find the amount of the force used.
14. A force of 60 newtons was used to pull a motorcycle and the work done was 240 joules. What distance did the motorcycle move?

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Chapter Eight

Diffusion and osmosis

Introduction

In Standard Five, you learnt about changes of matter. You learnt that matter can change physically or chemically. In this chapter, you will learn about diffusion and osmosis. The knowledge and skills obtained will enable you to use matter that can change from one state to another. You will also understand the roles diffusion and osmosis play in different body functions.

Diffusion

We always sense different good or bad smells in our environment. These smells can either be near or far away from where we are. For example, the smell of nice food may spread from the kitchen or dining room to outside the house. This can cause a person to have the desire of eating that food. The spreading of smell from an original point to the whole surrounding happens by diffusion. Therefore, diffusion is the movement of particles of matter from an area of high concentration to that of low concentration. For example, the spreading of a drop of a liquid colour in water. Another example is the spreading of perfume smell in a room.

Importance of diffusion

Diffusion is important in the daily life of human beings and living things. The importance of diffusion includes the following:

(a) It enables perfume or chemicals sprayed in one point of the house or car to spread evenly in the whole area.

(b) It enables carbon dioxide gas from the air to penetrate into plant leaves.

(c) It allows oxygen gas to leave the plant cells through the stomata.

(d) It enables carbon dioxide gas to leave animal cells and enter the blood.

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(e) It enables the nice smell of flowers to reach and attract some insects that cause pollination.

(f) It helps animals to recognise the location of other animals by sensing the smell that spreads in the air.

(g) It helps in the absorption of food in animal digestive systems.

Activity 1: *Demonstration of diffusion in gases*

Requirement: perfume

Procedure

1. Spray the perfume in one corner of the classroom.
2. After five minutes, ask your fellow pupils who are at the other corner of the class what they smell.

Activity 2: *Demonstration of diffusion in liquids*

Requirements: liquid dye or coloured powder, clean water, tea spoon, and glass container such as cup or bowl or beaker or jug

Procedure

1. Pour clean water into the glass container.
2. Measure one tea spoonful of a liquid dye or coloured powder.
3. Put the dye or coloured powder in the glass container containing water prepared in the first step. Do not stir (See Figure 1).
4. Wait for five or more minutes, then observe the results. What do you see?

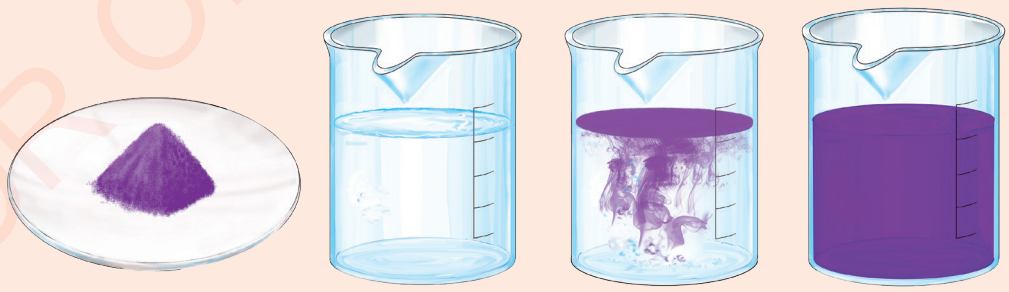

Figure 1: *Diffusion of a dye in water*

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Harmful effects of diffusion

Although diffusion has many advantages to human beings and the environment, it can have harmful effects as well. The harmful effects which may be caused by diffusion include spreading of harmful gases. The gases may affect the health of living things. The gases that spread by diffusion can cause air or water pollution.

Human beings inhale air which has been polluted by gases from cars and cigarette smoke. The gas may also be contaminated by pesticides and gases from factories or from accumulated waste. The gases spread as they move from areas of high concentration to low concentration. As they spread, they reach human beings and other living things hence, affect them. Smoke travels far away from waste burning areas to human habitats by diffusion. Dumping of solid or liquid chemicals in one point of a dam may spread throughout the dam. Such chemicals have serious effects to living things using water and those living in it.

Exercise 1

Answer the following questions in your exercise book.

1. Using examples, explain the meaning of diffusion.
2. Mention three advantages of diffusion.
3. Explain four negative effects of diffusion in daily life.

Osmosis

Osmosis is the process by which water molecules move from a solution of low solute concentration to a solution of high solute concentration through a semi-permeable membrane.

Experiment: *Investigating how plants absorb water through osmosis*

Aim:	To show how osmosis occurs in living cells
Requirements:	cassava or potatoes or pumpkins, heat source, salt, pan, knife, two glass bowls or beakers or two glass plates, water and a tea spoon

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Procedure

1. Peel two potatoes and cut them to make a hole in each so that they look like bowls. Use cassava or pumpkins in case there are no potatoes.
2. Boil one of the holed potatoes for five minutes. Leave the other potato raw (unboiled).
3. Put two tea spoonfuls of salt into the hole of each of the prepared potatoes.
4. Pour some water into two different beakers and make sure that the potatoes will not be covered by water (See Figure 2).
5. Put each salt containing potato into two different beakers containing water.
6. Mark each beaker with a pencil to show the water level.
7. Wait for two or more hours.
   (a) What happened?
   (b) Why was one of the potatoes boiled?

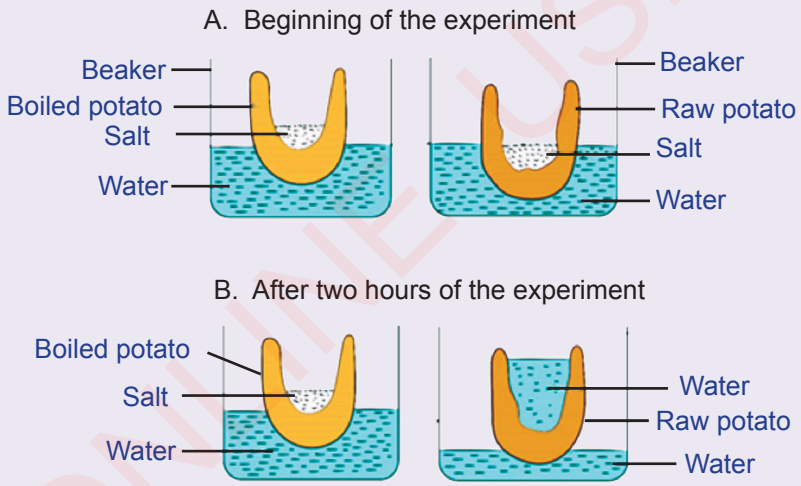

Figure 2: *The occurrence of osmosis in potato cells*

In this experiment, there was a salt solution in the raw potato. Water in the beaker had no salt. Water in the beaker penetrated the cells of the raw potato to the concentrated salt solution. The cells of living things have a semi-permeable membrane which allows specific molecules to penetrate. The process in which water moves from a dilute solution to a highly concentrated solution through a semi-permeable membrane is known as osmosis. The boiled potato did not allow water to penetrate through because its cells were dead.

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Importance of osmosis

Osmosis is important especially in the bodies of living things. The importance of osmosis includes the following:

1. It balances water in the body cells of a living thing.
2. Plant roots absorb water from the soil by osmosis.
3. Osmosis helps cells and organs of a living thing to have their specific shapes.
4. It helps in food preservation. For example, salt is applied on meat in order to reduce water and kill germs.
5. It distributes nutrients and oxygen gas throughout the body and removes carbon dioxide from the body.
6. It makes plants firm and minimises shrinking.

Exercise 2

Answer the following questions in your exercise book.

Section A

Fill in the blanks by using either the term diffusion or osmosis.

1. The process by which molecules of matter move from high concentration to low concentration is known as _____.
2. The movement of water molecules from a solution of low solute concentration to that of high solute concentration through a semi-permeable membrane is called _____.
3. Plant roots absorb water from the soil by the process of _____.

Section B

Answer the following questions:

4. Mention five advantages of osmosis.
5. Mention other three experiments which you can do to demonstrate diffusion.
6. Basing on the concept of diffusion, explain why rotten materials should be buried.
7. Why didn't water penetrate the boiled potato in the experiment done?

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8. Osmosis is important to plants. Explain.
9. Agricultural experts advise that only little amounts of mineral fertilisers should be applied around the plant stem. Give the reason, using the knowledge of osmosis.

Vocabulary

Concentration the amount of a substance contained in a solution or a mixture

Molecule a small particle of a liquid or gas

Solute a substance that is dissolved in a solvent, for example, salt which is dissolved in water

Solution a liquid mixture in which the solute is uniformly distributed in the solvent

Solvent a substance that dissolves a solute, for example, water which dissolves salt

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Chapter Nine

Spreadsheet program

Introduction

In Standard Five, you learnt about the concept of a computer, uses and the precautions to consider when using a computer. Also, you learnt about the concept of Word processor program and its uses. In this chapter, you will learn about the concept of Excel program, opening, saving and closing an Excel program. You will also learn things to consider when preparing a worksheet and the precautions to take when using an Excel program. The knowledge and skills acquired will enable you to use the Excel program to organise personal or organisational information. Some of the information that can be prepared using an Excel program include budget, agricultural production, payroll and examination results.

Meaning of a spreadsheet

In everyday life various activities are performed. For example, teachers perform a variety of activities involving academic tasks, school management and administration. Some of the tasks that are performed by teachers include preparing examination results, pupils' academic reports and keeping their academic records. Likewise, teachers keep records of school assets and prepare a school budget using paperwork. These tasks consume a lot of time to prepare. Do you think there is any method that can help to simplify these tasks? A spreadsheet program can be used to simplify these tasks. Spreadsheet is a software that deals with manipulation, analysis and presentation of numeric data. It can be used to prepare budgets, pupils' examination results, pupils' database and staff particulars by using a worksheet. Generally, spreadsheet is a computer application used to enter, organise, analyse and compute data in an electronic format.

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Importance of using spreadsheet

Spreadsheet can be used to enhance effectiveness and efficiency in various areas related to data collection and analysis. For example, in the field of accounting activities such as budgeting, sales projections and financial calculations are performed by spreadsheet. In education, spreadsheet is also used to prepare information related to pupils' progress reports, research, educational statistics, time table and scientific information. Therefore, a spreadsheet program is very important in the day-to-day activities for an individual or organisation.

The spreadsheet enables you to:

1. Update data automatically without necessarily performing other calculations when a formular is applied.
2. Produce neat professional work.
3. Spell check automatically using text proofing facility.

   Note: Grammar in Excel program is not for writers, as it is in Word processor
4. Present information easily in graphs and charts.
5. Use tools that enable modification of font styles such as italic, font colour and font size.

Exercise 1

Answer the following questions in your exercise book.

1. Explain the meaning of a spreadsheet program.
2. Mention the benefits of using a spreadsheet program.
3. Explain the benefits of using spreadsheet over using paperwork in doing calculations.
4. What is the difference between word processing and a spreadsheet program?
5. Explain the relationship between word processing and a spreadsheet program.
6. Apart from education and accounts, what other fields use spreadsheet?

Starting and closing an Excel program

Excel is one of the spreadsheet programs that allows you to analyse and organise information. There are various steps on how to start and close an Excel program. These steps depend on the computer programs settings, operating system and the version of the Excel program. You can use a

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computer with any operating system such as 'Windows 8 or 10'. There are steps to follow for a beginner to start the Excel program. The steps shown in activity 1 enable you to start the Excel program using a computer with 'Windows 10'.

Activity 1: *Starting Excel 2013*

Steps

1. Click the start button , the 'Start' menu will appear, see Figure 1 (a). Search in the list 'Microsoft Office' using the top and bottom scroll bars. See arrow number 2.
2. Click the drop-down menu on 'Microsoft Office 2013' as shown by arrow 3, in Figure 1 (a).
3. The spreadsheet 'Excel 2013' will appear in the list. Look at arrow number 4.
4. Then, click 'Excel 2013' to start, from the list. (See Figure 1 (a))

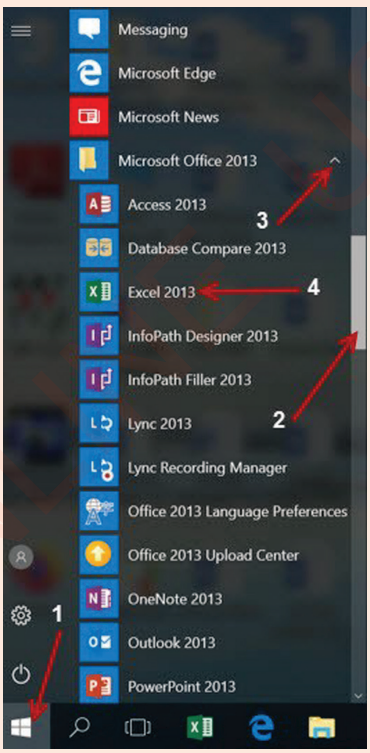

Figure 1 (a): *Starting Excel from list*

Alternatively, you can start the Excel program by typing the word 'excel' in the search box as shown by arrow number 1 in Figure 1 (b). 'Excel 2013' will appear as shown in arrow number 2.

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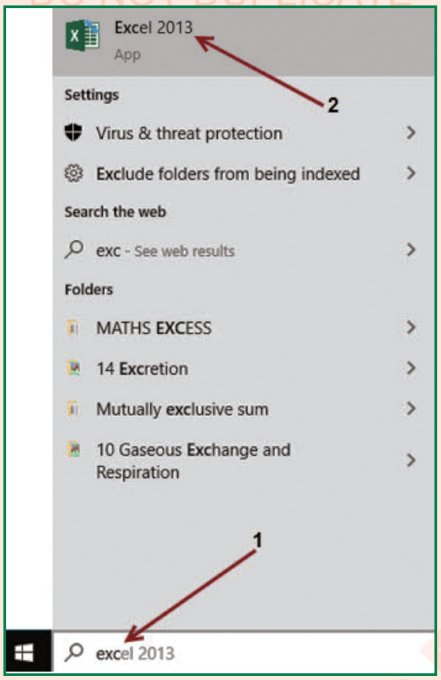

Figure 1 (b): *Starting Excel by searching*

5. From the display program menu, Click the 'Excel 2013' option. The Excel program will open a page with various templates including a blank workbook. Other templates are invoices, calendar, charts, budgets and business. You can browse other templates by clicking the scroll bar as shown in arrow number 3 of Figure 1 (c). Since you are opening the program for the first time, click the blank workbook.

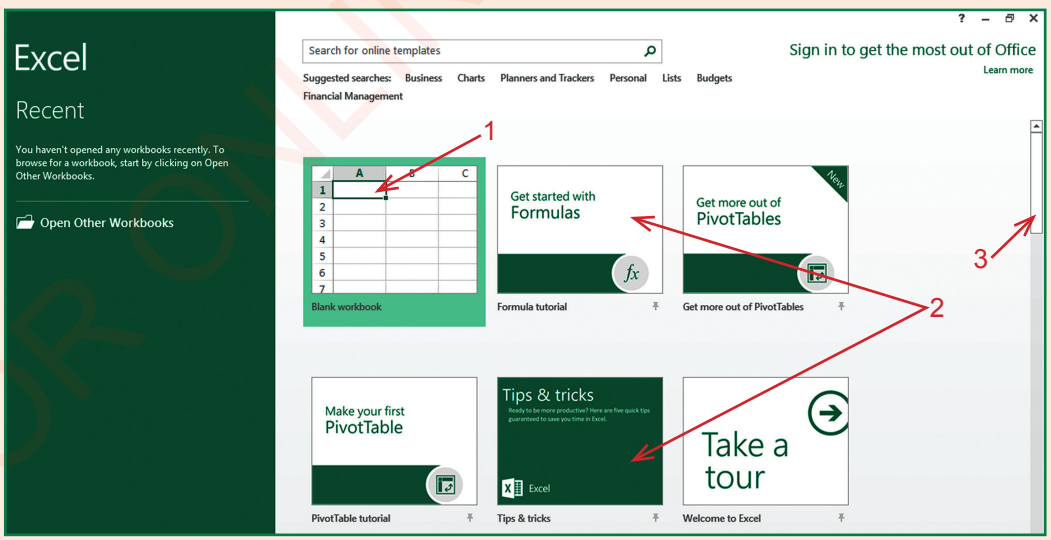

Figure 1 (c): *Blank workbook template*

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6. The Excel program will open a window as shown in Figure 2.

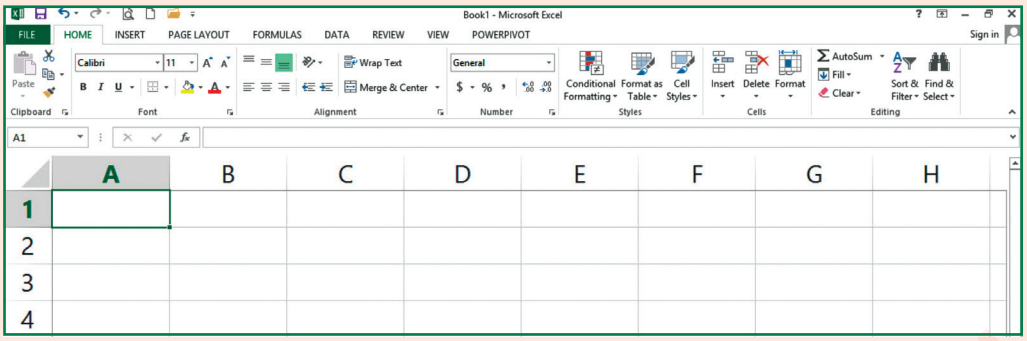

Figure 2: *Excel 2013 user interface*

Activity 2: *Clossing Excel 2013*

Click the X sign on the top right hand corner of the window to close as shown in Figure 3.

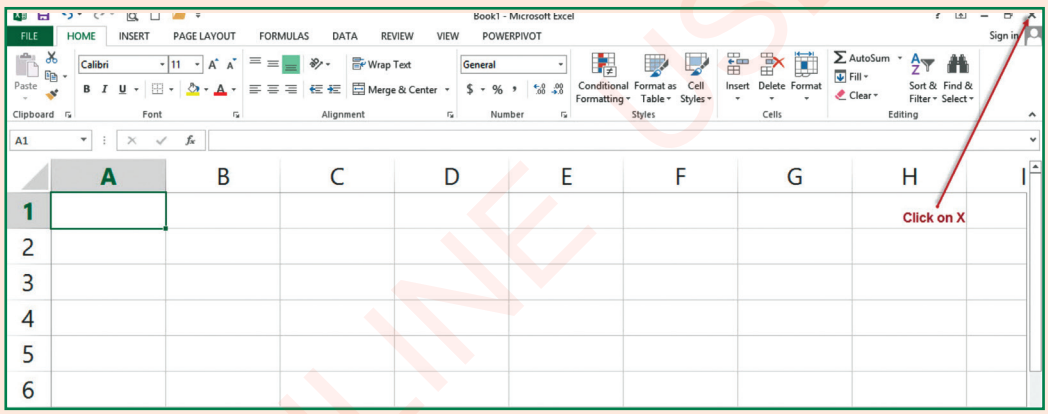

Figure 3: *Closing an Excel 2013 window*

Exercise 2

Answer the following questions in your exercise book.

1. Describe the steps you will follow to open and close an Excel program.
2. Based on your answers to question 1, what are the simplest steps between starting and closing an Excel program?

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Saving a workbook or file to a computer

When you enter or process any data in an Excel program, it is important to save it for future use. Data is saved by clicking the File tab and choosing 'save as' in the drop down menu. By default, all files are saved in the hard disk (drive C). Any data that is entered or updated into the worksheet should be saved by clicking the 'Save' button every time. Also, you can save the file in an external drive or a memory card. There are two main ways of saving data as elaborated in the sections that follow.

Save as: This method of saving data is used when saving a new file or you want to change the filename of the workbook. This step requires you to specify the filename you want to use and the location in which you want to save it. It is important to make the file name short and relevant to the work you are doing. By default the computer will save data on the 'Document' folder. You can also save data externally on a flash disk or memory card. The steps used to save a file are shown in Figure 4.

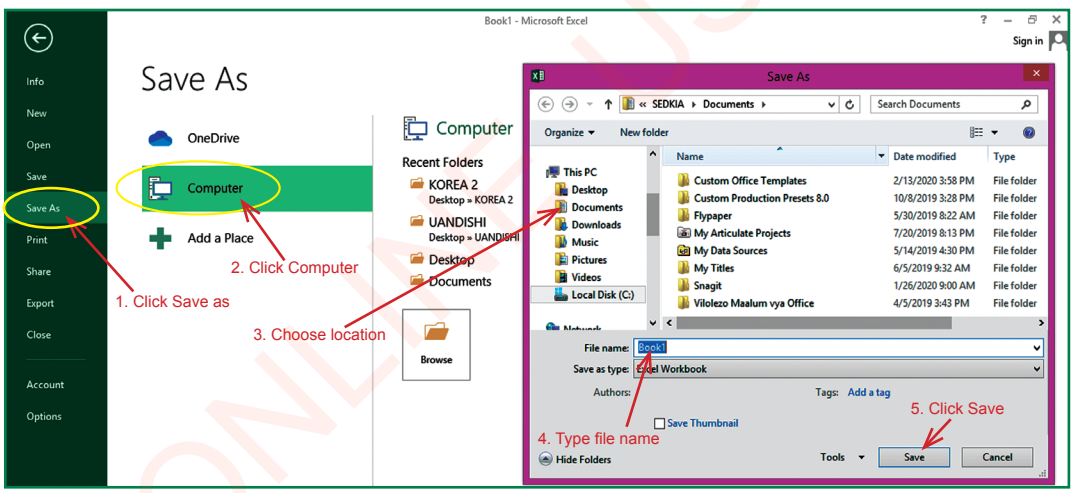

Figure 4: *Steps used to save a workbook*

Save: This is a way of saving data that is constantly growing as new data is entered in the worksheet. This way is usually used after using 'Save as' by clicking the 'Save' button as shown in Figure 4, step 5. It is important to click the 'Save' button every time you enter new data or make changes to avoid losing data in case power goes off.

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Functions of the menu bar

The spreadsheet program has two main bars at the top. These bars are title bar and menu bar.

Title bar: This displays the file name of the workbook that is being used and the name of the application software you are using. When you open excel for the first time, the workbook gets its original name as Book1. However, once you name and save it according to the activity involved, the Excel program changes its name. For example, you have prepared a budget for the purchase of school equipment and saved the file name as 'School equipment'. This bar will read 'School equipment' as shown in the diagram.

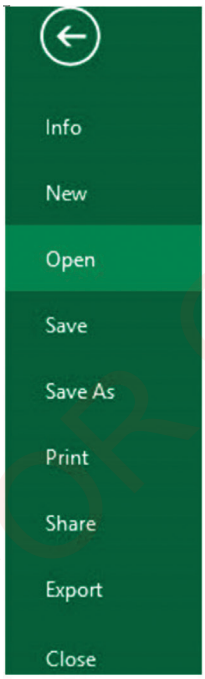


Menu bar: Displays a list of tab menu you use to give commands to the Excel program



Each tab menu displays a ribbon with a list of commands that allow you to work easily. A tab allows the user to access different groups of a menu in a program window. The menu bar consists of the different tabs, as illustrated in the sections that follow.

File tab: The file tab is part of the menu bar that contains a list of ribbon commands.



Functions of commands in File menu

Back: Shown by an arrow within a circle that the user clicks to go back to a previous step of a Workbook.

Info: Displays important workbook information such as protect workbook, inspect workbook, manage versions and browser view options.

New: Used to open a new workbook.

Open: It is used to open workbooks stored in a computer.

Save: Saves changes made to the workbook.

Save as: It is used to store a workbook file for the first time and provides an option to browse a location to save it.

Print: It is used to print a workbook and show print layout of a worksheet (how it will look like after printing).

Share: It is used to engage other people to receive, edit or send a workbook via email.

Export: It is used to convert file format.

Close: It is used to close a workbook.

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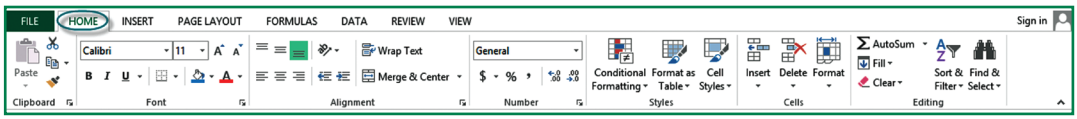
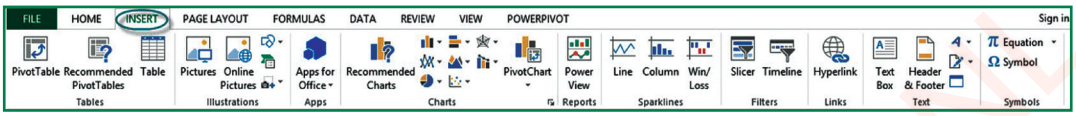
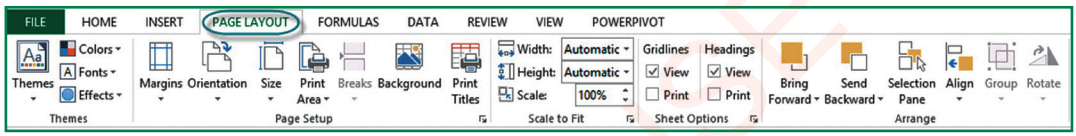
Home tab: This tab is used to perform common commands such as bold, underline, copy, and paste. It is also used to apply formats to cells in a worksheet.



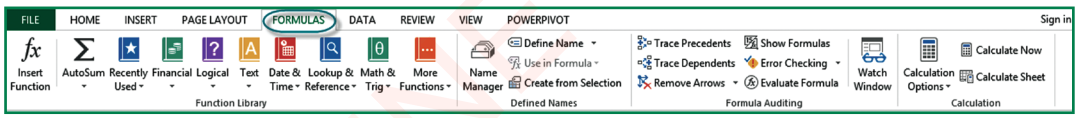
Insert tab: This tab allows the user to insert tables, illustrations, apps, charts, reports, spark lines, filters, links, texts and symbols.



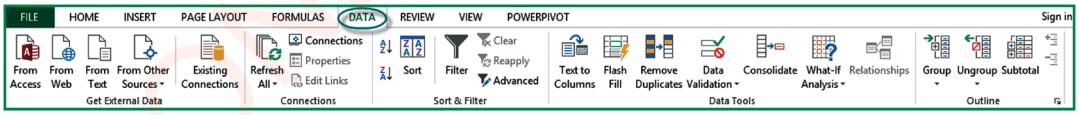
Page Layout tab: This tab provides tools for formatting a page. These tools include themes, page setup, scale to fit, sheet options and arrange.



Formulas tab: This tab provides various formats of formula, such as function library, defined names, formula auditing and calculation.



Data tab: You may use the Data tab to get external data, make connections, sort and filter data, data tools and outline.



Review: This tab enables you to make proofing on the worksheet, change language, add comments and changes such as protect sheet and track changes.



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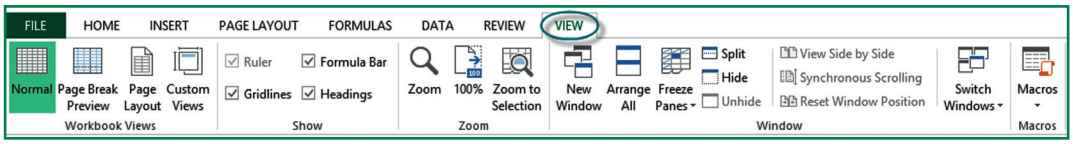
View: This tab displays groups of commands that provide an opportunity to view data or worksheet in workbook view, display, zoom, window and macros.



Features of Microsoft Excel 2013

When Excel 2013 is started, a blank workbook is created. The default title of the workbook is Book1. A workbook is a file that consists of worksheets. The user can insert additional worksheets by clicking add new sheet icon (+ sign). Usually the default setting is Sheet1 (See Figure 5).

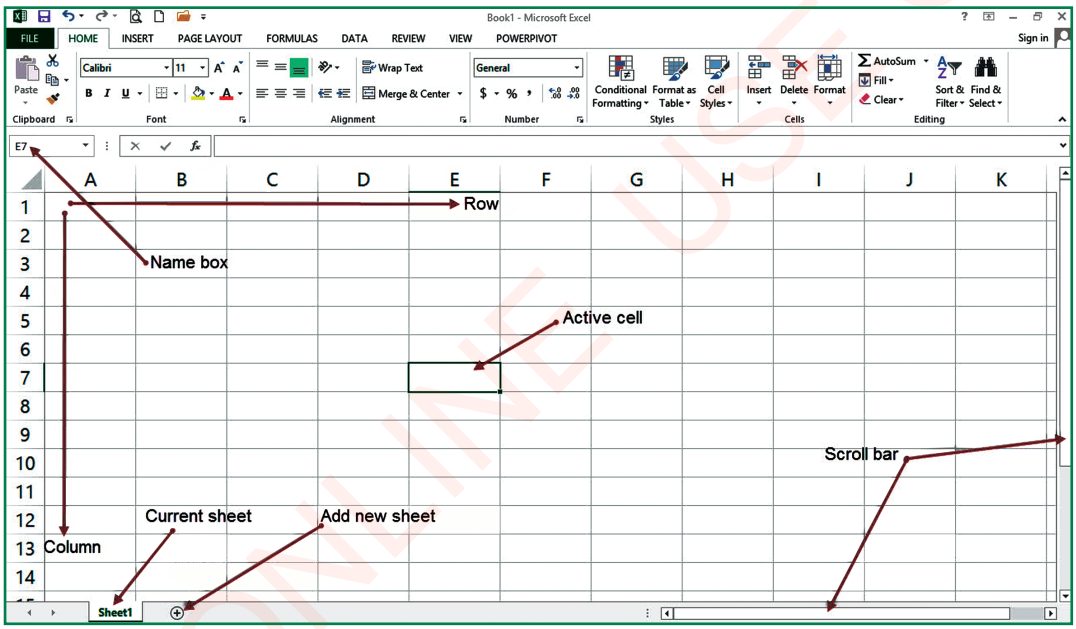


Figure 5: *Microsoft Excel 2013 interface*

The user interface in Figure 5 shows various features of Microsoft Excel 2013. Some of these features are explained in Figures 6, 7 and 8.

Workbook: A workbook is a collection of one or more worksheets in a single file. A workbook provides an opportunity to add one or more worksheets depending on the type or size of the work you are doing (See Figure 6).

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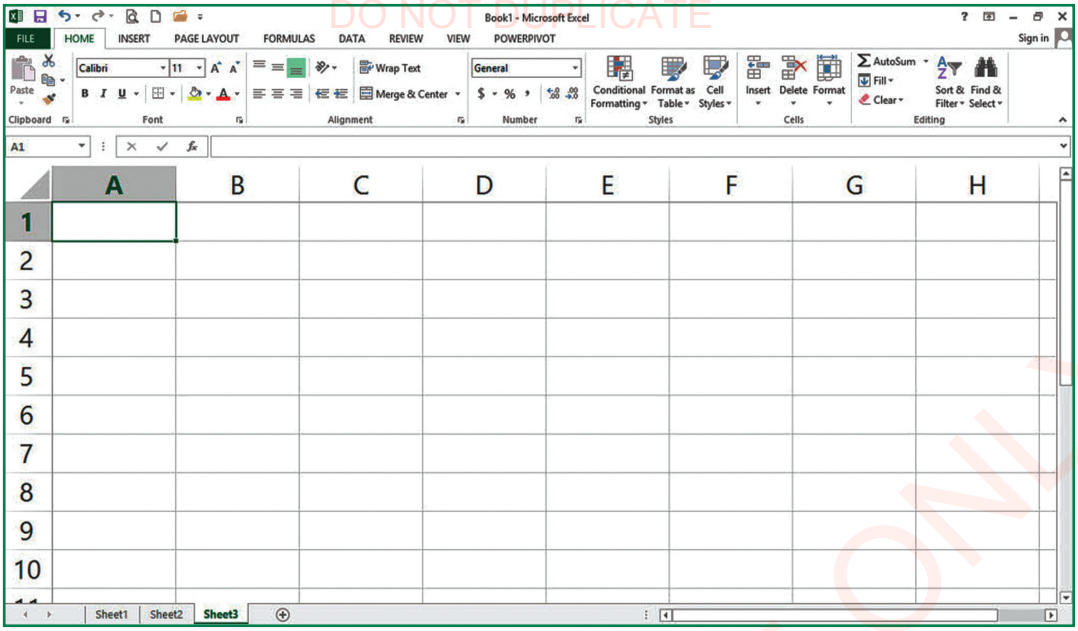

Figure 6: *A workbook with more than one worksheet*

Worksheet: This is a single sheet in a workbook created by a spreadsheet program such as 'Excel program'. It is a collection of cells organised in rows and column. Columns are labelled in alphabetical order such as A, B, C ... and the rows are listed by numerical values 1, 2, 3 ... Usually the default name of the worksheet is Sheet1. The intersection between columns and rows creates a cell. Each cell is different from other cells (See Figure 7).

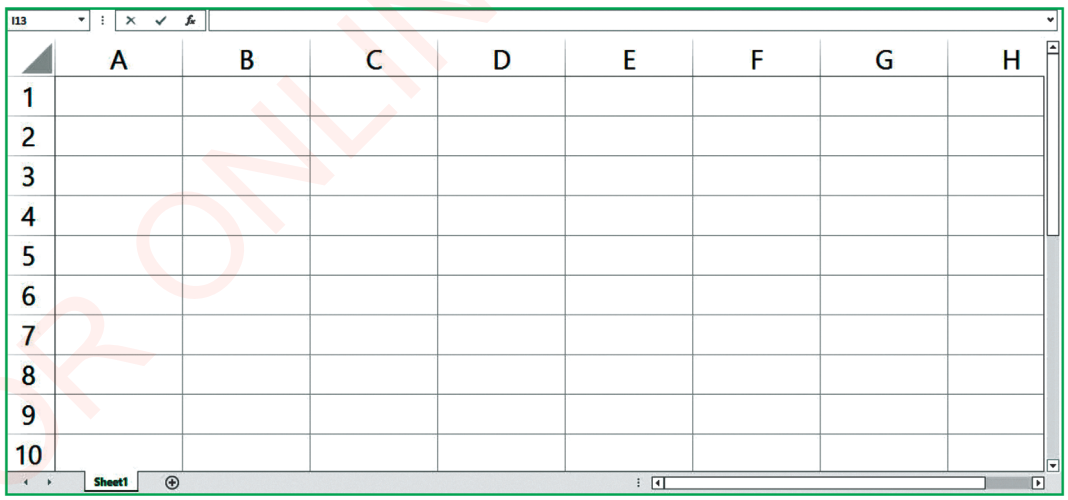

Figure 7: *Worksheet with cells*

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Cell: A cell is the intersection between a column and a row in a worksheet. A cell can be identified using a cell name, which consists of column letter and row number. An example of cell name is B4 shown in Figure 8.

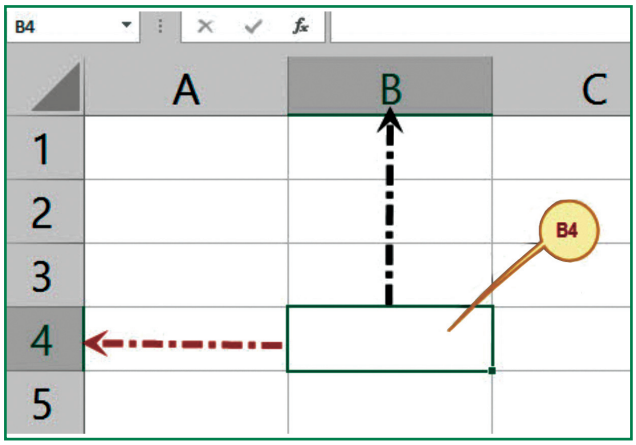

Figure 8: *Cell name*

Active cell: This is the currently selected cell for entering or editing data, for example B4 is the active cell (See Figure 8).

Creating a worksheet

All the tasks of entering, organising, analysing, processing and producing results is done in the worksheet. The user should be careful in creating a worksheet so as to give accurate results of the work.

Things to consider when creating a worksheet

Data type: There are various types of data that can be entered into the worksheet cells, these data are text, numbers, dates and currencies.

Text: Text can include a number or a letter which is inserted into the cell. The text serves as a heading for the data to be identified. Texts are entered into active cells and then formatted according to need. Examples of texts include T682ADB, DA2B11, school, teacher and pupil.

Number: This is type of data that is the essence of the spreadsheet. The cell receives normal numbers, example 0, 1, 2, 3 ... But when you want to write a number that starts with 0, for example 05, you must format cell as a text or custom. Note that a spreadsheet does not accept roman numbers,

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it recognises them as standard text. For numerical data to be meaningful, it must have a heading.

Date: This is another type of data that can be entered in the cell. You can type a date in a different view by formatting a cell with a date style (See Figure 9). Examples of date style are 5/5/2019, 5 - May, 2019, 5 - 5 - 2019, May 5, 2019. The first date style is shown in Figure 9.

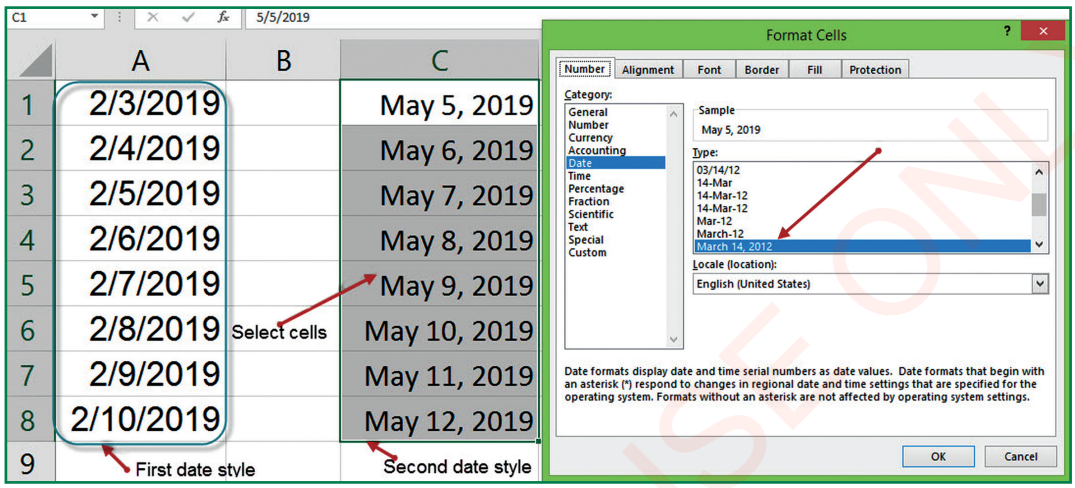

Figure 9: *Formatting date*

Currency: This is another type of data that can be entered in the cell. In order for a cell to accept currency data, it has to be written with a comma in every three digits from the right and then the cell can be formatted. Example 2,680,000 and 1,026.

Basic mathematical operator signs

Some of the signs used to describe numerical functions in a spreadsheet program differ from symbols of mathematical operations (See Table 1).

Table 1: *Mathematical operator signs*

Type of mathematical operations	Mathematical operator Sign	Mathematical operator Sign in Excel
Subtraction	-	-
Addition	+	+
Division	÷	/
Multiplication	×	*

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An Excel program is used to calculate basic and complex mathematical operations. There are three ways of performing calculations using an Excel program. These are:

1. Using numbers and mathematical operators.
2. Creating formula by cell reference.
3. Applying the built-in formula or functions.

Using numbers and mathematical operators: You can use a number followed by a mathematical operator and another number to get the answer. Example of: addition 2 + 2 = 4, see Figure 10 (a); subtraction 10 - 5 = 5, see Figure 10 (b); multiplication 2 × 3 = 6, see Figure 10 (c) and division 21 ÷ 3 = 7 see Figure 10 (d). Remember that all calculations start with the equal sign.

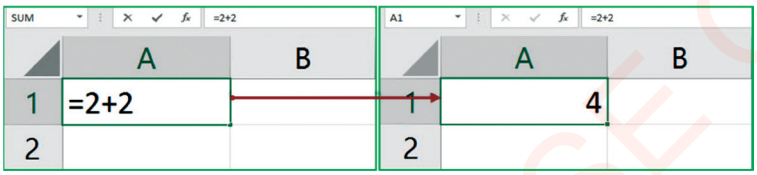

Figure 10 (a): *Addition*

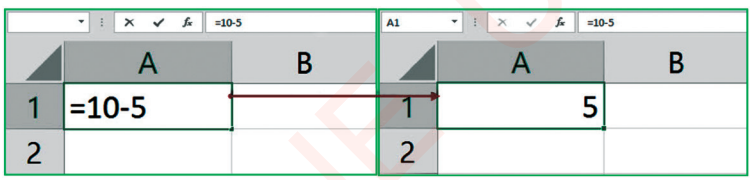

Figure 10 (b): *Subtraction*

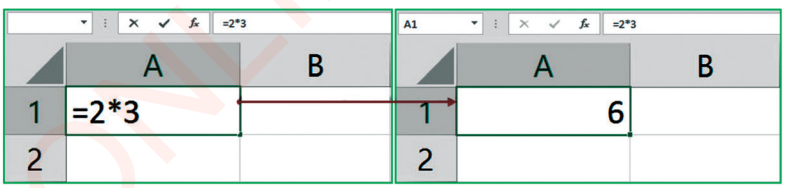

Figure 10 (c): *Multiplication*

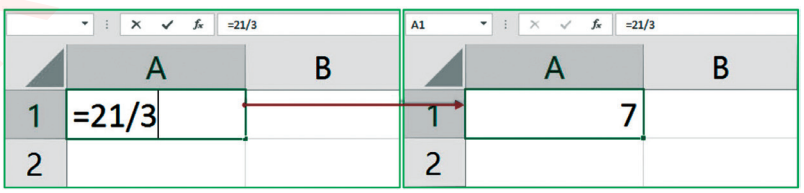

Figure 10 (d): *Division*

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The numerical answer of the equation appears after pressing the 'Enter' key located on the keyboard. The formula bar continues to show the relevant equation. When you write an equation in a cell, that equation also shows itself in the formula bar. When you finish press the 'Enter' key on the keyboard. The cell showing the answer and the equation continues to appear on the formula bar. See Figure 10 (a) to 10 (d). Remember to start with the equal sign each time you write a formula in a cell.

Creating a formula by cell reference: You can create a formula using a cell name followed by a mathematical operator and a second cell name. Example A1 + B1 will add together the numbers present in the given cells (See Figure 11 (a) to (d)).

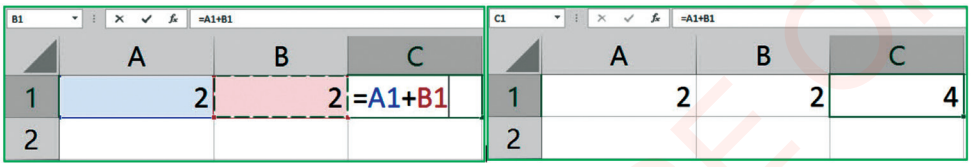

Figure 11 (a): *Addition by using cell reference*

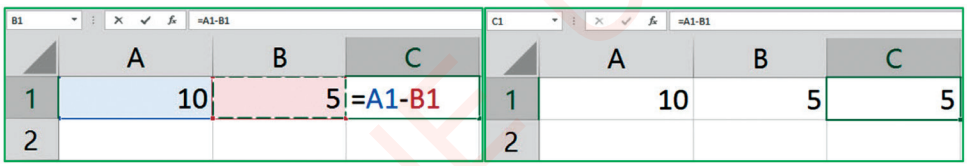

Figure 11 (b): *Subtraction by using cell reference*

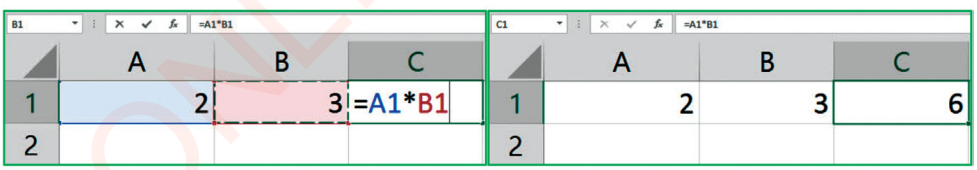

Figure 11 (c): *Multiplication by using cell reference*

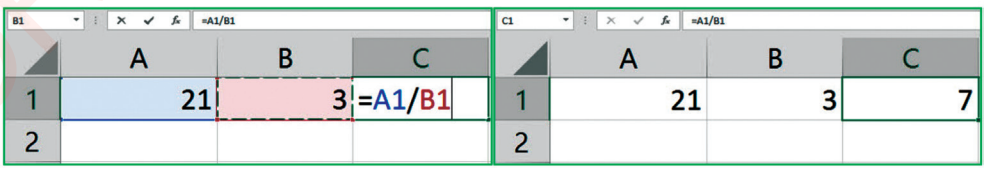

Figure 11 (d): *Division by using cell reference*

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Advantage of creating a formula by cell reference

1. It provides an opportunity to autofill formula without having to write it in the cells that follow with the same mathematical operator. For example, you are given three questions including 2 + 3=, 3 + 4= and 5 + 6= (See Figure 12).

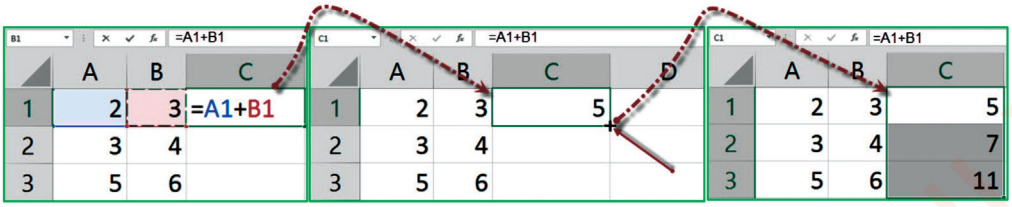

Figure 12: *The use of autofill*

2. When you replace a number in a cell, the formula does not change. This helps you to easily edit data without affecting the formula, the work format and the intended answer.

Steps for autofill formula

1. Type a formula in the response cell and press the 'Enter' key;
2. Select the answer cell and place the cursor in the lower right corner of the cell until it shows a plus sign (+); and
3. Press and hold the mouse without releasing and drag up to the end of the data. (See Figure 12).

Using spreadsheet built-in formulas or functions: The spreadsheet has predefined formulas built into it, to simplify computation. Some of these formulas are sum, average, maximum and minimum. When a teacher needs to calculate a score of ten pupils, he or she can use the spreadsheet to find the sum and average. In addition, the minimum and maximum will be calculated using the formulas built into the spreadsheet program.

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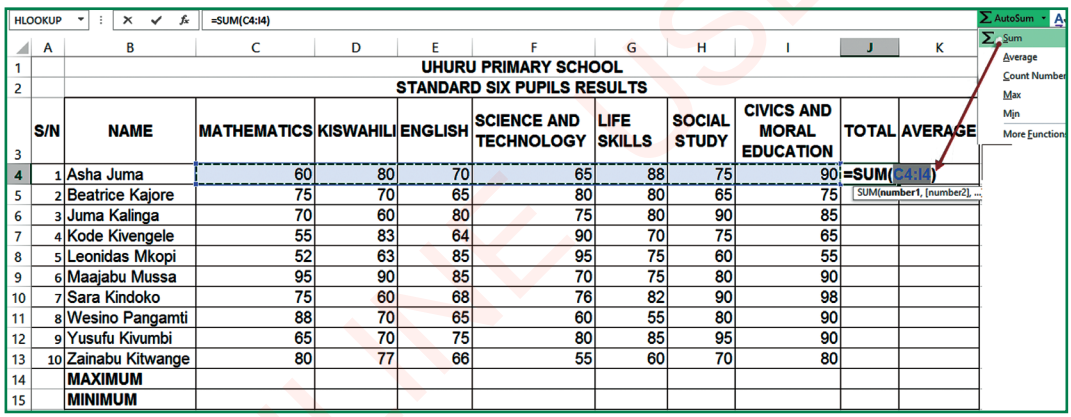
	A	B	C	D	E	F	G	H	I	J	K
1		UHURU PRIMARY SCHOOL									
2		STANDARD SIX PUPILS RESULTS									
3	S/N	NAME	MATHEMATICS	KISWAHILI	ENGLISH	SCIENCE AND TECHNOLOGY	LIFE SKILLS	SOCIAL STUDY	CIVICS AND MORAL EDUCATION	TOTAL	AVERAGE
4	1	Asha Juma	60	80	70	65	88	75	90		
5	2	Beatrice Kajore	75	70	65	80	80	65	75		
6	3	Juma Kalinga	70	60	80	75	80	90	85		
7	4	Kode Kivengele	55	83	64	90	70	75	65		
8	5	Leonidas Mkopi	52	63	85	95	75	60	55		
9	6	Maajabu Mussa	95	90	85	70	75	80	90		
10	7	Sara Kindoko	75	60	68	76	82	90	98		
11	8	Wesino Pangamti	88	70	65	60	55	80	90		
12	9	Yusufu Kivumbi	65	70	75	80	85	95	90		
13	10	Zainabu Kitwange	80	77	66	55	60	70	80		
14		MAXIMUM									
15		MINIMUM									

Figure 13: *Worksheet containing pupils' results*

Based on the data in Figure 13 you can find maximum and minimum and calculate the total and average as shown in Figure 14 (a - d) using the formula created previously.



	A	B	C	D	E	F	G	H	I	J	K
1		UHURU PRIMARY SCHOOL									
2		STANDARD SIX PUPILS RESULTS									
3	S/N	NAME	MATHEMATICS	KISWAHILI	ENGLISH	SCIENCE AND TECHNOLOGY	LIFE SKILLS	SOCIAL STUDY	CIVICS AND MORAL EDUCATION	TOTAL	AVERAGE
4	1	Asha Juma	60	80	70	65	88	75	90	=SUM(C4:I4)	
5	2	Beatrice Kajore	75	70	65	80	80	65	75		
6	3	Juma Kalinga	70	60	80	75	80	90	85		
7	4	Kode Kivengele	55	83	64	90	70	75	65		
8	5	Leonidas Mkopi	52	63	85	95	75	60	55		
9	6	Maajabu Mussa	95	90	85	70	75	80	90		
10	7	Sara Kindoko	75	60	68	76	82	90	98		
11	8	Wesino Pangamti	88	70	65	60	55	80	90		
12	9	Yusufu Kivumbi	65	70	75	80	85	95	90		
13	10	Zainabu Kitwange	80	77	66	55	60	70	80		
14		MAXIMUM									
15		MINIMUM									

Figure 14 (a): *Calculating total*

In order to make a calculation using the formula, select the cell that will hold the answer and click AutoSum icon '∑' in the editing group. Choose the sum from the pop up menu and select the range of data to be manipulated. Press 'Enter key' then apply autofill up to the last pupil. The formula reads =SUM(C4:I4) meaning the sum from cell C4 to cell I4. In extended form is = C4 + D4 + E4 + F4 + G4 + H4 + I4. In short, C4:I4 is called a range between C4 to I4. So, to find the average of those numbers its formula will read =AVERAGE(C4:I4). (See Figure 14 (b)).

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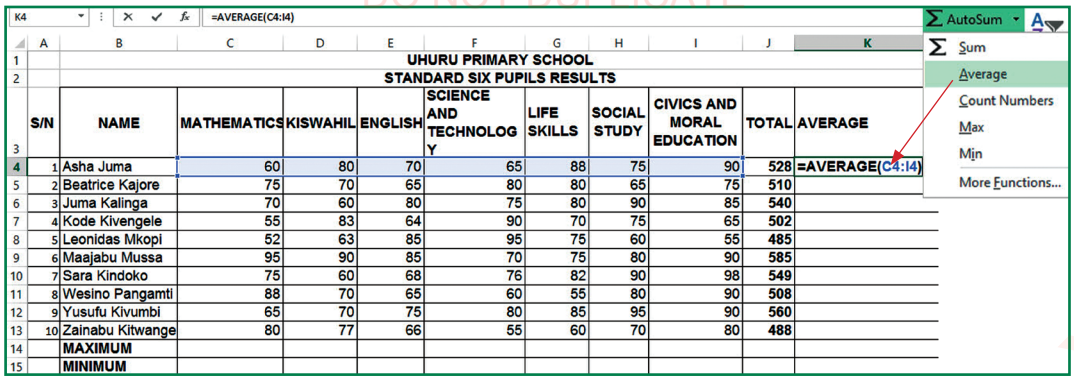
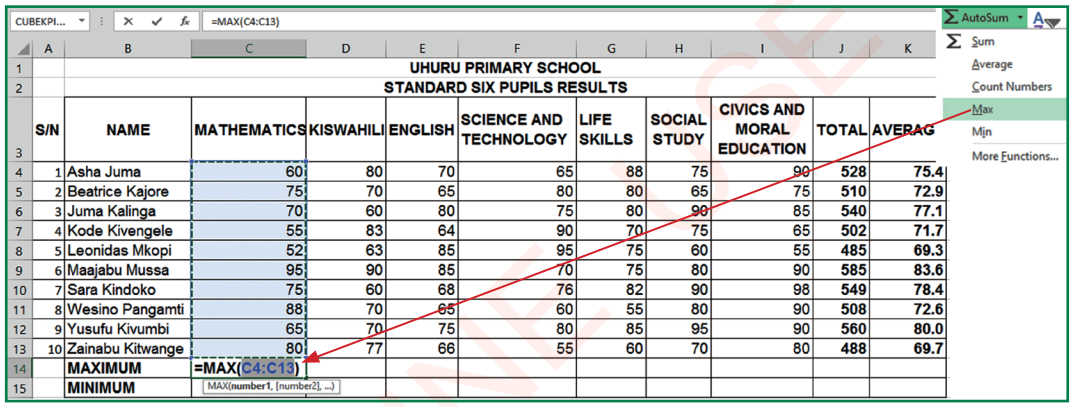


	A	B	C	D	E	F	G	H	I	J	K
1		UHURU PRIMARY SCHOOL									
2		STANDARD SIX PUPILS RESULTS									
3	S/N	NAME	MATHEMATICS	KISWAHILI	ENGLISH	SCIENCE AND TECHNOLOGY	LIFE SKILLS	SOCIAL STUDY	CIVICS AND MORAL EDUCATION	TOTAL	AVERAGE
4	1	Asha Juma	60	80	70	65	88	75	90	528	=AVERAGE(C4:I4)
5	2	Beatrice Kajore	75	70	65	80	80	65	75	510	
6	3	Juma Kalinga	70	60	80	75	80	90	85	540	
7	4	Kode Kivengele	55	83	64	90	70	75	65	502	
8	5	Leonidas Mkopi	52	63	85	95	75	60	55	485	
9	6	Maajabu Mussa	95	90	85	70	75	80	90	585	
10	7	Sara Kindoko	75	60	68	76	82	90	98	549	
11	8	Wesino Pangamti	88	70	65	60	55	80	90	508	
12	9	Yusufu Kivumbi	65	70	75	80	85	95	90	560	
13	10	Zainabu Kitwange	80	77	66	55	60	70	80	488	
14		MAXIMUM									
15		MINIMUM									

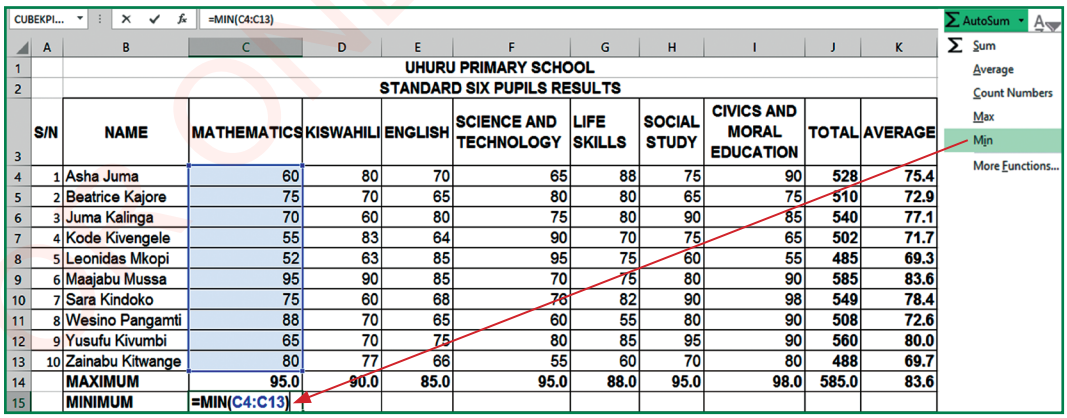
Figure14 (b): *Calculating average*

Follow the same steps in finding the maximum and minimum as shown in Figure 14 (c) to 14 (d).



	A	B	C	D	E	F	G	H	I	J	K
1		UHURU PRIMARY SCHOOL									
2		STANDARD SIX PUPILS RESULTS									
3	S/N	NAME	MATHEMATICS	KISWAHILI	ENGLISH	SCIENCE AND TECHNOLOGY	LIFE SKILLS	SOCIAL STUDY	CIVICS AND MORAL EDUCATION	TOTAL	AVERAG
4	1	Asha Juma	60	80	70	65	88	75	90	528	75.4
5	2	Beatrice Kajore	75	70	65	80	80	65	75	510	72.9
6	3	Juma Kalinga	70	60	80	75	80	90	85	540	77.1
7	4	Kode Kivengele	55	83	64	90	70	75	65	502	71.7
8	5	Leonidas Mkopi	52	63	85	95	75	60	55	485	69.3
9	6	Maajabu Mussa	95	90	85	70	75	80	90	585	83.6
10	7	Sara Kindoko	75	60	68	76	82	90	98	549	78.4
11	8	Wesino Pangamti	88	70	65	60	55	80	90	508	72.6
12	9	Yusufu Kivumbi	65	70	75	80	85	95	90	560	80.0
13	10	Zainabu Kitwange	80	77	66	55	60	70	80	488	69.7
14		MAXIMUM	=MAX(C4:C13)								
15		MINIMUM									

Figure 14 (c): *Calculating the maximum*



	A	B	C	D	E	F	G	H	I	J	K
1		UHURU PRIMARY SCHOOL									
2		STANDARD SIX PUPILS RESULTS									
3	S/N	NAME	MATHEMATICS	KISWAHILI	ENGLISH	SCIENCE AND TECHNOLOGY	LIFE SKILLS	SOCIAL STUDY	CIVICS AND MORAL EDUCATION	TOTAL	AVERAGE
4	1	Asha Juma	60	80	70	65	88	75	90	528	75.4
5	2	Beatrice Kajore	75	70	65	80	80	65	75	510	72.9
6	3	Juma Kalinga	70	60	80	75	80	90	85	540	77.1
7	4	Kode Kivengele	55	83	64	90	70	75	65	502	71.7
8	5	Leonidas Mkopi	52	63	85	95	75	60	55	485	69.3
9	6	Maajabu Mussa	95	90	85	70	75	80	90	585	83.6
10	7	Sara Kindoko	75	60	68	76	82	90	98	549	78.4
11	8	Wesino Pangamti	88	70	65	60	55	80	90	508	72.6
12	9	Yusufu Kivumbi	65	70	75	80	85	95	90	560	80.0
13	10	Zainabu Kitwange	80	77	66	55	60	70	80	488	69.7
14		MAXIMUM	95.0	90.0	85.0	95.0	88.0	95.0	98.0	585.0	83.6
15		MINIMUM	=MIN(C4:C13)								

Figure 14 (d): *Calculating the minimum*

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After completing the calculation of sum, average, maximum and minimum you can format data as you wish. For example, you can use different colours. The results will appear as in Figure 14 (e).

	A	B	C	D	E	F	G	H	I	J	K
1	UHURU PRIMARY SCHOOL										
2	STANDARD SIX PUPILS RESULTS										
3	S/N	NAME	MATHEMATICS	KISWAHILI	ENGLISH	SCIENCE AND TECHNOLOGY	LIFE SKILLS	SOCIAL STUDY	CIVICS AND MORAL EDUCATION	TOTAL	AVERAGE
4	1	Asha Juma	60	80	70	65	88	75	90	528	75.4
5	2	Beatrice Kajore	75	70	65	80	80	65	75	510	72.9
6	3	Juma Kalinga	70	60	80	75	80	90	85	540	77.1
7	4	Kode Kivengele	55	83	64	90	70	75	65	502	71.7
8	5	Leonidas Mkopi	52	63	85	95	75	60	55	485	69.3
9	6	Maajabu Mussa	95	90	85	70	75	80	90	585	83.6
10	7	Sara Kindoko	75	60	68	76	82	90	98	549	78.4
11	8	Wesino Pangamti	88	70	65	60	55	80	90	508	72.6
12	9	Yusufu Kivumbi	65	70	75	80	85	95	90	560	80.0
13	10	Zainabu Kitwange	80	77	66	55	60	70	80	488	69.7
14		MAXIMUM	95.0	90.0	85.0	95.0	88.0	95.0	98.0	585.0	83.6
15		MINIMUM	52	60	64	55	55	60	55	485	69.3

Figure 14 (e): *Formatted results*

Entering data in a worksheet: Before you enter data into a worksheet, you need to consider the following three aspects:

Purpose of creating the worksheet: The purpose of creating the worksheet helps you to determine the location of the data where the most important information needs to be easily seen. Example date, number and text.

Entering bulk data: The amount of data to be entered in a worksheet will determine how to organise your worksheet.

Printing a worksheet: Preview how to organise the data into the worksheet to make it easy if you have to print the worksheet.

Insert charts: A chart is a way of presenting data using graph so that data can be easily understood. The Excel program contains different chart styles. The most commonly used types of charts are columns, pie, and line charts. When inserting a chart consider the following aspects:

Identifying the idea or message to be presented: This will help you to select the type of data you need from the worksheet.

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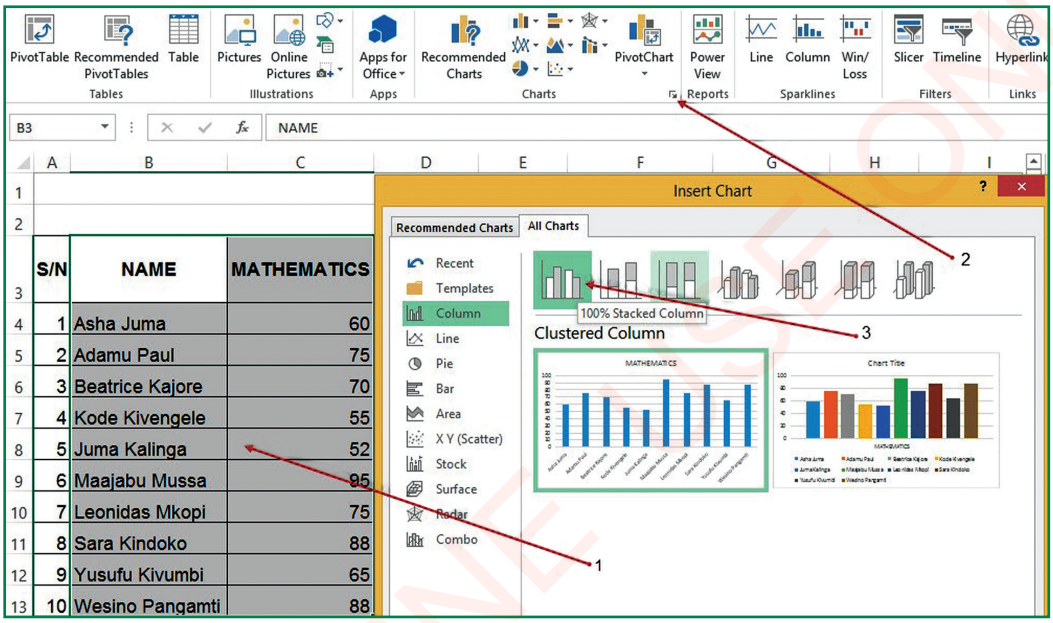
Choosing chart type: The type of chart you choose depends on the type of data and message you want to present. Thus, it is important to know the type of chart to choose.

To insert a column chart, follow the steps shown in Figure 15.

1. Select the data cells you want to use for inserting charts as shown in arrow number 1;
2. Click on the Insert tab;
3. Choose the type of chart you want to use, then click column. See arrow number 2 and 3.



S/N	NAME	MATHEMATICS
1	Asha Juma	60
2	Adamu Paul	75
3	Beatrice Kajore	70
4	Kode Kivengele	55
5	Juma Kalinga	52
6	Maajabu Mussa	95
7	Leonidas Mkopi	75
8	Sara Kindoko	88
9	Yusufu Kivumbi	65
10	Wesino Pangamti	88

Figure 15: *Steps for inserting a chart*

The results of the selected column chart from Figure 15 will be presented as shown in Figure 16.

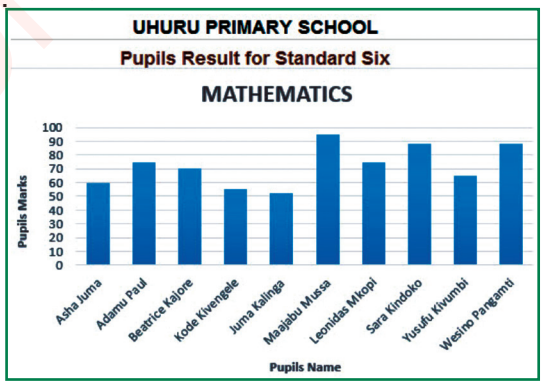


Figure 16: *Mathematical graphical results*

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Exercise 3

Answer the following questions in your exercise book.

1. When you enter data into a cell where else do the same data appear?
2. What does =SUM (A1:A6) mean in a spreadsheet program?
3. Write the formula used to calculate the average of the numbers entered in cells B1 to F1.
4. Find the sum of 144 and 28 using the Excel program and write your answer in cell C4.

Formatting data: The spreadsheet program contains tools that allow you to format data in various ways. Some formatting options include color change, text orientation, font size and font name styles. (See Figure 17).

	A	B	C	D	E	F	G	H	I	J	K
1	UHURU PRIMARY SCHOOL										
2	STANDARD SIX PUPILS RESULTS										
3	S/N	NAME	MATHEMATICS	KISWAHILI	ENGLISH	SCIENCE AND TECHNOLOGY	LIFE SKILLS	SOCIAL STUDY	CIVICS AND MORAL EDUCATION	TOTAL	AVERAGE
4	1	Asha Juma	60	80	70	65	88	75	90	528	75.4
5	2	Adamu Paul	75	70	65	80	80	65	75	510	72.9
6	3	Beatrice Kajore	70	60	80	75	80	90	85	540	77.1
7	4	Kode Kivengele	55	83	64	90	70	75	65	502	71.7
8	5	Juma Kalinga	52	63	85	95	75	60	55	485	69.3
9	6	Maajabu Mussa	95	90	85	70	75	80	90	585	83.6
10	7	Leonidas Mkopi	75	60	68	76	82	90	98	549	78.4
11	8	Sara Kindoko	88	70	65	60	55	80	90	508	72.6
12	9	Yusufu Kivumbi	65	70	75	80	85	95	90	560	80.0
13	10	Wesino Pangamti	88	77	66	55	60	70	80	496	70.9
14		**MAXIMUM**	**95.0**	**90.0**	**85.0**	**95.0**	**88.0**	**95.0**	**98.0**	**585.0**	**83.6**
15		**MINIMUM**	**52**	**60**	**64**	**55**	**55**	**60**	**55**	**485**	**69.3**

Figure 17: *Formatted results*

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Activity 3: *Entering and formatting data into an Excel program*

Prepare the worksheet and enter the pupils' results as shown in Figure 18.

	A	B	C	D	E	F	G	H	I	J
1	UHURU PRIMARY SCHOOL									
2	STANDARD SIX PUPILS RESULTS									
3	NAME	MATHEMATICS	KISWAHILI	ENGLISH	SCIENCE AND TECHNOLOGY	LIFE SKILLS	SOCIAL STUDY	CIVICS AND MORAL EDUCATION	TOTAL	AVERAGE
4	Asha Juma	60	80	70	65	88	75	90		
5	Beatrice Kajore	75	70	65	80	80	65	75		
6	Juma Kalinga	70	60	80	75	80	90	85		
7	Kode Kivengele	55	83	64	90	70	75	65		
8	Leonidas Mkopi	52	63	85	95	75	60	55		
9	Maajabu Mussa	95	90	85	70	75	80	90		
10	Sara Kindoko	75	60	68	76	82	90	98		
11	Wesino Pangamti	88	70	65	60	55	80	90		
12	Yusufu Kivumbi	65	70	75	80	85	95	90		
13	Zainabu Kitwange	80	77	66	55	60	70	80		
14	MAXIMUM									
15	MINIMUM									

Figure 18: *Data entered in a worksheet*

Instructions

1. Change the orientation of text of column header 'NAME' to 90° clockwise, 'subjects name' to 90° anticlockwise. Format the total and average by rotating text up, maximum and minimum to blue colour.
2. Calculate the following:
   (a) Total marks for each pupil.
   (b) Average score per pupil in one decimal place.
   (c) Maximum and minimum pass mark for each subject.

Sorting data

An Excel program allow users to reorganise data and filter them easily. The most common type of data sorting is alphabetical ordering from A - Z or Z - A, arranging numbers in ascending or descending order respectively.

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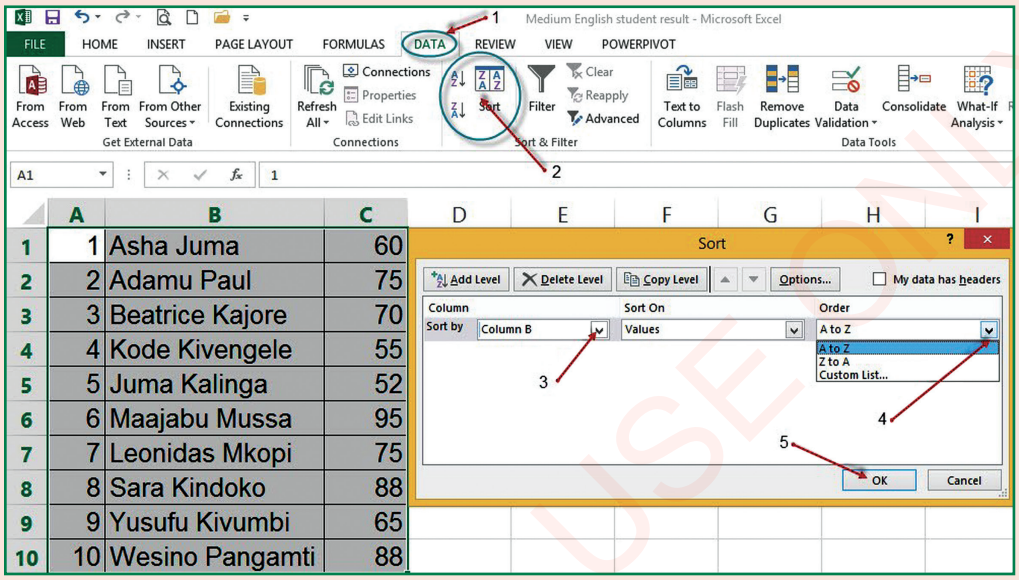
Example

When you want to arrange a list of pupils' names who have done mathematics in alphabetic order from A to Z, you have to use the sort order. The sort menu will list its names and symbols respectively from A - Z. Refeer to Figure 19 (a) to see the key steps.



	A	B	C
1	1	Asha Juma	60
2	2	Adamu Paul	75
3	3	Beatrice Kajore	70
4	4	Kode Kivengele	55
5	5	Juma Kalinga	52
6	6	Maajabu Mussa	95
7	7	Leonidas Mkopi	75
8	8	Sara Kindoko	88
9	9	Yusufu Kivumbi	65
10	10	Wesino Pangamti	88

Figure 19 (a): *Sorting data alphabetically*

Steps

1. Select your data and then click the Data tab (1).
2. Click on the sort command in the sort & filter group (2).
3. Click the drop down arrow in 'sort by' option and select column B which has names (3).
4. Click the drop down arrow in 'Order' and select A to Z (4).
5. Click OK (5).

Names will be arranged in alphabetical order as shown in Figure 19 (b)

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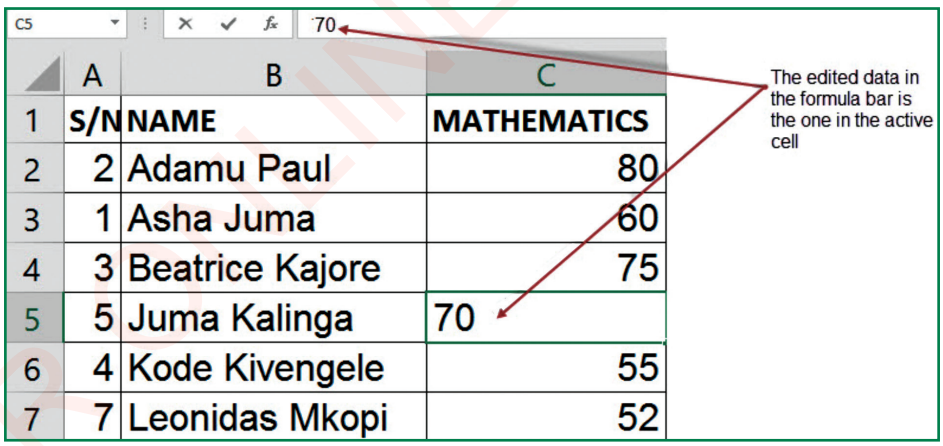
	A	B	C
1	S/N	NAME	MATHEMATICS
2	2	Adamu Paul	80
3	1	Asha Juma	60
4	3	Beatrice Kajore	75
5	5	Juma Kalinga	70
6	4	Kode Kivengele	55
7	7	Leonidas Mkopi	52
8	6	Maajabu Mussa	95
9	8	Sara Kindoko	75
10	10	Wesino Pangamti	88
11	9	Yusufu Kivumbi	65

Figure 19 (b): *Data arranged in alphabetical order*

Data editing

The user of an Excel program may make an error in adding data or want to add new data. Data that has been entered into cells can be changed by double clicking the cell and rewriting or using the formula bar. When you enter data in a cell area, the data you type appears in the formula bar. Figure 20 shows the data in the active cell that is ready to be edited into the formula bar.



	A	B	C
1	S/N	NAME	MATHEMATICS
2	2	Adamu Paul	80
3	1	Asha Juma	60
4	3	Beatrice Kajore	75
5	5	Juma Kalinga	70
6	4	Kode Kivengele	55
7	7	Leonidas Mkopi	52

Figure 20: *Editing data*

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Activity 4: *Formatting, organising and editing data*

Nandonde Primary School prepared a list of furniture and electronic equipment and the cost. In order to find out the actual cost of all items the head of school instructed the storekeeper to prepare a report. What method do you think the storekeeper used? Prepare the worksheet using the Excel program and information provided in Table 2.

Table 2: *List of furniture, electronic equipment and their cost*

S/N	Furniture	Amount (T. shilling)
1	One tables	30,000
2	Two chairs	15,000
3	Six desks	50,000
4	One cabinet	25,000
	Total cost of furniture	
	Electronic Equipment	
1	One television	350,000
2	Computer	800,000
3	Deco'der	90,000
	Total cost of electronic equipment	
	Total	

1. Find the total cost of furniture and electronic equipment. What formula did you use?
2. Format the row that contains total cost by filling in green colour.
3. If the head of school had a saving of two million shillings, show in the worksheet the balance.
4. The word 'Deco'der' is incorrectly typed, edit the word to appear as 'Decoder'.
5. Change the cost of Decoder to T.Shillings 250,000 instead of T.Shillings 90,000. What changes did you note in the grand total and what is the balance?

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Precautions to take when using an Excel program

When using a spreadsheet for any activities related to data use, you should observe the following:

1. Prepare a work plan for your worksheet.
2. Do not skip columns or rows when entering related data into a worksheet.

   Note: Skipping a column or row can result in the disconnection of data thus disrupting the process while analysing or calculating data.
3. Do not use a number as a header title. Since it cannot easily explain the message carried by such data.
4. Analyse your data according to your needs.
5. Make sure you save your file regularly.

Prepare a budget using an Excel program

Some families or institutions such as schools, often find themselves spending money excessively. This makes it difficult for some of these institutions or families to meet necessary requirements. The needs can be balanced by developing a budget that reflects income and spending. The budget provides an overview of income and expenditure. Thus, it is important for institutions, families or individuals to set up a good budget that matches their income. An Excel program is an important application software that helps you to budget easily and efficiently.

Activity 5: *Preparing a budget*

Mtakuja Primary School in Tabora District, received a monthly grant from the central government for school use. The head of school directed the procurement office and school committee to list the school's needs from January to June. The committee chairperson listed the following items: water bill per month 48 units and cost 2,000 shillings per unit; 22, reams of papers per month for price of 11,000 shillings per ream; electricity bill per month 58 units for 2,000 shillings per unit; 9 boxes of chalk for 7,500 each; 25 liters of toilet disinfectant for a price of 1,000 shillings per liter; 35 pcs toilet paper for the price of 1,500 shillings each. The head of the school assigned the school accountant the task to prepare a budget for

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these needs. He also directed him to deduct 4 per cent discount that the supplier promised to reduce from the total amount of goods purchased. The accountant prepared a six-month budget using an Excel program as shown in Figure 21.

	A	B	C	D	E	F	G
2	UHURU PRIMARY SCHOOL						
3	SIX MONTH BUDGET						
4	S/N	REQUIREMENTS	NUMBER OF ITEM	COST	MONTH	TOTAL	
5	1	CHALKS	9	7,500	6	405000	
6	2	REAM PAPER	22	11,000	6	1452000	
7	3	WATER	48	2,000	6	576000	
8	4	ELECTRICITY	58	2,000	6	696000	
9	5	TOILET DISINFECTANT	25	1,000	6	150000	
10	6	TOILET PAPER	35	1,500	6	315000	
11	Total					3594000	
12	Discount					143,760	
13	Gross total					3,450,240	

Figure 21: *Final budget*

Instructions

1. Prepare a budget using an Excel program.
2. Format the worksheet as shown in Figure 21.
3. After handing over the budget, the head of school noted that the following pupils needs were forgotten.
   (a) 6 boxes of pens a month for 5,000 shillings per box.
   (b) 42 erasers per month at a cost of 500 shillings per shot.
   (c) 42 metre rule at a cost of 1,200 shillings per rule.
   (d) 21 attendance registers at a cost of 3,000 shillings each.
   Add these requirements and find the grand total.

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Exercise 4

Answer the following questions in your exercise book.

Section A

Write **TRUE** for correct sentences and **FALSE** for incorrect sentences.

1. There is only one way to open an Excel program. _____
2. The formula in Excel is a type of data that helps to make calculation. _____
3. Creating a formula by cell reference helps to autofill formula to other cells that has the same expression.
4. The built-in formula in an Excel program works automatically. _____
5. The formula entered in the cell does not appear anywhere within the Excel program. _____
6. Any formula in an Excel program starts with the equal sign._____

Section B

Answer the following questions:

7. Name four types of data that can be entered in a worksheet.
8. Why is it important to write titles for data using text and not numbers?
9. How does the formula apply to a spreadsheet?
10. Name the benefits of using charts to present data.
11. What is the difference between doing calculations using numbers and mathematical operators and using a built-in formula?
12. What is the name of the area used to enter data in a worksheet?
13. What is the name of the rectangle formed by the intersection of columns and rows?
14. What is the name of the area in the worksheet program that displays the selected command or process in the worksheet?
15. In a spreadsheet program, columns are represented by letters and rows by numbers. What do they form when they intersect?
16. Write the formula that is used to enter the data in cell rows 6 and columns A to D in order to obtain the sum of the numbers in those cells.

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17. The ICT subject teacher marked the students' activities and their scores as follows:

	A	B	C	D
1	**S/n**	**Name**	**Scores**	**Adjustment scores**
2	1	Issa Kamo	96	
3	2	Hamza Dikio	75	
4	3	Seti Amosi	99	
5	4	Judi Amani	45	

Figure 22: *Pupils scores*

Write down a formula that will help you to fill in the empty cells on 'adjustment scores' after the teacher realizes that she or he had to fill 1/3 of the original scores using an Excel program.

18. Examine Figure 23 and then answer the questions:

E9

	A	B	C
1	982	878	1860
2	576	684	1260
3	513	19	27
4	885	285	600
5	45	28	1260

Figure 23: *Data calculation and results*

If the answers in C1 to C5 have been obtained by using the formula involving the cells of columns A and B, write the formula if:

(a) C1 and C2 have been obtained by addition.

(b) C3 has been obtained by division.

(c) C4 has been obtained by subtraction.

(d) C5 has been obtained by multiplication.

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19. Explain the benefits of using spreadsheet over using paperwork in doing calculations.
20. Distinguish the relationship between word processing and a spreadsheet program.

Vocabulary

Active cell	the selected cell in a spreadsheet
Drop down arrow	an arrow which is clicked to allow you to make a selection from a list. It is indicated by the symbol ▼
Memory card	a type of storage device that is used for storing media and data files. The memory card is used as an external storage device
Name box	a box that is located to the left of the formula bar that displays the selected cell in the spreadsheet program
Predefine function	a predefined formula that performs calculations using specific values in particular order
Template	a predesigned spreadsheet that can be used to create new spreadsheets with the same formatting and predefined formula

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Chapter Ten

Internet

Introduction

In Standard Five, you learnt about communication. In this chapter, you will learn about networks, network devices and types of networks. Likewise, you will learn the meaning of internet, internet security and importance of internet in everyday life. In addition, you will learn how to use e-mail and search engines to search information from the internet. The knowledge and skills acquired will enable you to use the internet for communication and searching for knowledge online. For example, searching for online books and research reports.

The meaning of a computer network

Read carefully the following scenario, then answer the questions that follow.

Kabanga is the youngest child of mzee Masurufu. One day during the holiday, he travelled to Katavi to greet his uncle. He visited his uncle's office. In the office, he saw a computer and an object that resembled a small radio with two horns protruding like snail's antenna. Inside the office there were five people using computers. The computers seemed to have wires connected from one computer to another. Kabanga asked his uncle, "Why are the computers connected to wires?''. The uncle replied, "The computers are connected by wires in order to share various resources like output and storage devices, files or information. This connection is called a computer network. A computer network is made up of two or more computers connected either by wires or without wires''. Kabanga thanked his uncle and said, "I certainly understand what a computer network means''.

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Questions

1. What do you learn from Kabanga's question?
2. Explain the meaning of a computer network?

Computer network devices

A computer network is formed by a variety of technologies that can be in form of software, hardware and wires. These technologies connect computers together by enabling them to communicate over the network. They help to exchange data or information and share resources like printers or scanners. Some of the devices used to make a network connection include a computer, router, network bridge, network switch and wires, as shown in Figure 1. The number of network devices used for connection depends on the type of network or geographical location where that particular network is administered.



Figure 1: *Computer network devices*

Advantages of a computer network

There are many advantages that can be obtained by using a computer network, including the following:

1. It helps to share resources from one computer to another becomes easy. This saves time that could be used to send information from one person to another.
2. It helps to reduce administrative costs. For example, the use of a networked printer helps to share it with other computer users who are in the same network.
3. It helps computers to share software. This reduces the cost of purchasing software for every individual personal computer. For example, buying a computer antivirus program for each computer is expensive.
4. It helps to save data or information in different locations to ensure data security.

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5. It helps to improve communication. For example, the use of e-mail in public and private offices, business industry, education and in other areas which provide social services.
6. It helps to reduces the cost of purchasing paper, printing and information or data transfer.
7. It helps to improves efficiency of individuals and institutions in general.

Types of computer networks

Computer networks are classified in various ways. Geographical area is one of the aspects used to classify computer networks. There are many types of computer networks commonly in use. In this section you will learn about two most popular types of computer networks. These networks are Local Area Network (LAN) and Wide Area Network (WAN).

Local Area Network (LAN): This is a type of network that connects computers which are located in a small geographical area. LAN connection can be done in a single room, office, school building, home or laboratory. Also, LAN can connect its network devices using wires, without using wires or both forms (wired and wireless) at once. An individual person, school, company or institute can own a LAN. The use of this type of network is specifically for people in the same small area where that network operates. For example, a company or organisation employees and college or school communities use LAN connections (See Figure 2).

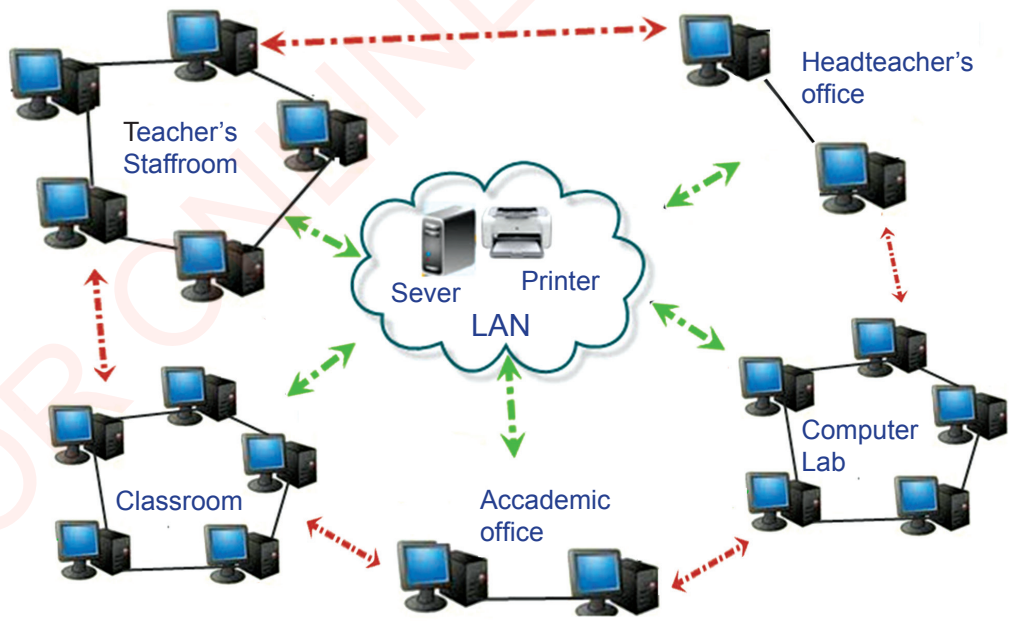

Figure 2: *Local Area Network*

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Advantages of using LAN

1. Easy to run and administer because it is located in one area.
2. LAN devices are abundant in the market and are cheap.
3. Simple to share files and folders.
4. Easy to administer a security policy to protect network users.
5. It provides the opportunity to store publications for shared use, for example using servers to facilitate sharing of database.
6. Network computers can share operating and application software. This helps to save the cost of buying software and installation for every client's computer.
7. Central back-up can take place automatically at regular intervals.

Disadvantages of using LAN

1. It covers only a small geographical area.
2. It is easy for hackers to have unauthorised access to the system programs and threaten the security of user information.
3. When the server crashes or gets technical faults, all users are affected.
4. It is easy for viruses to spread throughout the LAN system and affect all client computers.
5. It needs skilled personnel to install and administer a LAN.

Wide Area Network (WAN): A company or organisation may start with a small branch having few offices. This branch can be installed with a LAN to operate its activities and communication depending on the workplace. Later, the organisation or company may grow and expand its services to other new areas. For example, branches may expand from one town to another, one region to another or outside the country. When new branches are opened, Local Area Networks need to be installed to improve company's services.

These new branches may need to communicate or have connection with their headquarters in order to share information, data and monitor employees' performance. The computer network which is formed when LANs from different branches communicate with each other over the network, is known as Wide Area Network (WAN). Therefore, WAN is a computer network that connects computers over a large geographical area such as country, continent or the world (See Figure 3).

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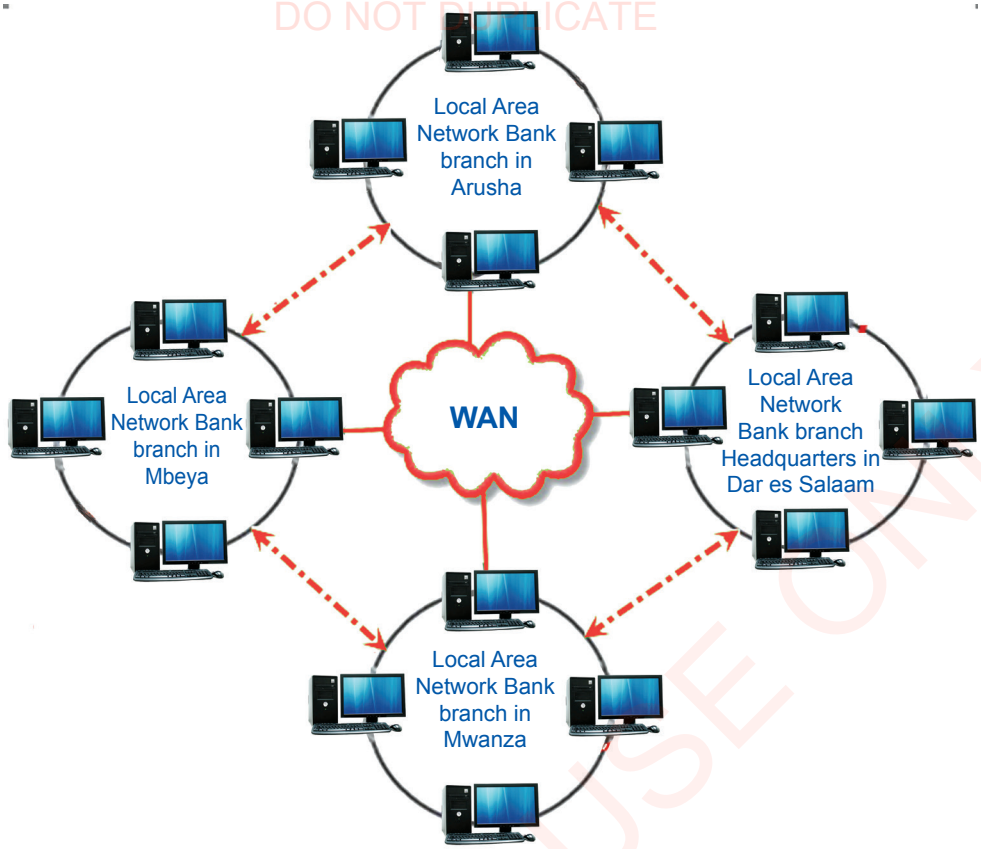

Figure 3: *Wide Area Network*

An example of a Wide Area Network is seen in banking transactions, where the computers at one branch share resources with other computers located in other areas. For example, if you have a bank account in Mwanza, you can receive and access the same service in Dodoma without going back to Mwanza. This is made possible because the bank branches connect their computers with that in the headquarters. Thus, there is no need to go back to the branch where one opened a bank account to access bank services. In this case, your bank account information is accessed through a Wide Area Network.

Some of computer network devices that are used in WAN for communication are satellite, modem and fiber optic cable. In WAN, both wired and wireless technologies can be used to connect computers. Normally, a Wide Area Network is owned by a public entity or organisation of private companies. Therefore, no individual person or company can claim the right to such property. Governments and communication companies can design and determine the structure and how the WANs should operate. The largest Wide Area Network in the world is called the internet.

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Advantages of using WAN

1. Extends its scope of communication throughout a wide geographical area.
2. Allows sharing of application software and other resources from different locations.
3. Provides online access to national and international trade markets.
4. Provides fast and secure communication to all national and international online users.

Disadvantages of using WAN

1. WAN has low security compared to LAN.
2. The cost of setting up a WAN is much higher than a LAN.
3. Running cost of WAN is high.
4. WAN requires a software program for prevention of users' data or information from hackers.

Exercise 1

Answer the following questions in your exercise book.

Section A

Choose the correct answer.

1. When two or more computers are connected for the purpose of communicating, what do they form?
   (a) Modem
   (b) Television
   (c) Network
2. How many major types of computer networks have you learnt with regard to geographical area?
   (a) 1
   (b) 2
   (c) 5
3. One of the following computer network devices does not form a computer network component.
   (a) Router
   (b) Switch
   (c) Battery

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4. Which among the following sentences explains the advantage of a computer network?
   (a) Provides fast and effective communication
   (b) Increases immorality in society
   (c) Copies bad behaviours
5. Which among the following is the long form of LAN?
   (a) Large Area Network
   (b) Long Area Network
   (c) Local Area Network
6. One of the advantages of a Local Area Network is:
   (a) Low cost
   (b) It is used worldwide
   (c) Increase in moral erosion

Section B

Answer the following questions:

7. Explain the meaning of a computer network.
8. Explain the difference between a Local Area Network and a Wide Area Network.
9. Which devices are used in a Local Area Network?
10. (a) Provide the long form of WAN.
    (b) List two advantages of WAN.

Internet

In the past, people used to communicate by means of drums, whistles, horns, trumpets or walking to convey messages. As technologies grew, people started to communicate by using letters, fax, and telegram. Nowadays, interpersonal communication by using letters has become scarce due to growth of digital communication technology. One of the most important developments in digital communication is the internet.

The internet is a broad electronic communication network that connects people, organisations, companies and governments worldwide (See Figure 4). In order to access data and information, computers are required to connect to the communication devices. People use interconnected networks known as internet to navigate to different websites, send e-mail, and conduct business and various research activities.Therefore, the internet is a

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collection of small networks that are linked together to communicate using special protocol. The internet has no ownership or central authority in its operations, technologically. It has no policy in its availability and usability. Internet security depends much on the security of LANs where regulations for communication are kept.

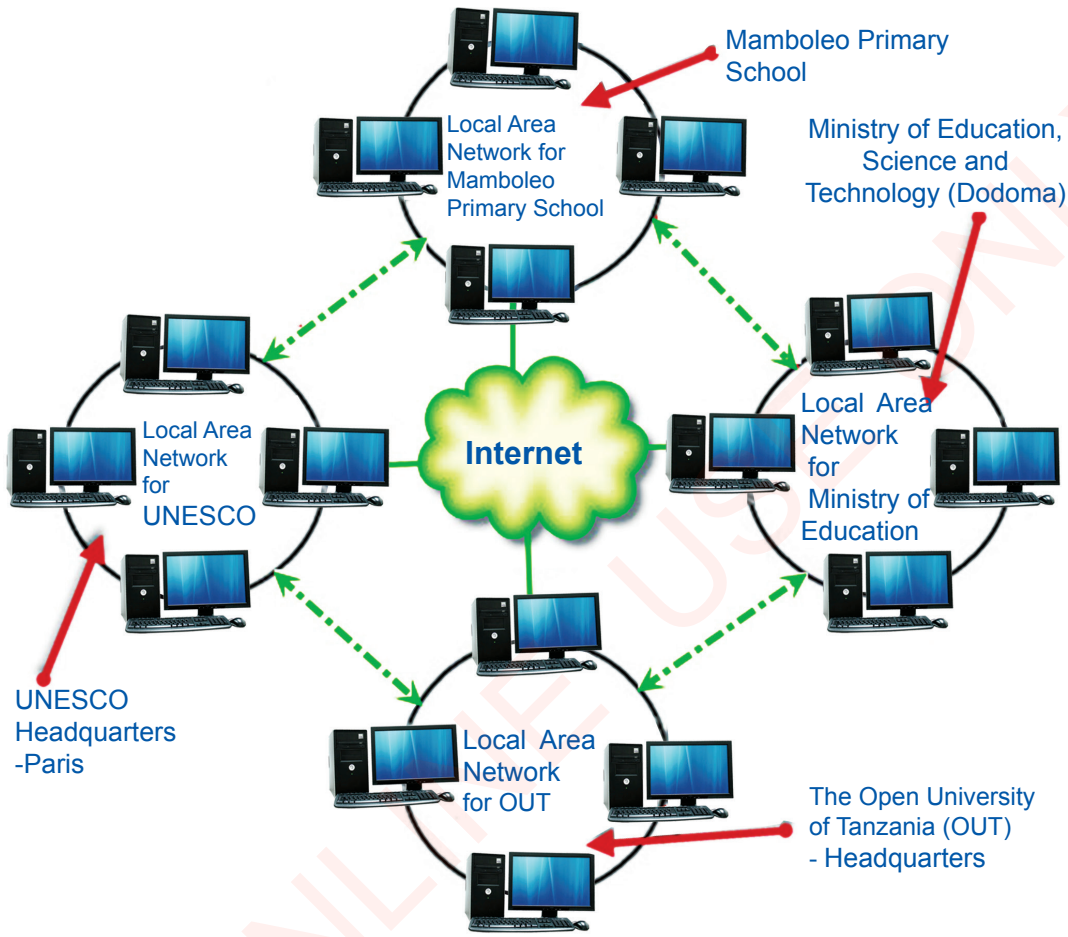

Figure 4: *The layout of internet communication*

Accessing information from the internet

The information on the internet can be accessed through a website. A website is a collection of webpages written using different computer languages. These pages give various information obtained from the internet. To access the internet, a web browser must be installed on a computer. A web browser is a software application that can navigate, retrieve and collect information from any network. In the internet communication system, every website has

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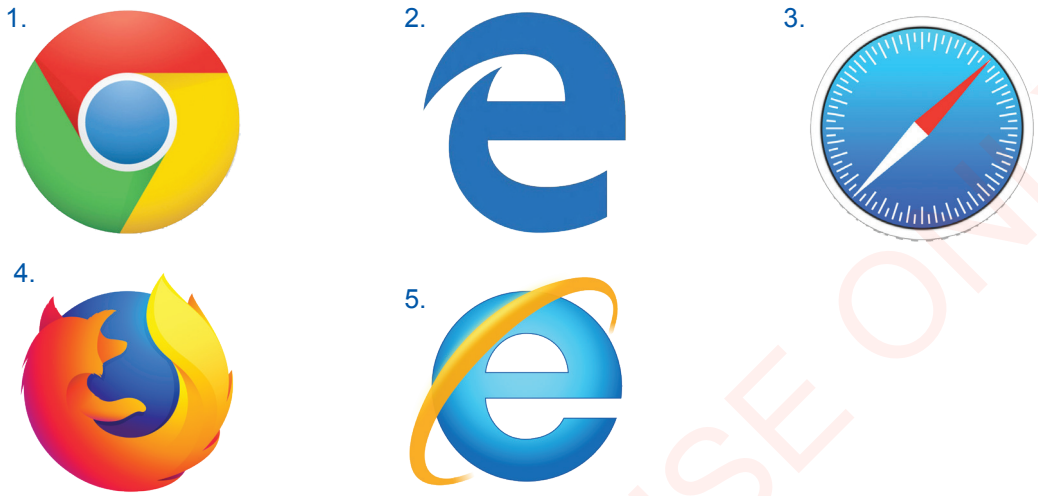
a unique address that is recognised by the web browser. A web address starts with three letters 'www'; for example, when searching information from the website of the Ministry of Education, the address 'www.moe.go.tz' will be typed in the address bar of a web browser. Some of the commonly used web browsers are Mozilla Firefox, Microsoft Edge, Safari, Google chrome and internet explorer. (See Figure 5).



Key: 1 = Google chrome, 2 = Microsoft Edge, 3 = Safari, 4 = Mozilla Firefox, 5 = Internet Explorer

Figure 5: *Web browsers*

Uses of the internet

The internet has globally brought a huge revolution in the fields of education, communication, business, health and entertainment.

Education: The internet is widely used for research, searching educational materials such as videos and pictures, sending and receiving academic publications. Various communications take place via e-mail, online phone calls and social networks such as Facebook, WhatsApp, Instagram and Twitter.

Business: The internet has become a vital link in business. People who do business use the internet to advertise their businesses. By doing so, it has become possible to sell and receive goods between sellers and customers for example, purchasing vehicle, selling tickets and providing various services like insurance. Financial services such as T-PESA, M-PESA, AIRTEL MONEY, TIGO-PESA and banking agencies have been motivated by the existence of the internet. Customer service from financial institutions

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is offered through the internet by some companies and business centres, for example online payment systems.

Health: Through the internet, medical practitioners can acquire or share medical information like diseases and medication from other experts.

Entertainment: The internet has changed ways people access entertainment. A variety of songs can be downloaded from the internet using data enabled mobile phones or personal computers. Watching movies, playing games and making tours can be possible via the internet.

Exercise 2

Answer the following questions in your exercise book.

1. Explain the meaning of the internet.
2. How is the internet useful in everyday life?
3. What is the difference between a website and a webpage?
4. What is a web browser?
5. List four (4) web browsers which you learnt.

Internet security

One of the things which needs to be taken into consideration when using the internet is internet security. Internet security comprises of policy, regulations and strategic plans to protect against attacks over the internet. When using the internet, you are supposed to observe limitations of use and permissions. Internet security helps to secure and manage internet activities. Users of the internet need to understand the correct use of the internet. To secure resources in the internet, you are advised to use a unique address and password. Insecured internet can harm an individual user, an organisation or a company.

The following are some of the internet security threats:

1. Computer virus, worms and Trojan horse
2. Internet hackers
3. Denial of service (i.e. this is a malicious traffic overload in the internet)
4. Data theft
5. Identity theft

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Network security infrastructure offers several levels of protection to prevent attacks, for example a firewall. Internet security helps to protect information or data from hackers, and from being damaged by viruses or computer worms.

Importance of internet security

The following are the reasons why internet security is important:

1. It helps to reduce the risk of data being compromised, lost, stolen or damaged. For example, it is risky to connect a computer to a network that does not have antivirus protection. A computer can receive viruses that can delete, copy or duplicate data.
2. If you do not have a strong password or you ignore to logoff your account, hackers can compromise it. Hackers can steal your data and use it for their own benefits. For example, if a hacker finds your bank account password, it is easy to use it to steal your money.

Internet precautions

The following are precautions to take in order to be safe when using the internet everyday:

1. Do not use the same password in different activities. Separate the passwords that you use at your workplace or financial transactions with those used in social networks.
2. Do not release your information if you are not sure of the receiver.
3. Avoid opening links, webpages or advertisements which you do not recognise, when using the internet.
4. Do not open any e-mail if you are not sure of the sender.
5. Make sure that your computer has an up-to-date antivirus.
6. Frequently, update your antivirus program to protect your computer against viruses.
7. Use a password that has no relationship with your personal information like date of birth.

Considerations for using internet

Your life depends on your various personal, professional, academic or business information. This information identifies who you are, where you live

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and what you do. Also, it describes your ability, your likes or your relationship to the world. In using the internet, often the system wants you to sign up. Registration will require you to provide your important information so that you get a password. Passwords will allow you to sign in and out of some internet services that require passwords. In order to be safe when using the internet, you are supposed to adhere to certain rules.

Keep personal information to a minimum: Do not provide your personal information beyond the requirements of the internet service. For example, if your online subscription is for job purposes you do not need to write personal information that is not relevant to your job.

Remember and keep your passwords safe: A password is like a key to open a strong room to secure money in the bank. The security personnel cannot leave the key unattended because he or she will lose money. So, you must keep your password confidential. Also, remember your password every time you want to access the internet. Hackers often try to predict passwords, so you are advised to have passwords that cannot be predicted easily. Strong passwords that cannot be easily guessed are created by combining numbers with uppercase and lowercase letters. It is not advised to use your name or date of birth as a password because it is easy to guess.

Be careful when searching for information: Make sure you do not open any unfamiliar application. This is because some applications may steal and transfer your personal information. Also, they can compromise your password and infect your computer with a virus. So, ignore any message that requires you to open an unfamiliar application.

Sign out after using your account: It is risky if your important data is misused. If criminals manage to hack your internet account, they may commit crimes using your identity. Therefore, when you have finished surfing the internet, make sure that you logout of your account and close the application.

Be careful with people you communicate with on the internet: In the internet, there are people of different behaviours. Some users are good and some are criminals, therefore when you doubt the communication you are doing with someone, block the communication. You can also report this to your teacher, parent, guardian or security agencies like police to seek help.

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Do not trust online friends too much, some of them hide even their age, character and attitudes to mislead others.

Be careful with what you download: Make sure you do not browse web pages or websites with contact which go against the culture of Tanzania. You can find that the information you are surfing is not morally acceptable. For example, if it cannot be shared in public, with parents or your teachers, stop downloading it. Also, avoid opening all links which have immoral content.

Be careful with what you publish: What you upload online reflects your real life and moral behaviour. Make sure you upload logical and moral contents which are not against Tanzanian customs and traditions onto the internet. Do not be part of crimes about which your mother, father and relatives will be embarrassed when they see them in public.

Install virus protection software for internet security: Although the internet security software may not protect you against every threat, it often detects and gives you an overview of the risks that are possible. So, make sure you install an internet security software which is up-to-date.

Exercise 3

Answer the following questions in your exercise book.

1. What is the meaning of 'password'?
2. At what time should the 'password' be used?
3. Create a password that comprises three numerals and five letters.
4. What will happen if a criminal compromises your internet account?
5. Which things should you avoid when using the internet in order to secure your data or information?

Effects of internet abuse

Internet use may have negative effects if the user is not careful. These effects affect society in areas of behaviour, attitudes, traditions and customs. Such effects can be divided into two main parts. The first part is internet abuse on children behaviour and attitudes and the second part is internet abuse and its impact to the society.

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Effects of internet abuse on children behaviour and attitudes

A child's behaviour and attitudes can be affected if he or she misuses the internet resources. If you interact with inappropriate information, the following are some side effects that you might experience.

Inappropriate content: The main use of the internet is to find and share information. But not everything published on the internet is good, some contents are wrong including false information. Immoral songs and movies are also posted online. If a child is free to use the internet without proper guidance, he or she finds himself or herself reading or acquiring information that does not conform to Tanzanian values. That kind of information destroys the child's cognitive and psychological development.

Internet addiction: There are beliefs that life cannot continue without the use of the internet. However, excessive use of the internet results in dependency or addiction. Addiction is a state of being affected psychologically so that one cannot stop doing a certain activity. This can affect a child physically, academically, morally and even in relationships. You can identify a child who is internet addicted by observing the way they form arguments among peers or parents. One visible sign is when they spend more time on the computer than on other developmental activities or exercises. Other visible signs include overweight, inability to self-explain, poor interaction with peer groups, low vision and physical pains.

Communicating with evil people: The internet has made the world a global village where people of various character can easily communicate. It is easy to find online friends when surfing the internet. Some may be familiar to you but others may not, and might be criminals. Criminals can mislead and teach you bad behaviour. For example, through the internet many children have been kidnapped and used as a bait in money laundering. Some have been engaged in the illegal sexual business at an early age, drug abuse and have even been lured to join terrorist groups.

Internet abuse and its impact to the society

Internet uses have been of great benefit in various fields of development. For example, uses for searching academic publications and for communication are among the benefits. However, the society is facing challenges and it is fighting to abolish internet abuse committed through this technology. The following are some challenges facing the society.

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Online theft: One of the challenges of using the internet is hacking of data. Hacking data is accessing the web or other people's database and using them without their consent. This data can be used to commit crime such as forgery, and to endanger the interests of others. For example, hacking of bank passwords gives the hacker the ability to make transactions and steal money.

Crime: Most of the crime incidents that occur are coordinated through the internet. For example, terrorists use social networks to encourage people to join, plan or carry out attacks. Drug dealers and other businesses use the internet to coordinate their illegal businesses.

Destruction of customs and traditions: Advancement in internet use has affected customs and traditions. Improper dressing, hair styles, drug abuse and watching pornography have emerged. This moral decay has resulted to separation of families, children misbehaving and adults practicing immoral behaviours not expected of their position in the society and family.

Wastage of time: If you are not careful with the use of the internet you may be a victim of wasting time or addiction. This leads to low performance, social isolation and affected health, for example, experiencing back pain, poor eyesight and obesity. Sometimes the use of the internet has affected the performance of people in the office because:

(i) A person addicted to the internet finds himself or herself spending too much time browsing the internet.

(ii) A person addicted to the internet will lose focus and efficiency towards official or development work. This will result into low quality work.

Academic fraud: One of the most common effects in education is academic fraud. People search for academic writings from the internet and publish them by pretending to be authors. This is a crime and abuse of the internet.

Spreading of computer viruses: The internet transmits computer viruses from one computer to another easily and this affects performance. The infected computer can cause loss of time, data and information. Criminals intentionally create and spread viruses online with the purpose of doing antivirus business or common internet crimes.

Destruction of peace and national security: People from inside and outside the country can use the internet to disturb peace and national security. Such

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people can seek information that can be used to spoil the nation and its citizens. Internet abuse can endanger the security and peace of the country. This is when important information on national security reaches people who do not have goodwill towards our country.

You should analyse, evaluate and weigh information you provide online before you send or publish it. If peace and national security are compromised this may lead to a decrease of productivity and work efficiency. This is due to violence and war that may cause the country's economy to collapse. War and violence can cause students to miss school. In addition, some families can lose their loved ones because of deaths. Concern for the security of our nation will help the country to be free from disasters, therefore, you should be a patriot for your country.

Ways to avoid internet abuse

The society needs to learn the best ways to avoid internet abuse and its consequences. In order to be a good user of the internet you have to adhere to the following:

1. Be focused on what you intend to do with the internet while avoiding staying too long surfing the internet for no apparent reason.
2. Get expert advice from teachers on how to search for information.
3. Have the tendency to learn and regularly discuss with your colleagues proper use of the internet.

Exercise 4

Answer the following questions in your exercise book.

1. Explain three uses of the internet.
2. What are the effects of using the internet for a long time?
3. List three precautions to be taken in order to protect yourself from the effects of internet use.
4. What risks should you avoid in order to protect yourself from the effects of internet use?

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E-mail

Interpersonal and office communication using paper has dramatically decreased; instead e-mail is currently used. E-mail is an electronic mail which may contain text or other attachments sent from one computer to another via the internet. Electronic messages could be sent from one person to another or to a group of people.

Advantages of using e-mail

There are many advantages of using e-mail. The following are some of the advantages:

Borderless international communication: E-mail is used to send electronic messages to distances which normal text mail would not manage to reach on time.

Low cost: The e-mail service costs very little for a person who wants to use the internet. You can use the same amount paid for e-mail service to surf for other information in the internet without additional charge.

Sharing of information: E-mail simplifies the task of sending bulk messages with same content to many people at the same time. Therefore, e-mail saves time and resources in preparing the same document to many people.

Easy referencing: The e-mail and attachments sent over the internet stay long in the internet for future reference. It is easy to retrieve them when you need them because they are stored safely by email service providers.

Easy to send: It is easy to write and send an e-mail compared to normal text mail. This is because some receivers are already in the database, so it is easy to recall their contacts.

Saves transmission time: E-mail uses a very short time to reach recipients anywhere worldwide compared to traditional paper communication.

Effects of e-mail use

Although e-mail has a lot of benefits, there are also some negative effects in its use. The following are some of the negative effects of e-mail use:

1. Message overload; some messages come without your consent.
2. If not careful, it is easy to send e-mail information to untargeted persons.

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3. It is easy for an e-mail attachment to transfer viruses from one computer to another.
4. Spam e-mail from hackers can get in without your consent.

Exercise 5

Answer the following questions in your exercise book.

1. Explain the meaning of e-mail.
2. Mention three advantages of using e-mail.
3. What are the negative effects that can face e-mail users?

Using e-mail

E-mail contains both sender and recipient's addresses. Also, e-mail has a special mechanism which can identify the sender and receiver of a message. In order to use e-mail, you are supposed to create an e-mail account in your institute or with any e-mail service provider.

Creating an e-mail account

There are various ways of creating an e-mail account. This depends on the type of web site you are using. Some web service provider companies like Google, Yahoo and Hotmail provide free service to create an e-mail account. Some e-mails are created for official use at work stations, but some are not official. For example, e-mail addresses like director.general@tie.go.tz and hawa.ali@out.ac.tz are official e-mail addresses for named institutions. In this section, you will learn how to create an account using Gmail free e-mail service.

Steps to create an e-mail account

You can create an e-mail account using Gmail through the following steps:

Step 1

Enter the website address 'www.gmail.com' in the web address bar and then press 'Enter' button on the keyboard. From Google 'Sign in' popup, click create account (See Figure 6).

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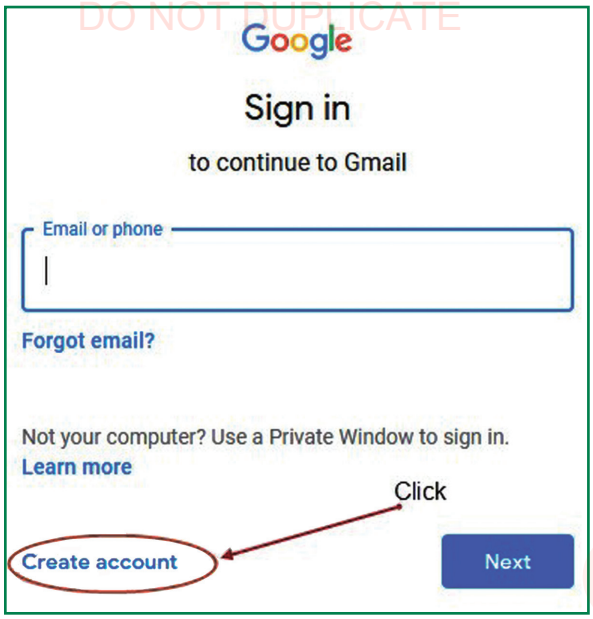

Figure 6: *Create and Sign in Gmail account*

Step 2

After clicking 'Create account', fill in all the required information such as first name, last name and the password you intend to use in the form that appears and then click 'Next' button (See Figure 7).

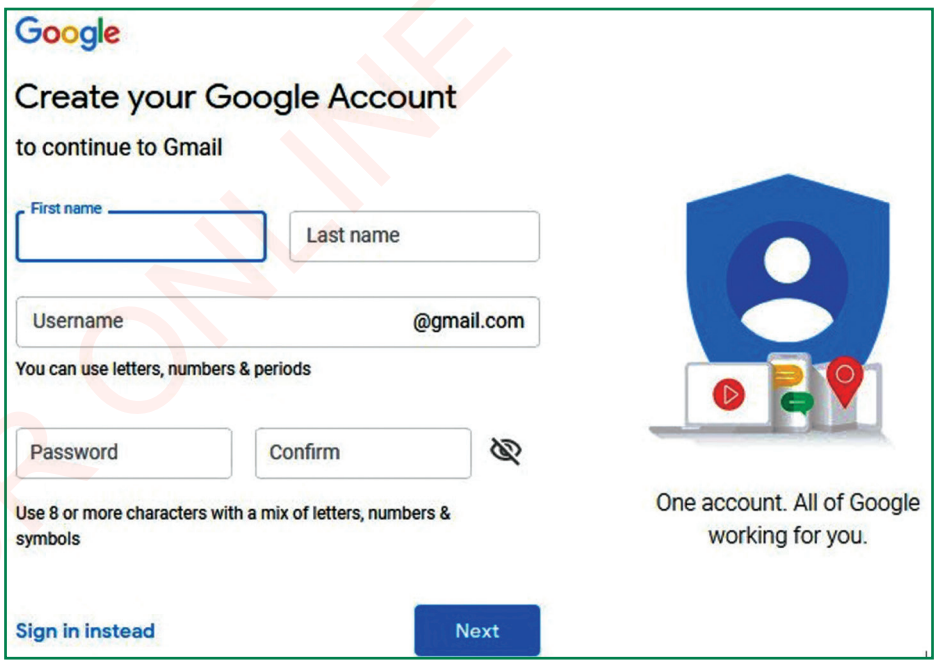

Figure 7: *Personal information form for creating a new account*

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Step 3

This step welcomes you for self-introduction because of the e-mail address you created. See Figure 8 (a), arrow number 1. Then click next you will have to fill in the phone number as shown in Figure 8 (b), arrow number 2. It is an option to complete a recovery email address in case you forget your login password.

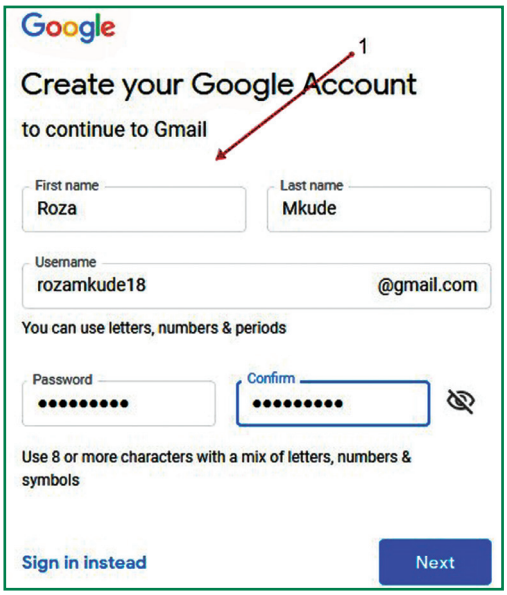

Figure 8 (a): *Gmail verification form for personal information*

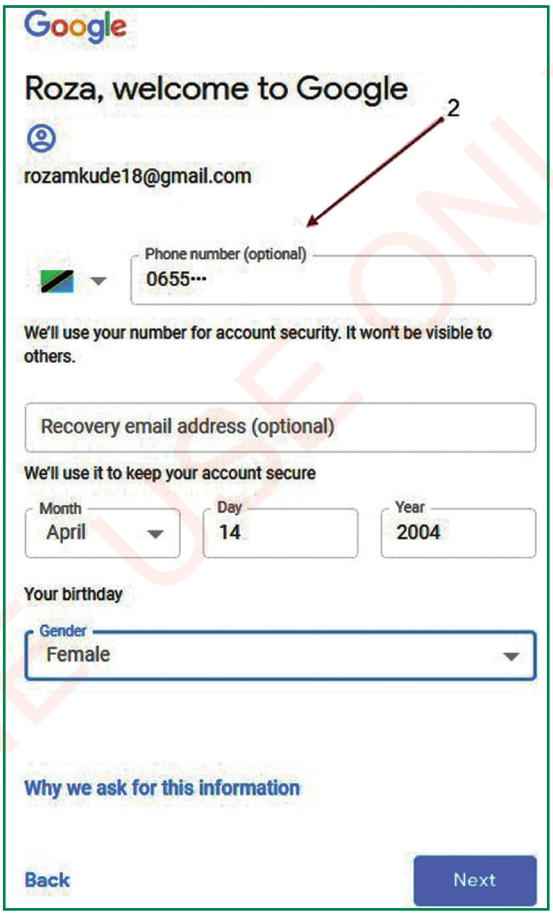

Figure 8 (b): *Gmail verification form for account recovery*

Step 4

Verify your phone number. In order to confirm your account, you will receive a text message that requires you to fill in the verification code box as sent in your phone. An example of a verification code is G- 920830. (See Figure 9).

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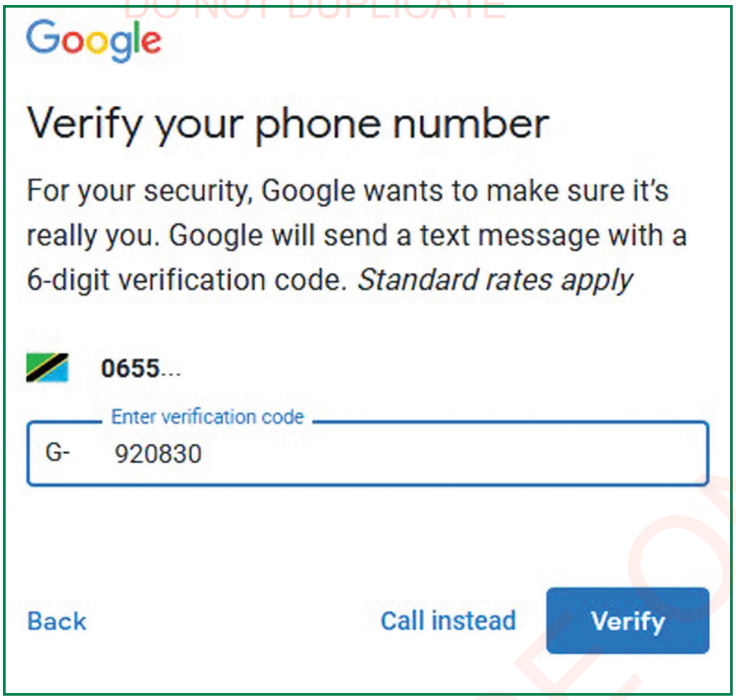

Figure 9: *Phone number verification form*

Step 5

This step will take you to the window of your registered e-mail account, ready for use. Look at the e-mail account view in Figure 10.

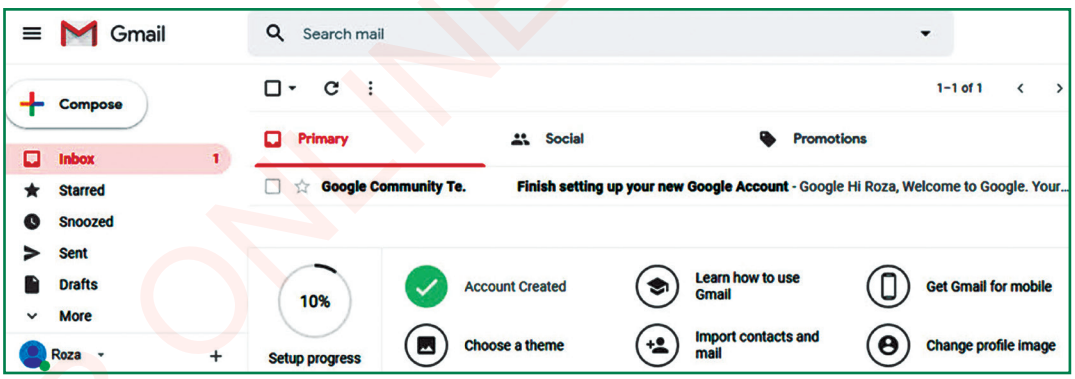

Figure 10: *View of new registered Gmail account*

Step 6

You can read the message sent by an e-mail provider. To read the message, click Inbox as shown in Figure 11, arrow 1. Then, click the bolded heading message as shown in arrow 2 and it will open a message for reading.

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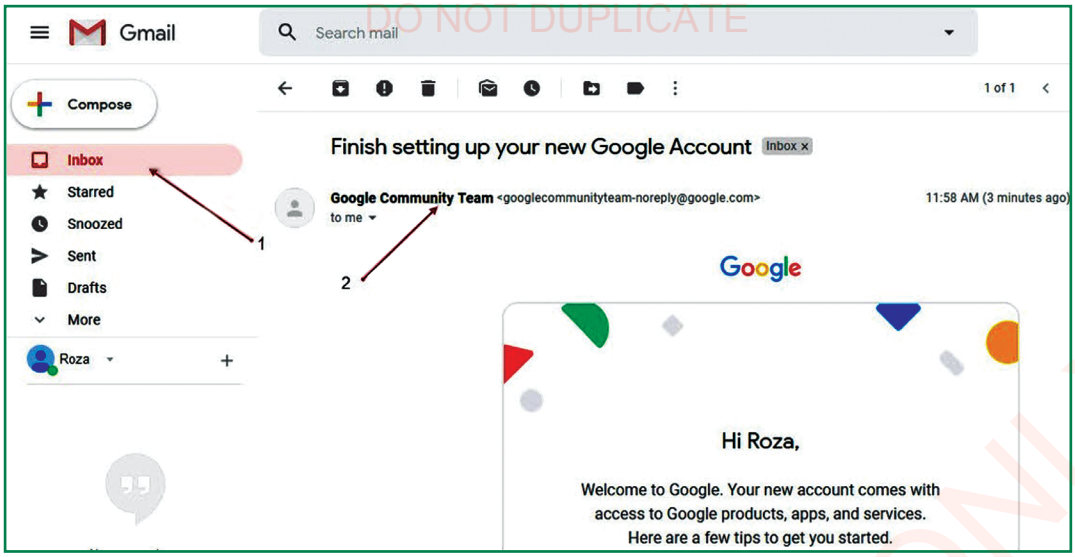

Figure 11: *New Inbox message*

Using e-mail for communication

The e-mail address that will be used at this stage of email use is the one you originally created through your Gmail account.

Steps to Login Gmail account

It is good to know how to get into the Gmail website address 'www.gmail.com'. Then, from the 'Sign in' dialogue box fill in the e-mail address you previously created. When you have filled out the email address, click the 'Next' button, see Figure 12 (a) and 12 (b).



Figure 12 (a): *Typing e-mail address to Sign in Gmail account*

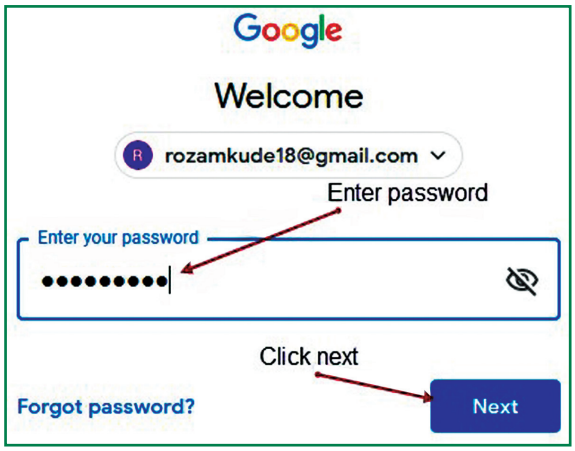

Figure 12 (b): *Entering password to Sign in Gmail account*

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Features of Gmail account

When using a Gmail account, you should know how to use various features of email (See Figure 12 (c)).

Compose: This feature is used when you want to write a new message to someone else. When you click 'Compose', a new message window pops up (See Figure 12 (c)).

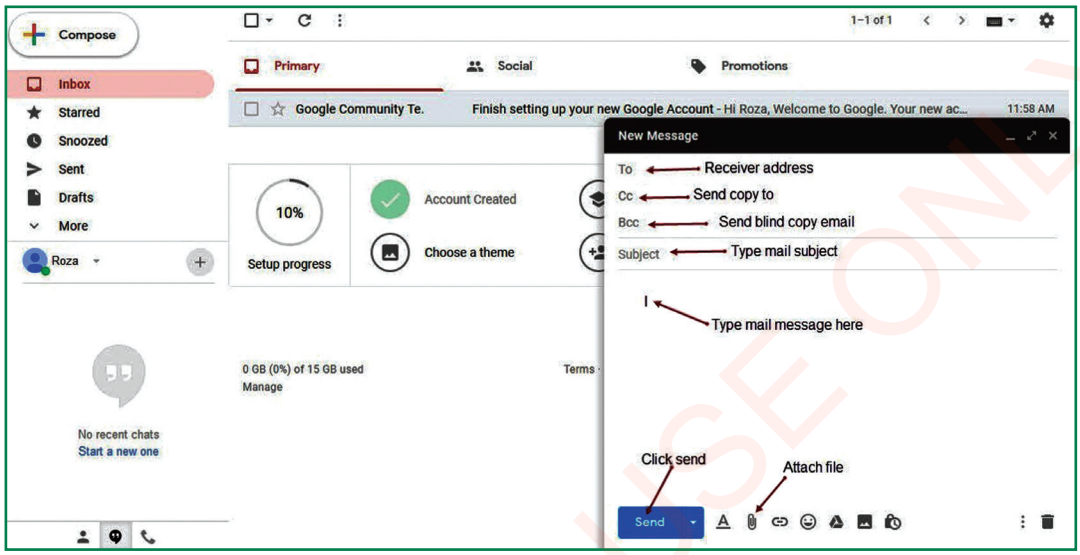

Figure 12 (c): *Features of a Gmail account*

Write the receiver's address and subject of your message in areas shown in the pop-up window. Type in the e-mail message before you click 'send' to send the e-mail. In case you have a file to send with e-mail, click 'Attach file' and follow the usual procedure to add a file from a storage device before you send the e-mail message.

Inbox: This feature shows the incoming message (See Figure 13).

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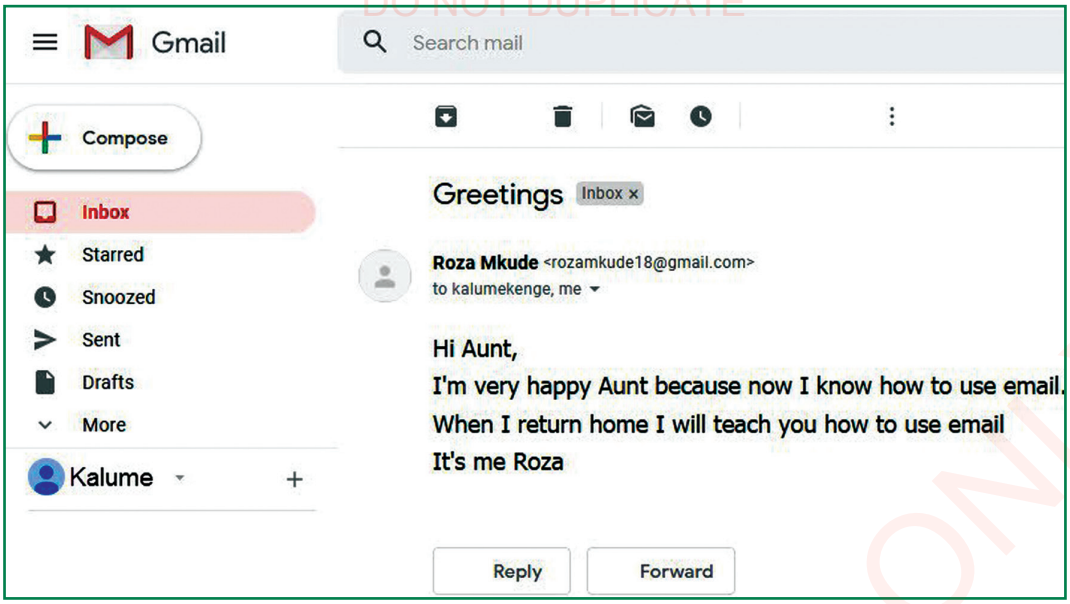

Figure 13: *Reading Inbox messages*

Sent: This feature stores the e-mail or message you sent.

Draft: This feature holds any incomplete and unsent messages.

All mail: This feature displays all sent and received e-mail.

Spam: This feature receives e-mail from informal senders or lost e-mails that failed to reach the inbox. Sometimes it stores controversial e-mail that the browser has deemed as coming from hackers.

Address: It is a menu where all e-mail addresses you have ever used or sent are stored.

Sign out: This feature lets you log out from your open e-mail and securely close your documents. Without clicking 'Sign Out' someone else may come to view all your information and steal data.

Things to consider when using e-mail

1. Write the recipient's e-mail correctly.
2. Write the header message.
3. Sign out your account after use.
4. Do not allow the browser to remember your password.

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Activity 1: *Using e-mail account*

Requirements: a computer with internet connection, a teacher's e-mail and other recipients' accounts

Steps

1. Use a word processor program to write a letter on behalf of the head of school about your appointment to do scientific research. Save your letter on the desktop.
2. Open the e-mail you have created and compose a message to be sent to the teacher's email.
3. Attach the saved principal's letter on the desktop to your e-mail.
4. Add recipients in the copy to (cc) and blind carbon copy (bcc) so that they are informed of what you have sent to your teacher.
5. Send the email and thereafter sign out from your e-mail.

Exercise 6

Answer the following questions in your exercise book.

1. Name five benefits of using e-mail.
2. How can you send the same e-mail to two people without one of them knowing you sent it to the other?
3. Why should you sign out from your e-mail account every time you finish using it?
4. Do you think it is important to include your phone number in the e-mail registration form?

Search engine

The internet enables you to use a search engine to search for information quickly, worldwide. All the information you need will be accessed anywhere and at any time through a browser installed on a computer, smartphone or tablet.

Meaning of search engine

A search engine enables you to search information by writing a question or phrase in the search box. The search results will contain the best list of sites that match the information you are looking for. Among those sites,

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you will select the site that contains the phrase or question you are looking for. Therefore, a search engine is a specialised software that searches and identifies information available online. It is mainly used to find websites related to the search by comparing search key words and database information on the web. The largest and most popular and well-known search engine is Google 'www.google.com'.

Types of search engines

There are many types of search engines on the internet. These search engines can be divided into three main categories.

Crawler search engines: These search engines use specialised software to search information from millions of websites. These programs work by following one site after another, to take information and return it to the search engine. When applications track information on a site and send it back to the engine, a spider-web-based network is created, which is called a web spider. Search engines that use this model to find information include Google, Bing and Yandez.

Human powered directories: These are search engines that are man-made rather than web spiders. Website owners represent their websites in a directory and editors who are human determine the value of site information and whether they should be included in the directory. The information from the directory is even better because it has been edited. Examples of search engines that use this style for reporting are DMOZ, dir.google.com and dir.yahoo.com.

Hybrid search engines: These engines work by listing websites or information obtained using both spider web or directory systems. They also utilise special human resource personnel who insert and organise information or websites into category groups that relate to a certain type of information or website. Examples of Hybrid search engines are Google and Yahoo!.

Steps to follow when searching for information using a search engine

You can use the following steps when searching for information using a search engine:

1. Double click any web browser which is seen on your computer screen. For example, Google chrome, Internet explorer, Safari, Mozilla Firefox (See Figure 5).

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2. Type a web address of a search engine, example www.google.com on a web address bar as shown by arrow number 1 in Figure 14, then press 'Enter' on the keyboard.



Figure 14: *An interface of Google search engine*

3. Type the keyword of your search in the place shown in arrow 2 on Figure 14, for example 'food digestion'.
4. Click the button written 'Google search' to allow the searching process, as seen from arrow number 3.
5. Evaluate your results as seen from Figure 15.

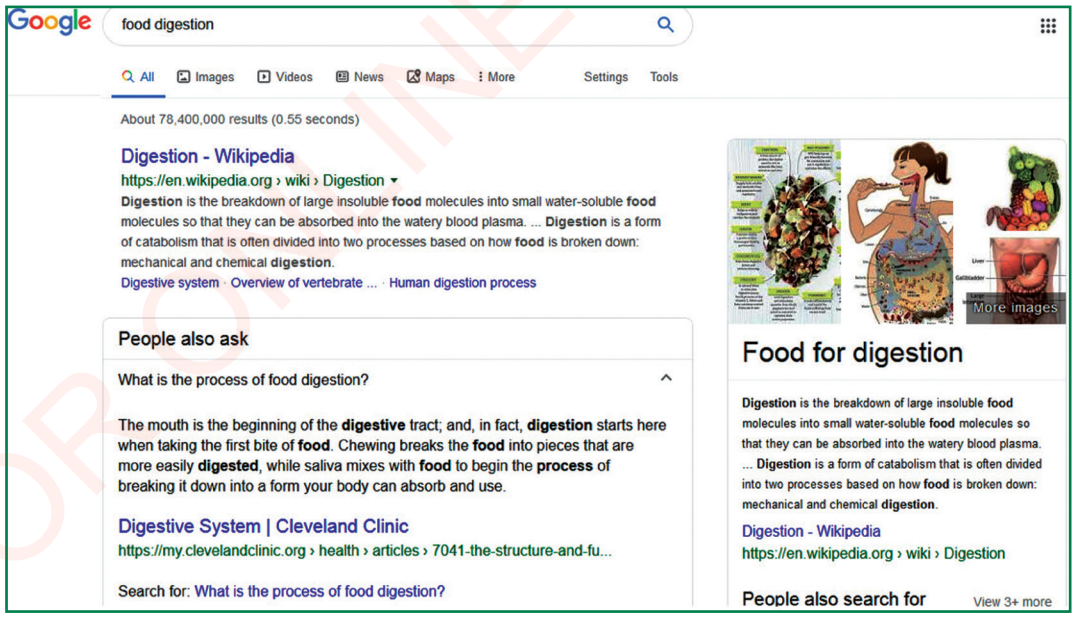

Figure 15: *List of search results*

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6. Click on one of the topics, the contents of the topic will open.
7. Read to verify if the selected topic suits your needs.

Activity 2: *Searching for information on the internet using a search engine*

Requirement: a computer with internet connection

Procedure

1. Double click any web browser on the screen of your computer.
2. Type the search engine address you are going to use, for example 'www.google.com', then press 'Enter key' on the keyboard.
3. Type 'conserve the environment' in the text search box, then click "Google search". Various information about environment conservation will appear.
4. Click one of the texts which reads 'ways to conserve the environment'.
5. You will be in a position to read the information about environmental conservation.

Importance of using a search engine

There are various benefits of using a search engine to find information. The following are some of the benefits:

1. Time is used effectively to search for information.
2. Cost of searching information is reduced.
3. Information is obtained any time.
4. Information prepared from various sources worldwide is available.
5. Relevant information is obtained from the right source.

Note: (i). Not all information obtained from the internet is reliable, you are supposed to evaluate the information that works best for you.

(ii). Not all web pages obtained during a search have correct information, it is important that you learn best ways of using search engines to get the right information.

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Exercise 7

Answer the following questions in your exercise book.

1. What does a search engine mean?
2. Is there any benefit of using a search engine?
3. What is the difference between a search engine and a web browser?

Searching for scientific and technological information

You can search for various scientific and technological information using a computer or mobile phone connected to the internet. When searching for information you have to write the question or keyword that will give you the correct search results. Keywords must be targeted to the topic you are looking for. For example, you can search for educational materials to learn about fertilisation in animals. A search engine will display all web pages with keywords 'fertilisation in animals', otherwise it will search separate words. First start the web browser and use the Google search engine to start your search. Type the keywords 'fertilisation in animals' in the search box. You will get more than 100,000 search results from various databases connected to the internet. Remember, if appropriate keywords are not used you will not get the correct information. For example, if you search the word 'animals' you can get information that does not show 'fertilisation in animals'. (See Figure 16).

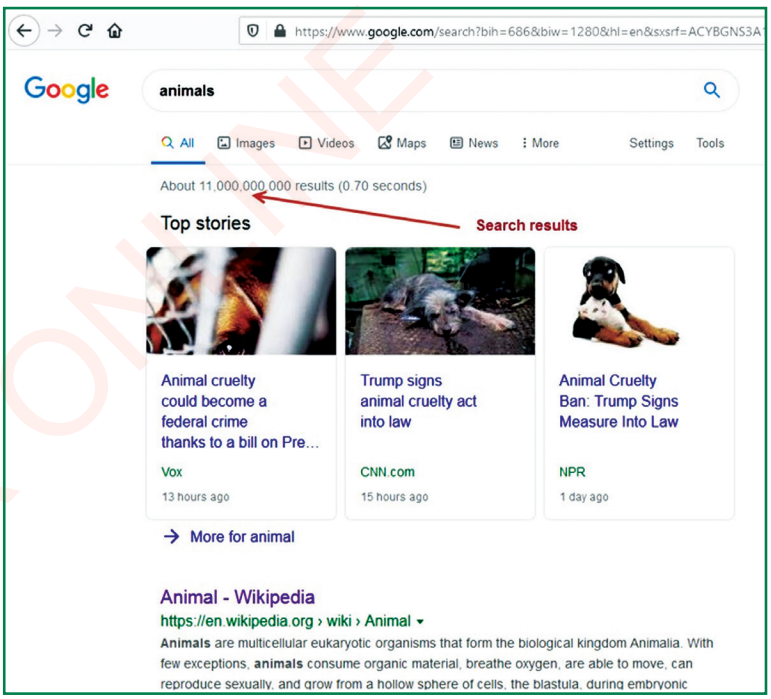

Figure 16: *Many and unintended search results*

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If you type keywords 'fertilisation in animals', results are as shown in Figure 17. Different search engines have different capacities to store information in their databases. So, search results differ from one search engine to another. Try to use www.bing.com to search for information on 'fertilisation in animals' and compare the results with google results.

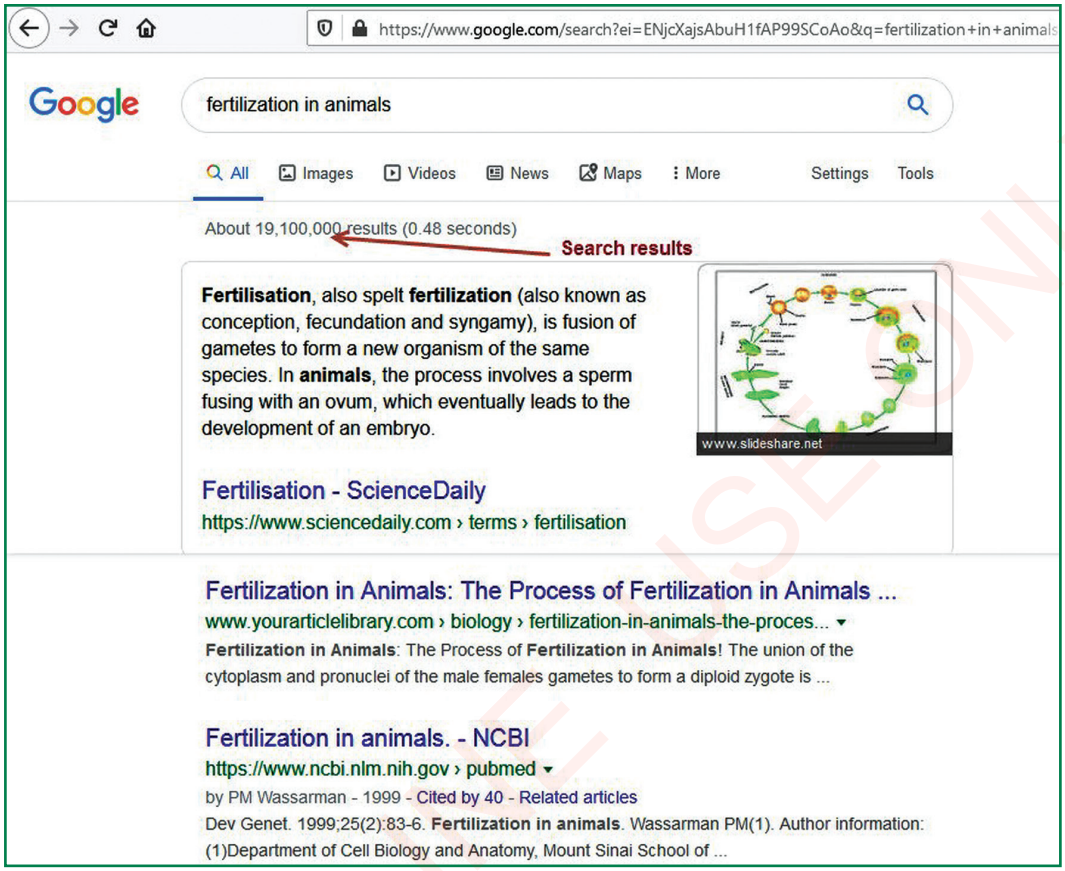

Figure 17: *Few and intended search results*

Some common web browsers which are currently used in computers and mobile phones are Internet explorer, Opera, Mozilla Firefox, PHX and Google Chrome. Some smart phones have applications which connect you direct to search engines without opening the web browser. From a display of search results, you can open your obtained results in terms of videos, images, maps or more option. You can also search for educational information and open your results in terms of videos. For example, you can use video sharing platforms like YouTube, Ustream and Vimeo to view educational videos.

Evaluating scientific information: Information from the internet should be filtered after you have downloaded and before using it. The following scenario,

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justifies this. Kazimoto is a Science and Technology subject teacher at Mdete Primary School. One day she found the students arguing that their Social Sciences teacher had given free marks. Kazimoto asked his students, “Why do you think so?” The students replied, “The teacher posed a question which required us to search for information from the internet using a smartphone or computer. Ndekuse searched for a ten-page information, and Andunje searched for a four-page information. But, the teacher has given more marks to Andunje than Ndekuse, we think that the teacher is biased”. Do you think the students’ complaints are correct? To help the students, Kazimoto replied, “When searching for information on the internet using a computer or mobile phone, you should evaluate this information using several criteria. These criteria include its accuracy, reliability of the source, objectivity, content coverage and the time”. Therefore, before using information obtained from the internet, assure yourself that it has come from a relevant and right source. These evaluating criteria are described as follows:

Target group: You have to ask yourself: Who is the target group? Is it school children? Or is it for public consumption? Is this content specifically for that group?

Authority: Has the author identified himself or herself? If not ask yourself, why?’ Is the author competent in this content area he or she has published? If not, is there any information which convinces you to trust him or her? Can his or her reference be obtained in other locations? Is the author from an academic institution or any recognised organisation?

Accuracy: You have to ask yourself: Does the information have any grammatical errors? Does the information have any typographic errors? Is it possible to refer to the sources shown and be able to get them?

Objective: Does the author provide information that is relevant to the objective? Has the author clearly stated his or her views? Are the views of his or her own or are they academically sound?

Time: Is the information up-to-date?

The teacher asked students to explain who between Andunje and Ndekuse had fullfilled the criteria? When students considered Andunje’s and Ndekuse’s answers using the creteria discussed previously, they agreed that the teacher was right.

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Publishing scientific and technological information

Sometimes a student is expected to use a smartphone or computer to publish information online. The following should be adhered to when searching for and publishing information:

1. Ensure that the information you publish is your own and has not been copied from another person.
2. Ensure that the work to be published answers the needs of the society.
3. Ensure that the work to be published is up to date.

To publish your scientific and technological information online using Google or any other search engine, you will require assistance. Your ICT teacher, computer lab technician or subject teacher can assist in the technical process to upload online.

Activity 3: *Using a search engine to search for information about the importance of ICT in an education setting*

Requirement: a computer with internet connection

Procedure

Follow the procedure shown in activity 2 in order to search for information from the internet on the importance of ICT. Write a text of about one page.

Exercise 8

Answer the following questions in your exercise book.

1. What is internet?
2. What are the differences between internet and www?
3. Explain how the effects of the internet can be avoided?
4. Explain the meaning of internet security.
5. Explain what can happen if you are not careful with your password.
6. What are you supposed to do in order to stay safe from the effects of internet?
7. What challenges do you think you could face when searching for information using a smartphone or computer?

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8. Which steps will you follow to search for information on ''agricultural pesticides'' online?
9. Explain the uses of the internet in fields like health, education, communication and entertainment.

Vocabulary

Antivirus	a computer program that is used to protect a computer against harmful software. Some harmful software include virus and trojan horse
Bridge	a computer network device that joins two computer networks of the same type, especially a Local Area Network
Client	The computer on a network that request data from a server
Data	information like text, numerals, sound or image that can be processed by a computer
Firewall	a software designed to prevent unauthorised access to or from a private network
http	a protocol or language used by computer devices to communicate to each other over the internet to share information
Network	a group of interconnected computers or devices
Protocol	a set of rules or procedures for transmitting data between electronic devices
Router	a network device that transfers packet-based data between computer networks from one data centre to another that receives data by routing it
Server	a software program or computer in which that software is installed, providing services to other programs in the same computer or others in the network
Web browser	an application software that is used to search for information from the web pages

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Chapter Eleven

Environmental cleanliness

Introduction

In Standard Five, you learnt about cleanliness including personal hygiene. You also learnt the principles for health, behaviours which help to maintain good health and how to prevent organisms which transmit diseases. In this chapter, you will learn about the cleanliness of the environment including the sources, types and effects of waste, waste management and proper waste disposal. The acquired knowledge and skills in this chapter will enable you to maintain cleanliness of the environment and thus live in a clean and safe environment.

The meaning of waste

Waste is any substance which is either unwanted or makes a place dirty. Most of the time, the words waste and dirt are used to mean the same thing. Dirt can be observed when it is related to other things such as clothes, body and water. Dirt turns these things into a dirty body, dirty clothes and dirty water. Dirt can also be smelled. For example, you can smell sewage, a dirty body and dirty clothes. On the other hand, waste are substances that can be touched or observed. Examples of waste include broken bottles, food left-overs, pieces of paper and fallen tree leaves.

Sources of waste

Waste is produced from different human activities performed in the environment. These wastes are like food left-overs, broken utensils, used tins or bottles and packages. Other wastes include torn clothes and used water. Waste is also produced from remains of industrial raw materials, chemicals, dust and gas. Likewise, water used for cooling machines and smoke from factories, cookers and various machines usually are waste in the environment. In mining areas, chemicals and water which are used for

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different activities usually mix to form wastewater. Waste is also produced in commercial areas such as in markets and shops.

Activity 1: *To investigate sources of waste*

In groups of six pupils, investigate the sources of waste in your school surroundings then list them in your exercise books. Present your work in the classroom for discussion.

Exercise 1

Answer the following questions in your exercise book.

1. What is waste?
2. Mention two examples of waste produced from factories.
3. Mention three examples of domestic waste.
4. Briefly explain three sources of waste at your school.

Types of waste

Waste can be classified based on different criteria. These criteria are discussed below:

State of matter: There are three states of matter which are solid, liquid and gas. Therefore, in this category there are three types of waste namely solid waste, liquid waste and gaseous waste. Solid waste include tin, bottles, broken glass, pieces of iron metal, used packages and papers. Liquid waste include wastewater from homes, industries and mining areas and chemicals from laboratories, spilled liquid oil on land or water bodies. Gaseous waste on the other hand include smoke from motor vehicles, industries and incinerators. There is also gaseous waste that results from refrigerators, manure and decaying waste.

Decomposable and non-decomposable waste: Waste can be categorised into two main groups which are decomposable and non-decomposable. Decomposable wastes are those which can be broken down into simple

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substances by bacteria or fungi. These broken down substances become part of the soil. Examples of decomposable waste include food remains, faeces, paper and plant remains. Non-decomposable waste cannot be broken down into simple substances by bacteria or fungi. This type of waste remains in the environment for many years. Examples of non-decomposable wastes are plastic materials, metal scraps and broken glass. This type of wastes remain without being decomposed for many years. Therefore, they have serious side effects to the environment.

Toxic and non-toxic waste: Waste can be put into two groups of toxic waste and non-toxic waste. Toxic waste has harmful effects to living things like human beings and other animals. Examples of these wastes are used chemicals from laboratories in schools, hospitals, industries and mining industries. The remains of chemicals in agriculture such as fertilisers and pesticides are toxic waste. Non-toxic waste is that which has no direct harmful effects to living things. Examples of non-toxic wastes include paper, food and crop remains. Non-toxic wastes have different effects to the environment but they do not cause death to living things when they get in contact.

Activity 2: *Collection and separation of waste*

Requirements: gloves, waste bins, manila cards, glue and marker pens

Procedure

1. Wear gloves.
2. Take two pieces of manila paper and glue them to the two waste bins. On the first bin, write ‘DECOMPOSABLE WASTE’ and on the second bin write ‘NON-DECOMPOSABLE WASTE’ as shown in Figure 1.
3. Go around the school environment and collect waste.
4. Separate waste into decomposable and non-decomposable groups. Discuss how the waste can be disposed of.

   Students should work in groups of four each.

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Figure 1: *Pupils collecting and separating waste*

Exercise 2

Answer the following questions in your exercise book.

1. Mention three types of waste according to their state of matter and give two examples in each group.
2. Mention the types of waste produced in your environment.
3. List two areas where toxic waste is produced.

Effects of waste

Poor waste management causes a number of effects to the environment and to living organisms. For example, areas piled with decomposable waste are breeding sites for insects which spread diseases like houseflies and mosquitoes. These insects carry disease causing organisms from waste to uncovered foods. Eating contaminated food can cause people to suffer from diseases like dysentery, typhoid and cholera.

Waste is habitat for destructive animals like rats. Rats destroy properties like furniture, clothes and crops in the farm or in storage. Waste is also a

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hiding place for dangerous organisms like centipedes and snakes. These organisms can harm people and other animals because they contain poison. Piles of waste produce unpleasant smell which make the environment uncomfortable for people who live around them. Unpleasant smell from waste may cause nausea, vomiting and headache. Some wastes with sharp objects like broken bottles and iron nails are sources of injuries in our surroundings. A person injured with these objects experiences pain and can cause diseases.

Non-decomposable wastes stay longer in the soil and water, therefore they prevent proper air circulation and cause death to living organisms. If not properly disposed of, solid waste can block flow of water in trenches and cause floods as shown in Figure 2. Floods may have many consequences including destruction of properties, death and eruption of diseases like dysentery and cholera.



Figure 2: *Floods due to blockage of water trenches by waste*

Likewise, liquid waste affects the environment when poorly disposed of. Wastewater contaminated with chemicals from industries and mining areas pollutes water sources. This makes water unsafe for humans and other living things. Contaminated water affects the soil and leads to poor agricultural yields. Sometimes this water has bad smell which annoys people.

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Gaseous wastes have many effects to living things and the environment because some of them are toxic. An example of toxic gaseous waste is carbon monoxide which is produced during incomplete burning of charcoal. When this gas is inhaled, it interferes with the ability of the blood to transport oxygen in the body and can cause death. Some gaseous wastes when released into the air tend to destroy the ozone layer which prevents harmful radiations from reaching the earth. Those radiations may cause diseases like skin cancer to organisms especially human beings.

Some gases that pollute the atmosphere are called greenhouse gases. Greenhouse gases are gases in the earth's atmosphere that trap energy. They let sunlight pass through the atmosphere but they prevent the heat caused by sunlight from leaving the atmosphere. Examples of greenhouse gases are carbon dioxide and methane. These gases make a layer in the atmosphere which prevents escaping heat from the earth's surface. This causes climatic changes which are associated with disasters like drought, floods and frequent storms.

Exercise 3

Answer the following questions in your exercise book.

1. Non-decomposable waste has harmful effects to the environment. Explain with examples.
2. Mention five diseases which occur due to poor waste management.
3. Explain the effects of liquid waste to the environment.

Waste management

It is important to ensure that waste is properly managed and destroyed to prevent its effects. Waste management involves the following methods:

Reduction of waste production: Waste results from the use of different materials. Materials which are used once and disposed of like plastic water bottles, bags, plates and cups produce waste. It is advised to use materials which can be used more than once in order to reduce production of waste.

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Storage of waste in bins before destruction: One of the methods of waste management is the use of waste bins at schools, homes and in areas where people gather like bus stations or markets. When waste bins are properly used, they prevent spreading of waste in the environment. These waste should be kept separately by considering whether they are decomposable or non-decomposable. In areas where there is chemical waste, this should be separated and stored differently depending on whether they are toxic or non-toxic. This will help during their destruction. Gaseous waste is detoxified before being released to the atmosphere. This is because it has effects to living things. Usually gaseous waste from factories is processed before being released in order to reduce its effects in the environment.

Reuse of waste: Another method of reducing waste in the environment is to reuse the materials in similar or different manners. Some materials can be used without being returned to the factory. For example, empty buckets of paint or washing soap can be used for carrying water. Empty plastic water bottles and paint cans can be used in growing vegetables and flowers as shown in Figure 3. Beverage glass bottles are returned to the factories where they are washed and reused. This method is simple and reduces the amount of waste in our environment.



Figure 3: *Flowers grown in plastic bottles and bags*

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Recycling of waste: Recycling is among the best methods for waste management in which waste is processed into new products that can be used again. This method helps to reduce waste in our environment. For example, plastic bottles as shown in Figure 4 and glass bottles are taken back to the factory for making new bottles. Used papers are converted into soft paper for making newspapers and charcoal. Iron metal scraps are melted to make new substances like iron bars and sheets. Animal and plant remains like bones and crops may be used to make animal foods.

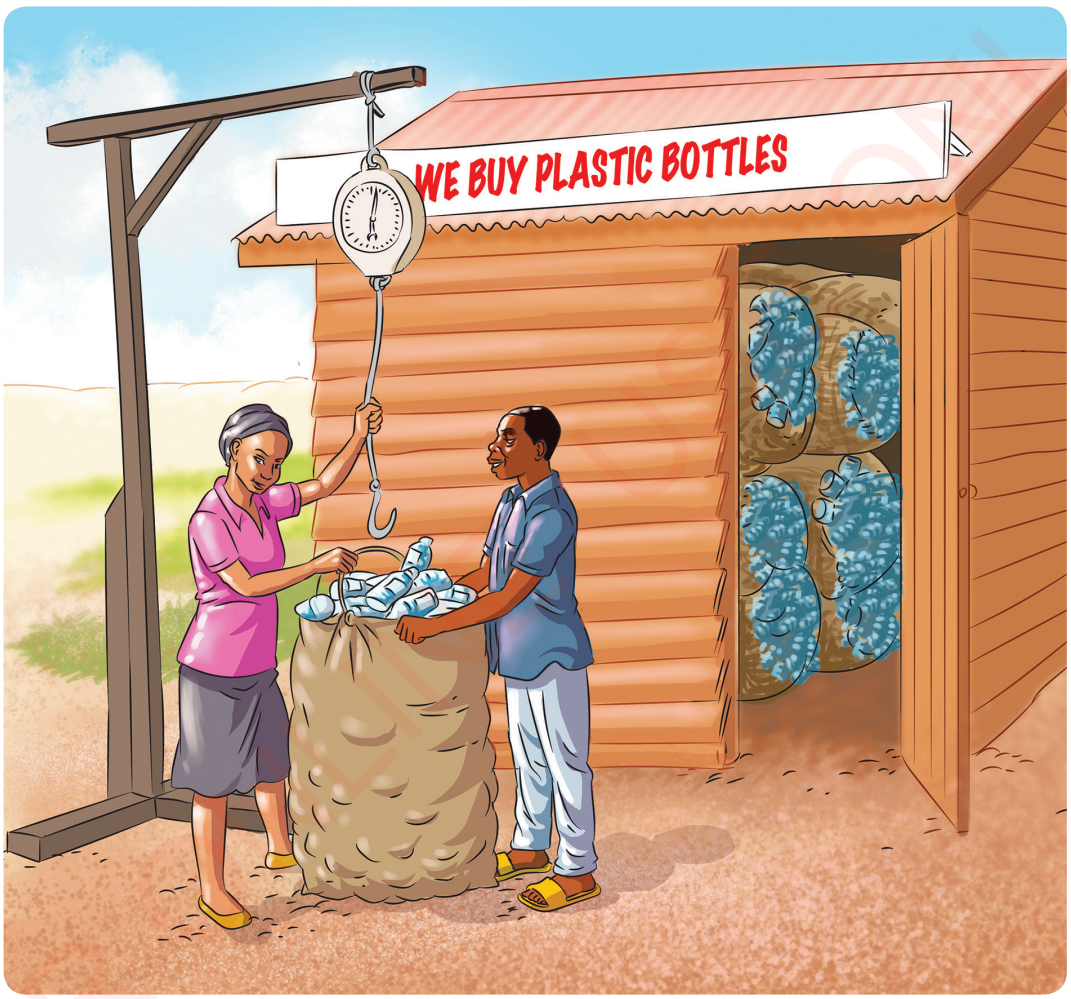

Figure 4: *Weighing of empty plastic bottles for recycling*

Making compost and biogas: Waste can be managed by converting them into forms that produce energy. For example, some of decomposable waste is used to produce biogas. Biogas is produced when waste is decomposed

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by bacteria in the absence of oxygen gas. The biogas is collected in a special plant for different uses. It is used for cooking and generating electricity to run different machines. Waste used to make biogas include faeces from cattle and human beings. Food remains and crop remains such as sisal can also be used in generating biogas.

Likewise, decomposable waste can be collected in a pit to make compost manure. The waste is regularly mixed to ensure decomposition. When these wastes are well decomposed, they can be taken to the farm for use as manure.

Exercise 4

Answer the following questions in your exercise book.

Section A

1. Choose the correct answer and write it in your exercise book.
   (i) Waste bins should be _____.
      (a) big
      (b) modern
      (c) from factories
      (d) with a lid
   (ii) Decomposable waste can be used to make _____.
      (a) scientific instruments
      (b) water carrying containers
      (c) food for insects
      (d) compost
   (iii) Growth of disease causing organisms is influenced by _____.
      (a) solid waste only
      (b) waste management
      (c) piles of waste
      (d) production of compost
   (iv) The aim of wearing gloves while cleaning the environment is to _____.
      (a) reduce solid waste
      (b) remove bad smell
      (c) prevent from infectious diseases
      (d) increase smartness at work

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(v) Sweeping in open spaces, in grass and under trees helps to _____.

(a) increase insects
(b) bring bad smell
(c) increase their sizes
(d) reduce negative effects of waste

2. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.

(a) There are only two methods of waste management. _____
(b) It is not easy to separate solid waste. _____
(c) Types of waste are grouped together depending on aim of the destroyer. _____
(d) Dangerous insects live in waste only. _____
(e) For proper destruction of waste, you need to separate them. _____
(f) Unpleasant smell is the result of keeping waste in the right place. _____
(g) Plastic wastes are very harmful to our environment. _____
(h) Not all wastes produce biogas energy. _____
(i) Human faeces are among the sources of biogas. _____

Section B

Fill in the blanks with the correct answer.

3. Materials which can be recycled to manufacture new substances include _____, _____ and _____.
4. Destructive organisms which reproduce in waste are _____, _____ and _____.
5. With regard to the states of matter, waste can be grouped into three types namely _____, _____ and _____.
6. Raw materials for biogas are _____, _____ and _____.

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Section C

Answer the following questions:

7. List five examples of solid wastes which are produced in your school.
8. Mention five effects of poor waste management.
9. Proper waste management and destruction can be of great benefits. Explain by giving examples.
10. Differentiate between recycling and reuse of waste.
11. With examples, explain two effects of gaseous waste to human beings.
12. Briefly explain two methods used in destruction of non-decomposable waste.

Vocabulary

Compost	a decayed mixture of plant and animal waste used to improve the soil
Decomposition	slow destruction or breaking down of organic matter by natural processes
Ozone layer	a layer in the upper atmosphere that prevents harmful radiation

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Chapter Twelve

First aid

Introduction

In Standard Five, you learnt about provision of first aid to a victim of fire accident. In this chapter, you will learn how to provide first aid to vomiting and diarrhoea patients. The chapter will also provide you with the skills of providing first aid to a person with a fractured bone, drowning and snakebite victims. The acquired knowledge and skills will enable you to have the ability of providing first aid to different patients and victims.

First aid for a vomiting person

First aid is the immediate assistance given to a sick or injured person to reduce pain and save life before being taken to hospital. In everyday life activities, a person can get involved in an accident or fall ill suddenly. Therefore, the victim needs immediate assistance. Vomiting may happen to a person anytime and anywhere. It may be caused by eating contaminated foods and drinks or suffering from a disease in which vomiting is one of its symptoms. Vomiting leads to loss of large amounts of water and mineral salts from the body within a very short time. Loss of water and mineral salts leads to body weakness and tiredness to the victim. Therefore, a vomiting victim needs first aid for quick restoration of water in the body.

Procedure for providing first aid to a vomiting person

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;

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4. Give the patient a lot of fruit juice to restore water, mineral salts and strength; and
5. Take the patient to hospital immediately.

First aid for a victim of diarrhoea

Diarrhoea refers to the frequent passing of loose and watery stool from a person. This problem leads to loss of much water from the body just as vomiting. Diarrhoea can be caused by taking contaminated foods or drinks. Loss of water in the body leads to serious effects such as weakness, tiredness and even death. Thus a victim of diarrhoea needs to be given first aid immediately in order to save life.

Procedure for providing first aid to a victim of diarrhoea

The following are important steps to be taken to help a person who has diarrhoea:

1. Place the patient in a safe and clean place;
2. Give the patient a solution of oral dehydration salts to restore water lost by diarrhoea;
3. Give the patient plenty of fruit juice and safe water to restore the lost water and mineral salts; and
4. Take the patient to hospital immediately.

Activity 1: *Preparation of a mixture or solution for a victim of vomiting and diarrhoea*

Requirements: sugar, table salt, table spoon, lemon or ginger, one litre of water, jug and tea spoon

Procedure

1. Fill the jug with one litre of clean and safe water.
2. Add one table spoonful of sugar.
3. Add one tea spoonful of table salt.
4. Squeeze lemon or ginger juice into the mixture.

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5. Stir the mixture thoroughly.
6. Give the patient a small amount of the drink.

Exercise 1

Answer the following questions in your exercise book.

1. Mention two causes of vomiting and diarrhoea.
2. Explain how to prepare a solution for a victim suffering from vomiting and diarrhoea.
3. Explain the effects of vomiting and diarrhoea.

First aid for a person with a bone fracture

A person can have a bone fracture due to various accidents such as falling or collision during a game. Accidents can also involve cars, motor cycles and bicycles. First aid for a victim with bone fracture is very important when an accident occurs. The victim of a bone fracture can be identified when the fractured body part fails to function. The affected part normally swells and results into severe pain.

Types of fractured bones

Inner fractured bone: A bone fractures into two or more parts without protruding onto the skin surface, as it is illustrated in the Figure 1. The fractured bone may also be with cracks, but the affected outer part can only show some swelling.

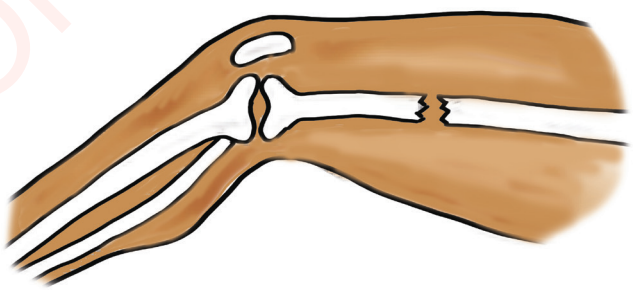

Figure 1: *Inner fractured bone*

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Wounded fractured bone: This is a type of fractured bone that can occur in two forms. The first form is when the fractured bone penetrates the muscles causing a wound. Another form is when the fractured bone penetrates the muscles up to the skin surface resulting to an open wound.

1. Figure 2 shows a fractured bone into two pieces which penetrates the muscles causing a wound without penetrating the skin surface.

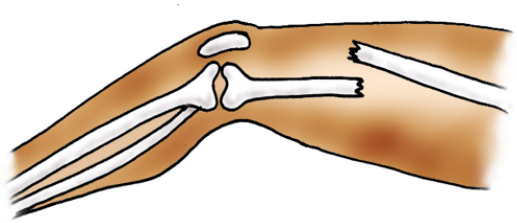

Figure 2: *A fractured bone with an inner wound*

2. Figure 3 shows a fructured bone into two pieces and protruding to the skin surface causing a wound on the muscles and skin.

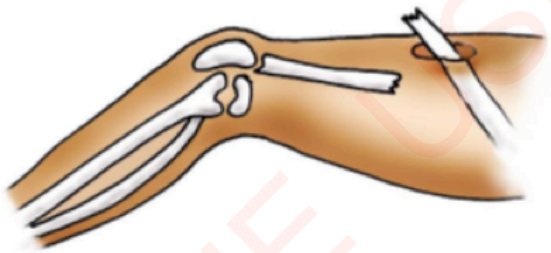

Figure 3: *A fractured bone with skin surface wound*

A bending fractured bone: In this type of accident a fractured bone bends without breaking into pieces. This type of bone fracture is like a fresh stick when bent it breaks but not into pieces as it is shown in Figure 4.

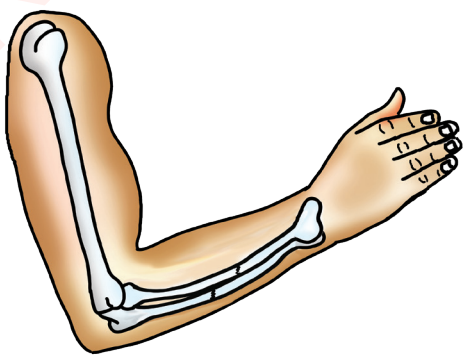

Figure 4: *A bent fractured bone*

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How to attend a victim of a fractured bone

The following procedure should be followed:

1. Calm down the patient and reassure him/her of his/her safety.
2. Before providing any aid, stop any bleeding using a clean and safe piece of cloth.
3. Provide first aid at the place of accident. In case there is observable injury around the fractured bone, cover it hygienically and do not attempt to relocate the bone to its original position.
4. In case a victim has been shocked, provide first aid for shock first before other steps.
5. Carefully support the fractured body part by clamping it with a clean and strong piece of wood or it can be clamped onto another body part of the victim.
6. Allow the victim to lie down in a quiet place then hold the fractured bone part with a hard, light wooden clamp. This will ensure that the fractured bone does not move. Note that, the wooden clamp should be long enough to support the whole fractured part. Where necessary the following should be done:
   (a) Cover the fractured body part by using cotton, a piece of cloth or soft grass. This is useful in the protection of the fractured part against injury from the wooden clamp and bandage as it is shown in Figure 5.
   (b) If two wooden clamps are needed, then they must be of the same size.
7. Take the victim to the hospital using a type of transport that will not cause more injury.

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Figure 5: *First aid for a victim of a fractured bone*

Activity 2: *A role play on provision of first aid*

Perform a role play with your friends on providing first aid to a victim of a bone fracture.

Exercise 2

Answer the following questions in your exercise book.

1. Mention three symptoms of a fractured bone.
2. Identify three types of a bone fracture.
3. Explain how you will provide first aid to a victim of a fractured leg.

First aid for a drowning person

Drowning is the suffocation and respiratory impairment caused by someone being submerged in or under water. A person can fall accidentally into deep water and fail to swim. Likewise, a person who is capable of swimming may fail to swim due to obstacles found in water. Thus, this person swallows excessive amount of water when trying to draw in air. A drowning person takes excess water in the stomach and lungs, thus fails to breath. The first aid to a drowning person who has not fainted is to be removed from

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the water. This should be followed by assisting the person to remove the swallowed water from the stomach and lungs. The water in the stomach and lungs prevents the person from proper breathing.

If a drowning victim has not fainted, the first aid provider should be very careful. This is because the drowning person is normally in a state of panic, struggling to save his/her life. The victim might hold the first aid provider tightly and cause both of them to drown. Therefore, the first aid provider should not touch the victim. A piece of cloth or a rope can be used to pull a drowning victim out of water as shown in Figure 6.



Figure 6: *Saving a drowning person*

Procedure for providing first aid to a drowning person

Follow these steps to provide aid to a drowning person who has fainted.

1. Remove the person quickly from the water.
2. Lay the person on his/her back then help him/her to breathe by the mouth to mouth method. Strongly breathe into the mouth of the victim. This helps air get past any water that may be causing blockage in the breathing passage ways and lungs. It is important to take precaution of diseases that might be spread by mouth to mouth contact between the victim and first aid provider. This can be done by using a piece of clean cloth to separate them.
3. While laid on his/her back, tilt the head sideways, then slowly press the stomach up and down several times as illustrated in Figure 7.

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4. Quickly lift the victim up and tilt the head a bit downward to make the person vomit.
5. Repeat steps 2, 3 and 4 three or four times.
6. Take the victim to the hospital.

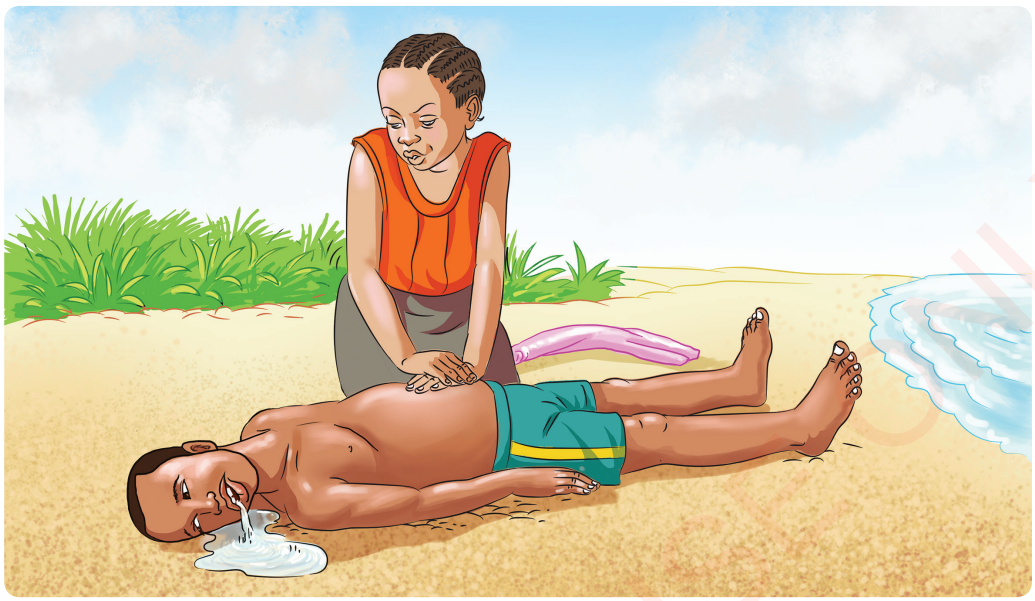

Figure 7: *Rendering first aid to a person after drowning in water*

Exercise 3

Answer the following questions in your exercise book.

1. List the steps for providing first aid to a person who has fainted due to drowning.
2. Explain how to save a person who is drowning in water and has not fainted.
3. What precautions should be taken when saving a drowning person?

First aid for a person bitten by a snake

A snakebite is an injury caused by a bite especially of a poisonous snake. There are various types of poisonous and non-poisonous snakes. Poisonous snakes are dangerous organisms. Such snakes produce poisons which spread quickly in the body of the victim. The poison can cause death if the victim is not immediately provided with first aid. Symptoms of a victim of snakebite are swelling and severe pains.

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Procedure for providing first aid to a victim of snakebite

First aid for a victim of snakebite is provided using the following procedure:

1. Calm the victim and make him/her stress free. This procedure helps to lessen blood pressure that could cause fast spreading of the poison. If possible, identify the type of snake that injured the victim. If the snake is seen, identify its colour. This will help during treatment of the victim.
2. Remove tight clothes, belt and rings from the bitten body part to avoid swelling.
3. If the victim has a wound wear gloves, clean the wound using cotton wool containing spirit to kill germs. Cover the wound using a bandage or a clean piece of cloth as it is shown in Figure 8.
4. Take the patient to the hospital quickly or call for a medical practitioner.



Figure 8: *First aid for a snakebite victim*

Things not allowed to do when providing first aid to a snakebite victim

When providing first aid to a snakebite victim never do the following:

1. Making an incision or cut with anything on a snake bitten part.
2. Sucking the blood or poison from the wound by using your mouth.
3. Giving the patient a drink containing caffeine like coffee, or alcohol.
4. Trying to catch the snake that bit the injured person.
5. Giving the patient any medicine.

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Exercise 4

Answer the following questions in your exercise book.

Section A

Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.

1. You are supposed to incise or cut the snake bitten part and suck the poison. _____
2. You should press the stomach of a drowned person while lying down on his/her stomach. _____
3. Never attempt to relocate a fractured bone during provision of first aid. _____
4. Lemon and ginger help to prevent nausea for a vomiting person. _____
5. Help a drowning person to breathe by strongly breathing air through mouth-to-mouth. _____

Section B

Answer the following questions:

6. Mention three types of accidents that can cause bone fracture.
7. Mention three precautions which should be taken in order to avoid vomiting and diarrhoea.
8. Mention three precautions to consider when providing first aid to a snakebite victim.
9. What items are used to help a drowning victim?
10. Explain how to provide first aid to a person who is vomiting and has diarrhoea.
11. Why is it important to use equal-sized wooden clamps in giving first aid to a person with a fractured bone?
12. Explain the procedure on how to provide first aid to a person bitten by a snake.
13. A person bitten by a snake is not allowed to lift up the bitten body part. Why?

Vocabulary

Wooden clamps pieces of wood that are used to support a fractured leg or hand

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Chapter Thirteen

Sexually Transmitted Diseases (STDs), HIV and AIDS

Introduction

In Standard Four, you learnt about the effects of Human Immunodeficiency Virus (HIV) infection. You also, learnt about the importance of caring and supporting people living with HIV and Acquired Immuno Deficiency Syndrome (AIDS). When you were in Standard Five you learnt the use of Anti-Retro Viral drugs (ARVs). In this chapter, you will learn more about sexually transmitted diseases (STDs), HIV and AIDS, ways to prevent infection and the effects of HIV infection. You will learn about personal hygiene and proper meals for a person living with HIV and AIDS. You will also, learn about the effects of HIV and AIDS at the family, society and national levels. The acquired knowledge and skills in this chapter will enable you to avoid infection from sexually transmitted diseases and HIV. In addition, they will enable you to know how to take care of people infected with sexually transmitted diseases and AIDS.

Sexually transmitted diseases

This is a group of diseases which are transmitted from an infected person to another person through sexual contact.

Types of sexually transmitted diseases

There are various sexually transmitted diseases each having its own symptoms in females and males. Sexually transmitted diseases include gonorrhoea, syphilis, chancroid, chlamydia, genital herpes and AIDS.

Gonorrhoea: This is a sexually transmitted disease which is caused by bacteria called Neisseria. This disease has different symptoms in females and males. Symptoms can show up between 2 to 7 days after infection.

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The symptoms cannot be discovered early in females. Some women do not show any symptoms of this disease. A pregnant woman can also transmit gonorrhoea to her baby during birth.

The symptoms of gonorrhoea in females include:

1. Discharge of pus from the vagina.
2. Bad smell from the vagina.
3. Pain during urination.

The symptoms of gonorrhoea in males include:

1. Pain during urination.
2. Discharge of pus from the penis.
3. Painful or swollen testes.

Syphilis: This is a sexually transmitted disease caused by bacteria called Treponema. An infected person experiences the symptoms from 10 to 21 days after infection. The symptoms are experienced by both males and females. A pregnant woman can also transmit syphilis to her baby during birth. The symptoms of syphilis include:

1. Painless sores on the penis or vagina, tongue, pelvis, at the mouth and anus.
2. Loss of hair.
3. Throat pain.
4. Fever and swelling of lymph nodes.

Chancroid: This is a disease caused by bacteria called Haemophilus. This disease has different symptoms in males and females.

The symptoms of chancroid in females are:

1. Sores in the vagina and anus.
2. Pain during urination and defecation.
3. Pain during sexual intercourse.
4. Abnormal vaginal discharge.

The symptoms of chancroid in males are:

1. Bleeding sores on the penis.
2. Swelling of lymph nodes and fever.
3. Painful and swollen testes.
4. Discharge from penis.
5. Pain during urination.

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Chlamydia: This is a disease caused by bacteria called Chlamydia. Female parts which can be infected include the cervix, anus and throat. Male parts which can be infected include the urethra, anus and throat.

The symptoms of this disease differ in females and males. A female with chlamydia infection shows the following symptoms:

1. Itching around the genitals.
2. Yellowish discharge with bad smell from the vagina.
3. Change of menstrual cycle.
4. Severe abdominal pain.
5. Pain during sexual intercourse.
6. Pain during urination.

An infected male shows the following symptoms:

1. Itching of the penis.
2. Pain during urination.
3. Discharge of pus from the penis during urination.

Trichomoniasis: This is a disease caused by a protozoan called Trichomonas. A person can have this disease without showing any symptoms.

Symptoms of trichomoniasis in females are:

1. Discharge of a yellow fluid with bad smell from the vagina.
2. Itching around the genitals.
3. Genital swelling and change into red colour.
4. Pain during urination.
5. Abdominal pain.
6. Pain during sexual intercourse.

The symptoms of trichomoniasis in males are:

1. Bad smelling discharge from the penis.
2. Itching on the genitals.
3. Bruises on the genitals.
4. Pain during urination.

These symptoms show between 5 to 28 days after infection.

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Genital herpes: This is a sexually transmitted disease caused by a herpes virus. Infected males and females experience similar symptoms that include the following:

1. Itching around the genital organs.
2. Blisters around the genitals.
3. Small soft sores in the genitals.
4. Swelling of lymph nodes in the pelvis.

These symptoms can be experienced between 14 and 21 days after infection.

HIV and AIDS: You have learnt that AIDS is Acquired Immuno Deficiency Syndrome. It is caused by a virus called HIV. It is impossible to identify an infected person by appearance. Diagnosis is the only way to detect an infected person. Do you remember the symptoms of AIDS you learnt in Standard Four? In Standard Five, you learnt about anti-retroviral drugs (ARVs). ARV drugs have minimised symptoms for HIV infection which were easily experienced before drug discovery. An HIV infected person using ARVs does not show any symptom. If a person with HIV and AIDS does not use ARVs, he/she will show the following symptoms:

1. Rapid loss of weight.
2. Frequent diarrhoea.
3. Body weakness and fatigue.
4. Swelling of lymph nodes.
5. Skin diseases like persistent rashes and scars.
6. Persistent fever.
7. Persistent cough.

Some symptoms of AIDS are the same as those of other diseases like diabetes and cancer. Therefore, it is important to go for medical diagnosis to confirm infection of HIV.

Prevention of STDs and HIV

The following are ways to prevent STDs and AIDS:

1. Abstaining from sexual intercourse before reaching the age of 18 years. There are many ways of transmission of STDs and AIDS but sexual

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intercourse is the major means of transmission. Hence, abstaining from sexual intercourse will protect you from such diseases.

2. Avoid sharing sharp objects like piercing needles, razor blades and other shaving tools.
3. Avoid sharing toothbrushes.
4. Avoid sharing underwears and towels. These can spread STDs.
5. Avoid sharing food pieces cut by the teeth of another person.
6. Use gloves when attending an HIV infected person or an injured person.
7. People living with HIV should adhere to advice from medical doctors to avoid further transmission.
8. Ensure that people infected with HIV get proper medical treatment of the STDs.
9. A pregnant woman and her husband must visit the clinic early to get medical diagnosis on STDs infection. If they are infected, they must get proper medical treatment. Also, if the mother is infected with HIV, she must be given medication to protect the baby in the womb.
10. A pregnant woman is advised to give birth at the hospital so that if the born baby is infected, it can be treated immediately.

The effects of STDs

Most sexually transmitted diseases can be treated except AIDS. Victims are advised to go to the hospital or health centre early when they experience symptoms of STDs. These diseases have serious effects if they are not well treated. These effects are listed in the following table.

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Table: *Sexually transmitted diseases and their effects*

Disease	Effects
Gonorrhoea	(a) Blocking of the urethra in males. (b) Blocking of fallopian tubes thus leading to ectopic pregnancy. (c) Infertility for both males and females. (d) Blindness to a baby infected during birth.
Syphilis	(a) Damage of internal organs such as the heart and brain, causing heart and brain problems. (b) Loss of hair. (c) Can lead to death.
Chancroid	Damage of reproductive organs.
Chlamydia	(a) Severe abdominal pain for females. (b) Blocking of the urethra for males. (c) Pain and swelling of testes. (d) Blocking of fallopian tubes leading to ectopic pregnancy. (e) Swollen pelvis.
Trichomoniasis	(a) Blocking of the urethra for males. (b) Severe abdominal pain.
Genital herpes	Sores in the genital organs.
AIDS	(a) Body weakness and lower immunity. (b) Opportunistic diseases leading to death.

Relationship between STDs, HIV and AIDS

Sexually transmitted diseases are associated with presence of wounds. It is easy for HIV to penetrate into the blood circulatory system through wounds. Therefore, sexually transmitted diseases increase the risk of getting HIV infection. A person with a sexually transmitted disease has high chances of getting HIV infection if not treated in time. Sexually transmitted diseases can also rapidly lower the body immunity of a person living with HIV, leading to AIDS.

Exercise 1

Answer the following questions in your exercise book.

1. Explain the meaning of sexually transmitted diseases.
2. Mention three symptoms of syphilis.
3. Explain the effects of gonorrhoea to:
   (a) females.
   (b) males.

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

Personal hygiene: A person with HIV and AIDS should ensure cleanliness of the body, clothes and the surrounding environment. A person with AIDS may be unable to wash his/her body and clean his/her bedroom. Therefore, it is important to help him/her with body cleanliness like cutting long nails, hair and washing the body. It is important to wash his/her clothes and bed sheets. It is good to take precaution when you are attending the patient to avoid HIV infection.

Balanced diet: You have learnt that HIV infection lowers the body immunity. A balanced diet increases the body immunity. People living with HIV and AIDS need a balanced diet in order to increase their body immunity. A balanced diet is food containing all the nutrients needed by the body in the right amounts. The nutrients required by the body include carbohydrate, protein, fat, vitamins and mineral salts as shown in the Figure.



Figure: *Example of a balanced diet for people living with HIV and AIDS*

People living with HIV and AIDS (PLWHA) are supposed to eat a variety of foods. A well balanced diet helps the body to get important nutrients for better health. People living with HIV and AIDS face a number of health problems. Some of them lose appetite and experience indigestion and poor assimilation of nutrients in the body. Due to these problems, people living with HIV and AIDS are advised to eat small amounts of food regularly in a day. This will enable them to meet their body needs.

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Safe meals: People living with HIV and AIDS are likely to be infected easily by other diseases. This is due to lowered body immunity. Food may be among the causes of infections if not prepared while observing proper hygiene. In order for the food to be safe, it is important to adhere to principles of personal hygiene during its preparation and serving. The cooking utensils must be clean and safe. Utensils should be properly washed using clean water and soap. The utensils must be left to dry in the sun or by using a piece of cloth.

Processed foods should be avoided by a person living with HIV and AIDS. The food must be safe and clean. The food must be well preserved to protect it from dust and germs. Vegetables and fruits especially those eaten without cooking should be washed with clean and safe water.

A person living with HIV and AIDS is supposed to avoid processed foods. These foods are processed with chemicals which can bring more problems to the victim. Eating warm food is appropriate for people living with HIV and AIDS. It is not advised to eat cold or foods prepared and kept for a long time. Cold foods must be warmed before eating.

Like with other people, a person living with HIV and AIDS is supposed to drink clean and safe water. Water should be boiled in order to kill germs. Drinking water must be kept in a clean covered container and kept in a safe place.

Importance of balanced diet for a person living with HIV and AIDS

Balanced diet is important to all people. A person living with HIV and AIDS requires more nutrients from a balanced diet. A well balanced diet helps in baby growth, development of the brain and energy to do work. It helps in new cells production and repair of dead or damaged body cells. Additionally, it enables proper functioning of '*Anti-Retro Virus drugs'* (ARVs) and reduces chances of getting opportunistic diseases. Another importance of a balanced diet is to replace lost nutrients during diarrhoea and vomiting. Similarly, a balanced diet raises the body immunity.

Exercise 2

Answer the following questions in your exercise book.

1. Write the long form of (a) HIV (b) AIDS (c) ARVs
2. Identify the types of food required by people living with HIV and AIDS.

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3. Mention two things required to improve the health of people living with HIV and AIDS.
4. Explain the importance of a balanced diet to people living with HIV and AIDS.

Effects of HIV and AIDS

HIV and AIDS can affect an individual person, family, society or the nation as a whole. You have learnt that when a person is infected with HIV and AIDS, the level of the body immunity decreases. When the body immunity is low, a person can easily be infected with opportunistic diseases like tuberculosis (TB), fever, diarrhoea and coughing. When a person living with HIV and AIDS get opportunistic diseases, his/her ability to work decreases. Inability to participate in productive activities leads to poverty. If the victim does not get proper food and medication, death may occur.

Likewise, HIV and AIDS affect the family. The family uses a lot of money in taking care of the sick person. The money spent for a victim could be used for development activities. The family also spends a lot of time caring for the victim instead of engaging in production activities. When the HIV infected person dies, dependants are left without assistance. Parents who die of AIDS, leave their children behind as orphans. The effects of HIV and AIDS do not stop at individual and family levels but it affects the whole nation. The nation loses workforce when people cannot work due to HIV and AIDS. The government spends a lot of money buying ARV drugs and for treatment of opportunistic diseases.

Exercise 3

Answer the following questions in your exercise book.

Section A

1. Write **TRUE** for correct statement and **FALSE** for an incorrect statement.
   (a) Sexually transmitted diseases is a group of diseases which is spread by air. _____
   (b) Sexually transmitted diseases have no cure except AIDS. _____
   (c) It is impossible to identify an HIV infected person by looking. _____

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(d) It is advised to wear hand gloves while attending a bleeding person in order to avoid HIV infection. _____

(e) People living with HIV are advised to adhere to medical advice in order to avoid infecting other people. _____

(f) Some of the sexually transmitted diseases cause blocking of the urethra in males. _____

(g) There is no relationship between sexually transmitted diseases and HIV and AIDS. _____

(h) People living with HIV and AIDS must maintain cleanliness. _____

(i) It is difficult for HIV to pass through wounds. _____

Section B

2. Match sentences in **List A** with correct responses from **List B** then write the answers in your exercise book.

List A	List B
(i) Family spends much time taking care of the victim instead of doing productive activities. (ii) It is one of the sexually transmitted diseases. (iii) It is one of the ways to prevent sexually transmitted diseases. (iv) Painless sores on the penis, vagina, tongue and anus. (v) The importance of a balanced diet to people living with HIV and AIDS.	(a) Effects of AIDS (b) Symptoms of syphilis (c) Symptoms of AIDS (d) Tuberculosis (e) Gonorrhoea (f) Abstain from sex (g) To increase body immunity (h) Opportunistic diseases

Section C

Answer the following questions:

3. Mention the symptoms of chancroid.
4. Mention four ways to prevent sexually transmitted diseases.
5. What is the relationship between HIV infections and other sexually transmitted diseases?
6. Mention foods which are not suitable for a person living with HIV and AIDS.

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7. Why is balanced diet important for people with HIV infection?
8. Explain the importance of personal hygiene to a person living with HIV and AIDS.
9. Explain the effects of HIV and AIDS to (a) Family (b) Nation

Vocabulary

Absorption	the process through which the end products of digestion are taken by the body cells
Ectopic pregnancy	a complication of pregnancy in which the embryo attaches outside the uterus
Lymph	transparent fluid produced in the body tissues
Nutrients	compounds essential to the life and health of a living organism
Protozoa	living organisms that belong to the kingdom protoctista, example amoeba
Sexual intercourse	the insertion of the penis into the vagina

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Chapter Fourteen

Hereditary diseases

Introduction

In Standard Four, you learnt about body immunity and types of communicable and non-communicable diseases. You also learnt about how communicable diseases are transmitted, their symptoms and preventive measures. In Standard Five, you learnt about epidemic diseases, their causes, symptoms and preventive measures. In this chapter, you will learn about hereditary diseases, their causes and their differences from other diseases. The chapter will also provide you with the precautions to be taken by people with hereditary disease. The knowledge and skills acquired in this chapter will enable you to identify hereditary diseases and ways to help the victims.

Hereditary diseases

Hereditary diseases are caused by genetic disorder. Genetic disorders are abnormalities in the genetic makeup of an individual. These genetic disorders are passed on from parents to their children. These abnormalities occur in the genes which are carried in the hereditary material. Hence a person with a hereditary disease has inherited genetic disorder from one or both parents. However, not all genetic disorders can result into diseases. Examples of genetic disorders that do not become disease include albinism and colour blindness. Genetic disorders that may become diseases include sickle cell anaemia and haemophilia.



Group discussion

1. What are hereditary diseases?
2. Is every genetic disorder a disease?

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Sickle cell anaemia

Sickle cell is an inherited condition that causes the red blood cells to change their shapes from a biconcave (Figure 1(b)) into sickle or half-moon shape. Shapes for sickle cells are as shown in Figure 1(a).



Figure 1(a): *Sickle cells*



Figure 1(b): *Normal cells*

Normally, red blood cells have haemoglobin which transports oxygen and carbon dioxide gases in the body. When the shapes of red blood cells change into sickle, their ability to transport oxygen in the body is reduced. The body of a person with sickle cell disease has a reduced ability to produce enough red blood cells. The sickle cells produced have a short lifespan. This condition leads into decrease of blood or sickle cell anaemia disease. Sickle-shaped cells also fail to pass through blood capillaries, leading into blockage of blood flow. This in turn, causes a shortage of oxygen in the body cells required for respiration and energy production.

Symptoms for sickle cell anaemia: Some of the symptoms of sickle cell anaemia are:

1. General body weakness. This condition makes the sick person weak and cannot walk or perform different activities.
2. Pain in different parts of the body. These parts include the arms, legs, stomach, back, chest and joints.
3. Frequent fever.
4. Swelling of legs and arms.
5. Frequent blood deficiency.
6. Hardening of joints accompanied with severe pains.

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7. Coughing and difficulties in breathing.
8. Loss of appetite, stunted growth and repeated infections.
9. Loss of consciousness resulting from poor blood flow into the brain.
10. Increased rate of heartbeat.

If these symptoms persist, they affect the spleen and can even cause death. The rupture of blood capillaries in the brain may cause immediate death to the person.

Precautions to take for people living with sickle cell anaemia: It is important to ensure that a person with sickle cell anaemia is well cared for. The following precautions should be considered:

1. A person with this disorder should drink enough water or fluids.
2. The person should be protected against opportunistic diseases that may easily attack him/her.
3. The victim should be immediately treated when sick.
4. The victim should be provided with proper meals to promote his/her body health and to enable the body defend itself against diseases.
5. A disordered person should be engaged in light physical exercises and must get enough time to rest especially during hot days.
6. The body temperature of the victim should be maintained and he/she must be taken to the hospital when the temperature exceeds 37 ^{o}C.

Exercise 1

Answer the following questions in your exercise book.

1. Explain the meaning of genetic disorders.
2. Give examples of inherited diseases in human beings.
3. Explain two conditions that lead into deficiency of blood in a sickle cell anaemia victim.
4. Which type of cells are affected and change into sickle shape?
5. Mention five symptoms of sickle cell anaemia.

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Haemophilia

Haemophilia is a disorder in which blood does not clot when a person is injured. Normally, when someone gets an injury, bleeding happens for some time then the blood clots. This however does not happen to haemophilic people, instead small wounds cause excessive bleeding for several days or weeks. This condition occurs to a person with a gene for haemophilia. Haemophilia is normally inherited from one parent or both parents. A mother can be a career without showing any effect but some of her children can be haemophilic.

A male parent with a haemophilic gene in his genetic materials will be affected by it. Males are more vulnerable to haemophilia than females. This is because males have a single X-chromosome in their gametes. This X-chromosome carries the gene for haemophilia. If the X-chromosome has this gene, the person becomes haemophilic. Females possess two X-chromosomes in their gametes which make it difficult for both of them to be affected at once. Females thus can carry genes for haemophilia without showing any of the symptoms. A female with haemophilia normally dies during adolescence because of too much bleeding during menstruation.

Symptoms of haemophilia: Some of the symptoms of a haemophilic victim are:

1. Excessive and prolonged bleeding from injury, after surgery, circumcision or after uprooting of a tooth.
2. Giving out urine or stool with blood.
3. Nose or gum bleeding that takes a long time.
4. Bleeds while coughing.
5. Pain in the leg or hand joints.
6. Navel bleeding for children and delayed navel healing.
7. A victim with bleeding in the brain experiences headache, stiff neck, vomiting, and difficulty in speaking. The victim may lose memory and undergo paralysis of some parts of the body.
8. A victim with internal bleeding may have swelling, severe pains, high body temperature and difficulty in walking.
9. A victim may also develop internal head bleeding.

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Prevention and control of haemophilia: Haemophilia has no specific cure but there are methods to prevent bleeding and treatment of its symptoms. A person with haemophilia may also be given medicine that improves the ability of the blood to clot in case of injury or bruises.

Precautions to undertake for victims of haemophilia

1. The victim must rest if there are symptoms of internal bleeding.
2. The victim should do special body exercises in order for the body parts to work normally.
3. Great care should be taken during dental treatment or surgery in order to prevent excessive bleeding.
4. The victim should not take medicine without prescription from a doctor.
5. The victim should be given enough care and counselling.

Table: *Differences between hereditary diseases and non-hereditary diseases*

Criteria	Hereditary	Non-hereditary
Cause	Caused by defects in genetic materials.	Are not caused by genetic materials in anyway.
Treatment	Most of them have no cure due to their causes.	Most of them have a cure.
Types of victims	They are inborn.	Occur to any person at any time.
Duration of the disease	They are permanent in the life of an individual.	Most of them are temporary.
Family history	There can be a family history of some people with a similar disease.	Are not associated with family history.
Methods of transmission	They are not transmitted but inherited.	Are transmitted through several ways like air, body contact, food and sexual intercourse.
Prevention	It is impossible to prevent these kinds of disease.	Most of these diseases can be prevented by observing health principles.

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Exercise 2

Answer the following questions in your exercise book.

Section A

1. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.
   (a) Both sexes can equally get haemophilia. _____
   (b) Sickle cell anaemia causes blood deficiency. _____
   (c) Difficulty in walking is a symptom by people with sickle cell anaemia and haemophilia. _____
   (d) Sickle cell anaemia is an inherited disease. _____
   (e) Haemophilia can be transmitted through blood transfusion from a person suffering from haemophilia. _____
   (f) The father is a career of genes for haemophilia. _____

2. Choose the most correct answer from the following questions:
   (i) Genetic diseases are caused by _____.
      (a) defects in genetic materials
      (b) effects of environmental pollution
      (c) germs or pathogens
      (d) low body immunity

   (ii) One among the following is a symptom of sickle cell anaemia _____.
      (a) bleeding for a long time after an injury
      (b) rupture of blood vessels in soft tissues
      (c) giving out stool with blood
      (d) periodic blood deficiency

   (iii) Medicines for improving clotting of blood when a victim of haemophilia is injured _____.
      (a) decrease the effects of haemophilia
      (b) increase the effects of haemophilia
      (c) do not help a person with haemophilia
      (d) cure haemophilia

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Section B

Answer the following questions:

3. List four symptoms of a person suffering from haemophilia.
4. Can the teeth of a haemophilic victim be removed without a problem? Explain.
5. Mention two differences between sickle cell anaemia and haemophilia.
6. Why do hereditary diseases have no cure?
7. Explain three differences between hereditary diseases and non-hereditary diseases.
8. Why can't a sickle cell anaemic patient be completely healed even after blood transfusion?
9. Mention four precautions that should be observed by people living with sickle cell anaemia.

Vocabulary

Gene	the basic physical and functional unit of heredity
Genetic materials	hereditary materials which are present in every living organism
Heredity	the biological process of passing traits and characteristics from parents to offsprings
Hereditary material	materials which are passed on from parents to children. They are also called DNA
Spleen	an organ in the upper part of the abdomen helping in the production and removal of dead cells in an animal's body

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Chapter Fifteen

Health services

Introduction

In Standard Four and Five you learnt about HIV and AIDS and other diseases that affect the body. You also learnt about how to care for people infected with HIV/AIDS and their special health care. In this chapter, you will learn about health services provided to various groups of people and the characteristics of each group. The knowledge and skills acquired through learning this chapter, will help you to adhere to health principles in order to promote good health.

Community health services

Health is a state of being physically, mentally and socially well and free from diseases. Good health is important because it contributes to personal, family and national development. Health services are services offered to patients, families and communities by medical workers. These services are provided by the government and private organisations to promote health in the community. Health services are provided to special groups of people in the community. Examples of these services include health education, counselling and medical treatment.

These services are provided based on guidelines from the health sector in the government. The special groups include children, pregnant women, youths, the elderly and patients with HIV/AIDS, non-infectious diseases such as diabetes, high or low blood pressure and asthma. Private organisations include religious and charitable organisations.

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Importance of health services



Discuss with your fellow pupils

What is the importance of health services in the community?

Availability of health services in the community is important due to various reasons including the following:

1. To lower or remove cost of medical treatment for patients with non-infectious diseases. In most cases people suffering from these diseases cannot afford treatment costs as some may not be able to do productive work. Provision of community health services will therefore reduce deaths related to these diseases.
2. To lower treatment costs and other services for pregnant mothers and children below five (5) years of age. The main purpose is to minimise mother and child deaths in the community. Some of the services provided to the mother and child are vaccination for children, counselling and medical checkups during pregnancy. Moreover, the services help to predict the possible date of delivery and provide treatment to children under five years of age. Through these services, parents are encouraged to visit health centres with their children to get these health services so as to reduce deaths.
3. To promote healthy life for people in the community.
4. To reduce the severity of chronic and epidemic diseases in the community.
5. To reduce new infections for diseases such as HIV/AIDS and tuberculosis. In such clinics, counselling and treatment services are provided to prevent new infections.
6. To help the elderly who cannot afford health services.
7. To protect and educate youths against infectious diseases such as AIDS, hepatitis B and tuberculosis. This enables the youths who are the workforce of the nation to remain healthy and productive, so that they could contribute to their own development and that of the nation at large.
8. To provide special guidance to pregnant mothers and their husbands. This kind of training prepares them psychologically and emotionally to overcome challenges during pregnancy. They are also counselled on how to take care of pregnancy. In addition to counselling services they also undergo checkups for STDs and HIV infections. Examples of STDs are syphilis and gonorrhoea.

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Examples of community health services

There are different units that provide health services in the community. In most cases these units are available in hospitals, health centres and dispensaries. However, some units may not be available in hospitals depending on the target group and the particular type of health services offered by that unit.



Group discussion

What are the types of services offered in health centres?

There are many types of services offered in health centres. Such services include checkups for diabetes, blood pressure, HIV and tuberculosis. Other services include counselling and guidance on proper use of medicines and balanced diet both to patients and healthy people. They provide education and guidance to youths on sexual and reproductive health. The health centres also provide health education on child care and maternal health. Moreover, they provide cost-free or cheap medical treatment for children and pregnant women. The health centres also provide medical treatment and other health services to the youth and elderly in the community.

Groups of people who need special health services

There are various groups of people in the community who need special health services. Such groups include children, pregnant women, youths and elders. The other group of people who need special health services are people with non-infectious diseases like diabetes, heart diseases, cancer and asthma. Services for other diseases such as AIDS are also provided. These groups need help from the government and community in general in accessing special health services.

Health services for children

These are special health services that are available for children under five years. The services are normally offered in clinics, health centres or hospitals where special units are allocated for providing these services to children. In some health centres these services are offered together with maternal health care services. This is because maternal health care services for pregnant women and children are closely related. This relationship occurs because the foetus needs are similar to those of a baby below five years.

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Health services offered for children

The health services that are offered to children include treatment and vaccination against deadly diseases. The health services that are offered are described in the following sections.

Diagnosis test: Various checkups and tests are done to find out the child's health progress. Such checkups include weight measurement, as it is shown in Figure 1 and diagnosis of different types of diseases which affect children.



Figure 1: *Measuring and recording the weight of a baby*

Technical advice: Advice is provided to parents on how to take care of their children, to promote their health. For example, when a baby is under or over weight, the mother is advised on the type of diet to give to the baby in order to restore its normal health.

Provision of vaccines and medicine: Vaccination is the injection of an agent that resembles a disease causing organism into the healthy body to stimulate the body immunity. Vaccination can be administered through injection or orally by swallowing pills or drops containing a vaccine. If a

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person is vaccinated against a particular disease, the ability of the body to fight against that specific disease is stimulated. Some of the diseases that children can be vaccinated against are measles, tetanus, poliomyelitis, tuberculosis, hepatitis B and smallpox. Vaccination helps to strengthen immunity of children against various opportunistic diseases which are dangerous to their well-being especially children under five years. Moreover, children are given vitamins to strengthen their body immunity. Other types of health services include treatment of infections by various worms.

Protective devices: Apart from the vaccinations given to children, they also need facilities to protect them against diseases. Some parents cannot afford these facilities for their babies. It is for this reason that special vouchers for the parents are offered by the clinics to enable them to buy facilities at a reduced price. Examples of facilities offered at a reduced price are treated mosquito nets. A mosquito net protects the child against malaria and other diseases that are transmitted by mosquitoes.

Treatment for children: When children are taken to the clinics they undergo health checkups by specialists. In case they are diagnosed with any medical condition they are given appropriate treatment. Children who require further treatment are taken to a special ward for further checkup and treatment.

Training on child care: In clinics parents are given various training which help them in parenting. This training is important because it helps parents to raise their children following proper health care principles. The training offered includes how to prepare a balanced diet for a child, warning signs for child's poor health and how to control diseases in children. They are also educated on the importance of using family planning methods and are given such services by specialists. In addition, parents are instructed on how to provide first aid to children. Moreover, parents are educated on the importance and appropriate way for breastfeeding as well as proper care for their children.

Breastfeeding

Mother's milk is the best food for the child. This milk is important because it contains necessary nutrients for child's growth. The mother's milk, especially within the first six months is important for the child's body immunity. It is

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important for the mother to ensure a proper sitting position of the baby when breastfeeding. The proper sitting position of the baby as shown in Figure 2 prevents the baby from chocking. It also enables the baby to suck the milk with comfort.

The importance of breastfeeding:

1. Mother's milk is safe and easy to access by the baby because it is naturally produced by the body of the mother.
2. It is a natural food which meets the requirements of the body.
3. Breast milk has a natural temperature required by the baby's body.
4. Mother's milk enables the child to grow properly and maintain the normal body size to age ratio.
5. It prevents malnutrition in the baby in the first few months.
6. Breast milk contains natural immunity because it is rich in nutrients.
7. Breast milk does not require special preparation.



Figure 2: *Proper positioning of a baby during breastfeeding*

Proper child care

Children need physical and mental care. It is the responsibility of parents to ensure that their children have access to basic needs including taking them to the clinic. This will enable the children to get vaccines against various diseases and treatment when they fall sick. It is the responsibility of parents to ensure that children are safe and protected from accidents, body injuries and mental problems. Parents are responsible to make sure that children develop behaviours that are acceptable in the society. Another responsibility of parents is to make sure that children get enough and nutritious food to

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enable them grow well physically and mentally. They should also make sure that children have proper clothes and shelter. Moreover, parents are responsible to provide education that will help their children to lead good life.

Importance of health service centres for children

The health service centres are of great importance because of the various services which they provide. These services include:

1. Preventing disability which a baby can acquire at its early age due to diseases such as poliomyelitis.
2. Helping to reduce deaths that occur to children at an early age due to diseases.
3. Enabling parents to understand better ways of taking care of their children by observing proper dietary principles, treatment and vaccine.
4. Advocating for the importance of both parents to cooperate in bringing up and taking care of their children right from childhood.

Exercise 1

Answer the following questions in your exercise book.

Choose the most correct answer for each question.

1. Children who obtain treatment in the clinics are _____
   (a) children with albinism only.
   (b) those with health problems only.
   (c) all children under five years of age.
   (d) all children above five years of age.
2. What happens to children diagnosed, as being seriously sick? _____
   (a) They are allowed to go back home.
   (b) They are provided with appropriate treatment at the hospital or health centre.
   (c) Their parents are directed on how to provide them with first aid.
   (d) Their visit to the clinic is postponed until some other time.

Answer the following questions:

3. What is the meaning of “health”?
4. What is the meaning of “health services”?
5. Mention three health services provided for children.
6. Mention five advantages of mother’s milk to children.

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Health services for youths

The period between childhood and adulthood is called youth. This age is faced with many challenges including health challenges. Among health challenges facing youths are reproductive health, sexually transmitted diseases and drug abuse. In order to help youths to overcome these challenges, the government in collaboration with other stakeholders has established special centres which provide friendly services to youths.

Importance of health services for youths

1. To help the youth addicted to drugs to get restored to their normal health condition. The medical treatment and counselling offered help to rehabilitate them to their normal life.
2. To provide education to youths on how to cope with body changes resulting from adolescence.
3. To provide counselling on protection against HIV/AIDS infections and other sexually transmitted diseases.
4. Some of the health centres provide services such as food, clothing and shelter during training and medical treatment. These services are specifically provided to the drug addicts.
5. To help the drug addicts and other groups to be good citizens.
6. To connect the youth with national and international organisations so as to overcome different challenges facing them.

Services that are offered to youths in health centres

Health training: These centres provide special training for youths to enable them to protect themselves against diseases. The diseases that mostly affect the youth are sexually transmitted diseases and HIV/AIDS. Moreover, youths are trained about reproductive health and skills to avoid drug addiction. Likewise, youths are provided with moral education, to become good citizens.

Counselling: Youths are provided with counselling services to enable them to avoid various risky behaviours such as alcoholism, drug abuse, corruption and sexual intercourse. The health centres have a friendly environment for counselling as indicated in Figure 3.

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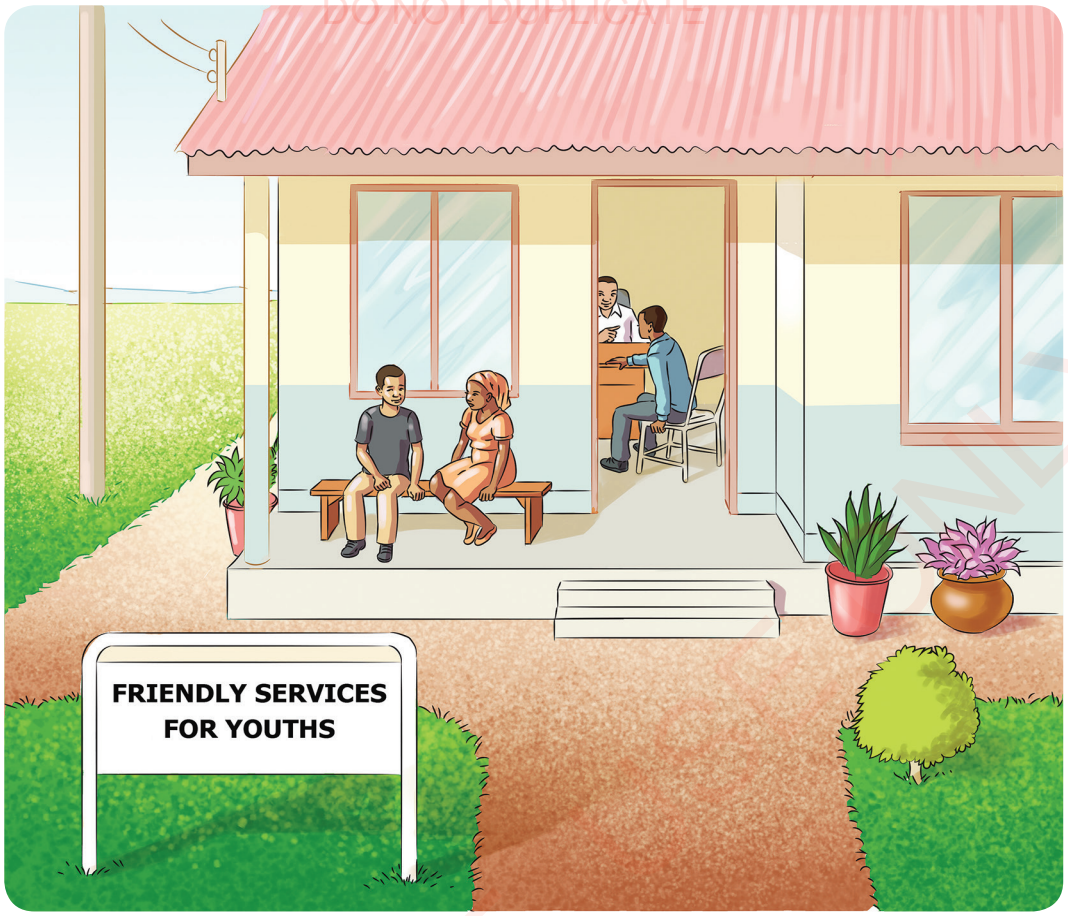

Figure 3: *Youth health services*

Grants: Some organisations provide grants to cater for the needs such as food, accommodation and clothing for youths in the centres. These services are provided for the entire period when they are attending special training and treatment. Also, entrepreneurial skills are offered to youths to provide skills to generate income and manage their life. Moreover, some centres offer small capital grants to enable the youth to start individual or group business after completing the rehabilitation programme.

Diagnosis and treatment: Some organisations offer services for youths to test for sexually transmitted diseases and HIV/AIDS and provide medical treatment. In most cases youths visit health centres for health checkup, counselling and medical treatment.

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Exercise 2

Answer the following questions in your exercise book.

1. Mention two reasons for the presence of youth health services.
2. List three types of health services that are offered to youths.
3. Briefly explain two health challenges that face youths.
4. What is the meaning of friendly health services for youths?

Health services for pregnant women

Pregnancy is the period a baby takes to develop in its mother's womb. During pregnancy women face many health challenges. If such challenges are not well addressed, they may lead to serious problems or even death. Considering the importance of these services, the government has established special clinics which deal with various challenges facing pregnant women. These clinics are special centres or hospitals that provide health services for pregnant women. The woman is advised to attend clinic as soon as she realises that she is pregnant. Normally, all services provided in health centres are sponsored by the government and other health stakeholders. It is for this reason that most services are offered free of charge.

The importance of health services to pregnant women

1. To reduce child and maternal mortality by encouraging pregnant women to access health services in specialised centres.
2. To provide appropriate education to pregnant women on sexually transmitted diseases, family planning and proper diet during pregnancy. This is possible as it is easy to get all pregnant women together.
3. To get medical tests and information on the development of a baby in the womb and various risk factors for pregnancy development.
4. To enable pregnant women to access treatment and special advice on the progress and growth of the child from health professionals.
5. To provide services and counselling for pregnant women with HIV/AIDS to help them deliver babies that are not infected with HIV.

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Services that are offered in clinics for pregnant women



Group discussion

What type of services do pregnant women get in clinics?

Read the following story carefully then answer the questions that follow.

Mama Salumu, Mwajuma and Neema are friends living in Mawasiliano village. In their village there is a dispensary that offers different services including health services for mothers and children. Neema was wondering why many pregnant women were going to the dispensary every day while they were not sick. One day Mwajuma and her husband went to get services in the clinic located in that dispensary. On her way back home she met Mama Salumu and Neema. Neema seemed to be surprised that Mwajuma was attending clinic that early. Their conversation was as follows:

Mama Salumu: Mwajuma, where are you coming from in this hot sun, walking so slowly?

Mwajuma: My dear, I am from the clinic.

Neema: Mmh! Why did you go to the clinic, while your pregnancy is still at its early stage?

Mama Salumu: I guess you don't know, just like I didn't know about the services provided in the clinic for pregnant women. Why don't you ask Mwajuma to explain to you?

Neema: Mmh! If that is the case, truly I have no idea. I thought women visit the clinic to be told when they were going to deliver, (Neema said this while showing a desire to learn more).

Mwajuma: Let us rest under this shade so that I can explain to you the importance of clinic. Apart from providing checkups on the development of the baby, advice on appropriate foods to use during pregnancy is provided. Moreover, in the first visit, you are supposed to attend the training with your husband. During that training, you will be advised on

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how to take care of the pregnancy and how to relate with your husband. I also took my husband along today to the clinic, he has now gone to the market.

Neema: Ah! My dear, can Musa, my husband really agree?

Mwajuma: Moreover, diagnosis for HIV is done in the clinic and advice on how to get an uninfected baby is provided. Furthermore, sexually transmitted diseases such as syphilis and gonorrhoea are diagnosed. This diagnosis helps to receive treatment which protects the unborn baby against infections. The clinic provides vaccines for various diseases like tetanus, smallpox and measles. Today I got the second vaccine and I am told there are still more vaccines.

Mama Salumu: So is it really that important? I only attended during the early days of pregnancy and stopped. I didn't know there are many services that I am missing.

Mwajuma: Also, you should know that in the clinic the likely time for delivery is estimated. This gives you chance to prepare yourself for the delivery day. In case of pregnancy complications, specialists provide proper advice on how to deal with the situation. If you do not attend clinic, you will not be able to understand such challenges and you will be putting your health in danger. In addition, in clinics we are educated on the best way to breastfeed the baby. We are also told about the right time to stop breastfeeding the baby.

Neema: We appreciate your advice Mwajuma. I have been suspecting some changes since last month, therefore today I will start talking to my husband about attending the clinic.

Mama Salumu: Surely, today I have understood the importance of the clinic to pregnant women. Neema, remind me so that next week I go to the clinic along with my husband.

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Figure 4: *Health service provided to pregnant women*

Exercise 3

Answer the following questions in your exercise book.

Section A

1. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.
   (a) The clinic for pregnant women offers diagnosis services only. _____
   (b) HIV/AIDS is one of the diseases for which pregnant women should be tested. _____
   (c) Husband and wife are treated for free in maternal and child health clinics. _____

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(d) Pregnant women are trained, given clothes, counselled and told the possible date of delivery in the clinic. _____

(e) A pregnant woman can start attending clinic any time she wishes. _____

(f) One of the aims of the clinic for pregnant women is to simplify services provision for them. _____

Section B

Answer the following questions:

2. Explain what might happen to a pregnant woman if she does not attend clinic.
3. What is the meaning of health services for pregnant women?

Health services for the elderly

Health care for the elderly involves special arrangements that are made to help old people to access health services. These services are provided at hospitals or specialised centres. These centres are either isolated or can be placed in the health facilities such as hospitals or dispensaries. Old age is the stage in life that a person attains after going through various stages of growth. These stages include infancy, childhood, adolescence and adulthood. Usually a person aged 60 years and above is called an old person and is therefore supposed to get free services at the health centres.

Likewise, the elderly that are not living in special centres can access health services in all centres and hospitals. This programme is according to the 2003 national policy. Also, old people who were once public servants are given health insurance identify cards. Old people who were not public servants and without health insurance identify cards are given special cards for free medical treatment. In order to protect and promote the health of the elderly there are various services that should be provided. The services provided are described in the sections that follow.

Health check-ups and treatment: The elderly often experience problems in their body systems. It is therefore necessary to do health check-ups from time to time. Health check-ups help to identify their health problems so that they could be handled immediately. Such problems include hearing problems

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and vision which might require use of hearing aid and spectacles respectively. Some of them may also suffer from chronic diseases like diabetes, prostate gland cancer and high blood pressure, thus they need treatment. These diseases are treated once the elderly visit health centres or hospitals.

Advice on various health issues: This group consists of people whose bodies contain a larger number of dying cells than those being produced. This situation makes them to require a balanced diet. Thus, the elderly are educated on suitable food types for maintaining and improving their health. Moreover, they are also advised on proper use of medication.

Provision of special health education: There are important things that the elderly need to know in order to meet the challenges of various health issues. Part of the education that they receive is on how to identify symptoms of dangerous diseases. They should be educated about the importance of seeking medical treatment immediately once they fall sick. In addition, these people should be educated on the importance of mental health and physical exercises. They should be guided on the use of various techniques including the use of modern technologies in doing exercises.

Importance of health services for the elderly

These services are of great importance to the community due to the following reasons:

1. To enable old people to access health services which would otherwise be difficult to get due to low income.
2. To enable these people to make positive contributions to the society and the nation by enabling them to live longer.
3. Increase social well-being by eliminating complaints of one of the forgotten groups of people in the society.

Exercise 4

Answer the following questions in your exercise book.

1. Mention two characteristics of the elderly, who are supposed to be treated in their clinics.
2. List the types of health services required by old people.
3. Mention two reasons of offering health services to old people.

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Health care for patients

Patients' health care services include all the services provided to patients such as education to enable them deal with the situations they are going through as shown in Figure 5. The main purpose of these services is to enable them to recover quickly and continue to live like other people. Likewise, for non-curable diseases, health care services help to minimise the effects of the diseases so that by getting relief patients are able to live their daily life.

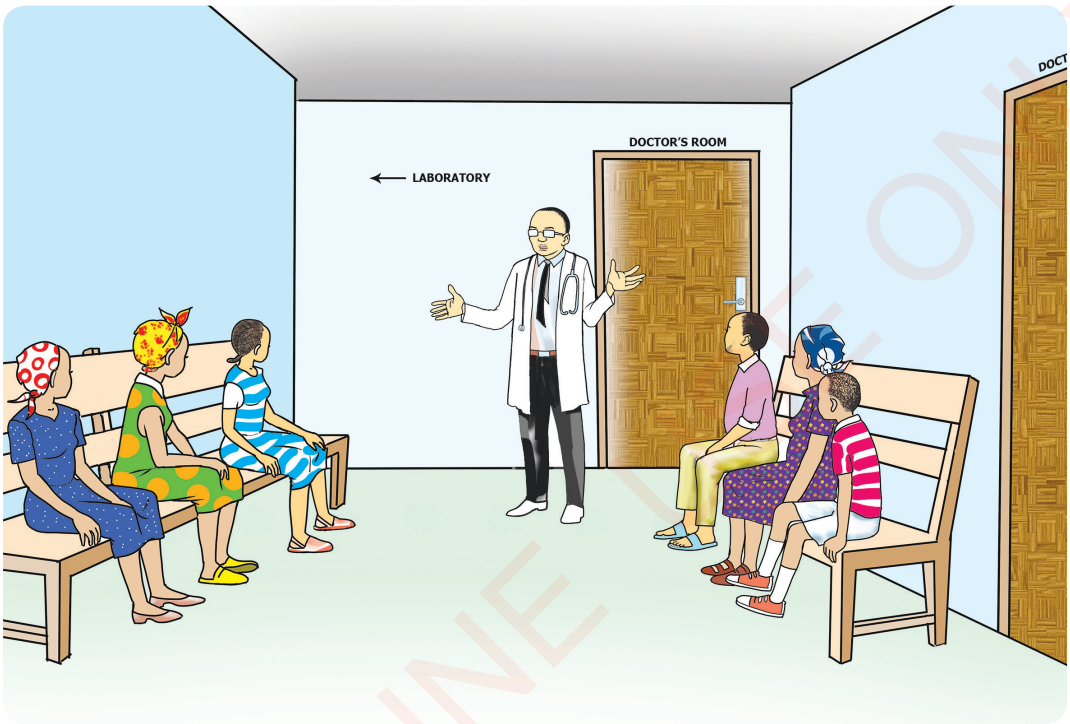

Figure 5: *Health education services at the health facility*

Importance of health care services for patients

Read the following story and then answer the questions that follow.

One morning, the headteacher ordered the bell to be rung, he was with a guest. He invited and introduced the guest as the District Medical Officer. The guest said that he would present a topic on health services for sick people. The guest explained to the pupils the meaning of health services. He also asked them to mention the health services they knew. The guest appreciated the good answers given by the pupils, he then allowed them to ask questions.

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A standard six pupil from Mtakuja Primary School named Chausiku raised her hand. After being allowed, Chausiku asked, “One day I heard my father and mother talking about health care for patients. Why is it important to have these services?”

“Thanks Chausiku for a very good question”, the doctor congratulated her with a smile. “Health services are offered in health facilities called clinics. There are clinics for curable and non-curable diseases. Non-curable or chronic diseases include diabetes, asthma, AIDS, heart diseases, cancer and sickle cell anaemia”.

The doctor continued to explain that usually there are three main advantages of attending the clinic. One of them is the follow-up of patients’ progress after initial treatment. This is very important as some medicines may affect some of the patients. Thus, the doctor may be required to change the medication once the effects are noted. “Are we together?” the doctor asked. All the students responded, “yes!” in a loud voice.

The doctor continued to explain, “These clinics also provide laboratory tests for various diseases and offer treatment when necessary. In many cases the diseases diagnosed require treatment. This helps to relieve the patients of pain and make them become stronger and get new hope”.

After a deep breath, the doctor continued, “Another advantage is counselling that is offered in health centres depending on the type of disease. The counselling aims to help patients to accept their conditions and make them understand how to go on with their life while attending treatment. They are also advised on how to protect themselves against new infections for diseases like AIDS and tuberculosis (TB). Furthermore, the infected people are strongly advised to ensure they protect others from infections”.

All pupils were listening to the doctor quietly and carefully all the time he was speaking. He continued to explain that along with advantages explained earlier, these clinics provide instructions on how to take care of oneself, types of diet and health principles.

After the speech, the doctor thanked the headteacher and promised to visit again when required.

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Questions

Answer the following questions in your exercise book.

1. What have you learned from this story?
2. Mention the advantages of health service centres in the community.
3. Why do you think the headteacher invited the doctor to visit the school?

Exercise 5

Answer the following questions in your exercise book.

Section A

1. Choose the most correct answer then write its letter in the blank.
   (i) The main purpose of health services for patients is _____.
      (a) to comfort them from various challenges in life
      (b) to help them recover quickly and resume their normal life
      (c) to advise them about income generation
      (d) to minimise living costs
   (ii) Availability of enough health specialists is one of the important qualifications of_____.
      (a) any community health clinic
      (b) counselling clinic for youth only
      (c) pregnant women clinic only
      (d) orphans centre only
   (iii) The following are risk behaviours for youths except_____.
      (a) alcoholism
      (b) marijuana smoking
      (c) love for work
      (d) drug abuse

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(iv) Diabetic patients are offered the service of _____ when attending their clinics.

(a) water drip

(b) blood transfusion

(c) advise on proper diet

(d) financial support

(v) The natural and best food for a new born child is_____.

(a) mother's milk

(b) cow's milk

(c) artificial milk

(d) nutritious porridge

Section B

2. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.

(a) All the health centres offer traditional treatment services. _____

(b) Small pox vaccine protects a child against measles as well. _____

(c) All children with serious cases during treatment are hospitalised in the clinic. _____

(d) When children attend clinic frequently they easily become infected with diseases. _____

(e) Parents with AIDS can give birth to a child without any infection. _____

(f) Pregnant women's clinic is for pregnant women and their husbands. _____

(g) The health services that are offered in the community are for the mother and child only. _____

(h) The first mother's milk is not good for the child because it is dirty. _____

(i) Parents are responsible to provide children with balanced diet. _____

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3. Fill in the blanks.

   (a) Health services in the community are offered by _____and _____.

   (b) Special groups of people in the community that need health services are _____, _____, _____ and _____.

   (c) A pregnant woman is required to attend clinic together with her husband especially during _____.

   (d) Three advantages of maternal and child health clinics are_____, _____, and _____.

   (e) One of the advantages of health services for the elderly is_____.

Section C

Answer the following questions:

4. Which groups of old people are provided with health insurance identity cards?
5. Mention the types of health services required for the elderly.
6. List three challenges that youths face and hence require them to seek health services.
7. What is the importance of vaccination in the body of a child?
8. List two characteristics of an old person who should get free health services.
9. Mention three characteristics of a person who should get health services from youth-friendly health centres.
10. Mention two advantages of taking a child under five years of age to a health clinic.
11. Explain the responsibility of parents to their children.

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Chapter Sixteen

Blood circulatory system

Introduction

In Standard Four and Five you learnt about the digestive system and reproductive system in human beings. In this chapter, you will learn about the blood circulatory system in human beings. Specifically, you will learn about the parts of the blood circulatory system, how the system works and its importance. You will also learn about the disorders of the blood circulatory system and the relationships between the blood circulatory system and other body systems. The knowledge and skills acquired in this chapter will enable you to avoid habits which will affect the blood system thereby maintain a healthy blood circulatory system.

Meaning of the human blood circulatory system

Blood circulatory system is a system that transports blood, nutrients and waste products in the body. The system consists of blood, blood vessels and the heart. The heart pumps the blood through blood vessels to other parts of the body.

Parts of the human blood circulatory system

The blood circulatory system is made up of the blood, heart and blood vessels. Each part has specific functions for the proper functioning of the system.

Blood is a fluid tissue, which is made up of plasma, red blood cells, white blood cells and platelets. The largest part of the blood is plasma which makes about 55% of total blood volume.

Plasma: Plasma is blood fluid containing water and other substances such as proteins, antibodies and dissolved salts. The main role of plasma is to transport nutrients, hormones and proteins to other parts of the body where they are

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needed. The plasma also collects waste products from cells and maintains body temperature. It contains proteins that help blood to clot upon injury. It also contains antibodies that help to fight against disease causing organisms.

Red blood cells: These are round biconcave cells which lack the nucleus as shown in Figure 1.



Figure 1: *Red blood cells*

Red blood cells carry a pigment called haemoglobin which contains iron molecules. Haemoglobin gives blood its red colour. Red blood cells are formed in the bone marrow. The red blood cells live for about four months. The old red blood cells are usually destroyed by the liver which releases iron molecules. The iron is reused in the production of new red blood cells. The function of red blood cells is to transport oxygen and carbon dioxide in the body.

White blood cells: These cells have irregular shapes and are capable of changing their shapes as shown in Figure 2. They have a nucleus and are formed in the bone marrow and lymph nodes. The main function of white blood cells is to protect the body against disease causing organisms.

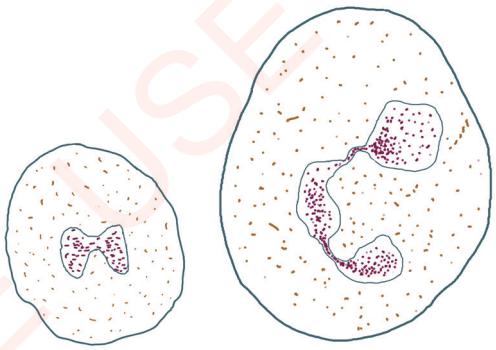

Figure 2: *White blood cells*

Platelets: These are small blood cells which lack a nucleus as shown in Figure 3. They have irregular shapes and are produced in the bone marrow. The main function of the platelets is to prevent bleeding when blood vessels are damaged.



Figure 3: *Platelets*

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The heart

The heart is a muscular organ located in the chest and is situated on the left hand side of the human body. The main function of the heart is to pump blood passing through it to other parts of the body. Figure 4(a) shows the external structure of the mammalian heart. The mammalian heart is divided into two parts, which are left and right side as shown in Figure 4(b). Each side of the heart consists of two chambers, upper and lower chambers. Therefore, the heart has four chambers.

The upper chambers are called atria and the lower chambers are called ventricles. Therefore, the heart consists of the right atrium, left atrium, right ventricle and left ventricle. The lower chambers are larger than the upper chambers. Between the atria and ventricles of each side there are valves. The heart has four main valves. Two of these valves are found where the large blood vessels called the aorta and pulmonary artery connect to the heart.

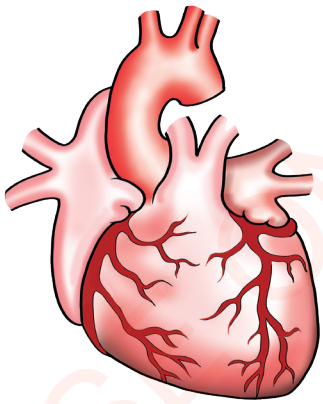

Figure 4(a): *External structure of the mammalian heart*

Although the hearts of animals like mammals have four chambers, the hearts of other animals are different. For example, amphibians such as frogs have three chambers in their heart.

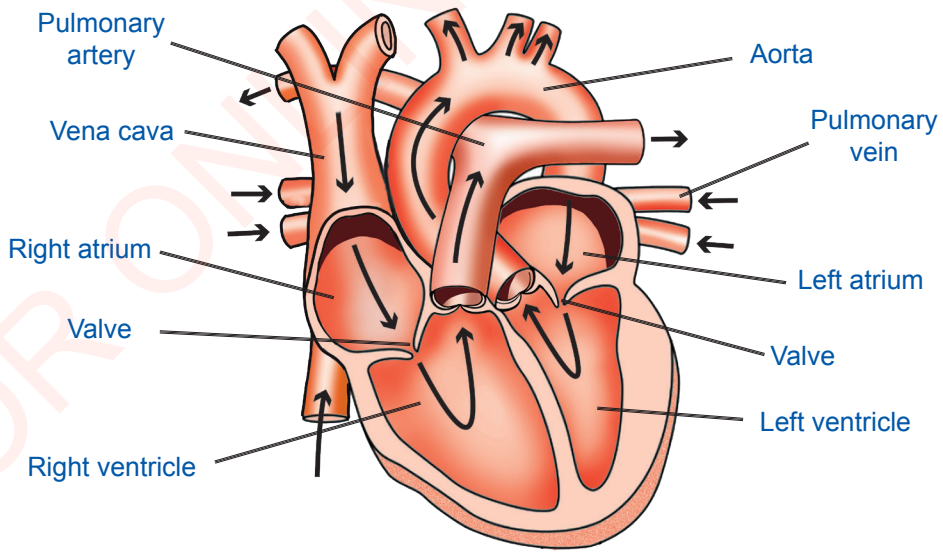

Figure 4(b): *Internal structure of a mammalian heart*

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All atria are found in the upper part of the heart, while the ventricles are found at the lower part of the heart. The walls of the ventricles are thicker than those of the atria. This is because the ventricles pump blood to the lungs and other parts of the body. The wall of the left ventricle is thicker than that of the right ventricle because the left ventricle pumps blood to different parts of the body. The right ventricle pumps blood towards the lungs.

The left atrium is connected to the pulmonary vein which carries oxygenated blood from the lungs. The blood is then pumped to the left ventricle. The right atrium is connected to the vena cava which receives deoxygenated blood from all parts of the body and passes it to the right ventricle. The pulmonary artery carries deoxygenated blood from the right ventricle to the lungs. The aorta receives oxygenated blood from the left ventricle and carries it towards different parts of the body.

How the heart pumps blood: Heart chambers contract and relax in turns. When the ventricles relax, the atria contract, similarly when the ventricles contract the atria relax. The contraction and relaxation of ventricles and atria produce the heartbeats. The heartbeats cause pumping of blood from the heart through blood vessels. A normal pulse rate average is 70 beats per minute. The heartbeats ensure continuous circulation of blood throughout the body. When the atria contract, the valve found between the atria and ventricles opens, then blood is pumped to the ventricles. When the ventricles contract, the valves found between the atria and ventricles close to prevent the back flow of blood to the atria. Contraction of the left ventricle causes pumping of blood to all parts of the body through the aorta. Furthermore, contraction of the right ventricle causes pumping of blood to the lungs through the pulmonary artery. Valves separating the left ventricle and aorta and that separating the right ventricle and the pulmonary artery close to prevent back flow of blood to the ventricles.

Blood vessels: Blood vessels are networks of hollow tubes that transport blood throughout the body. These blood vessels are arteries, veins and capillaries.

Arteries: These are blood vessels which transport oxygenated blood from the heart to other parts of the body except the pulmonary artery. The pulmonary artery transports deoxygenated blood from the right ventricle to

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the lungs. The pulmonary artery is the only artery with valves. The function of the valves is to prevent back flow of blood to the heart to ensure one direction of blood flow. The aorta is the largest artery which carries blood from the heart to different parts of the body.

Veins: These are blood vessels which transport deoxygenated blood from different parts of the body to the heart except the pulmonary vein. The pulmonary vein transports oxygenated blood from the lungs to the heart. All veins carry blood to the heart. Usually, this blood has low pressure. Therefore, all veins have valves to prevent backward flow of blood as shown in Figure 5(a) and 5(b). However, the movements of muscles help to increase blood pressure flowing towards the heart.

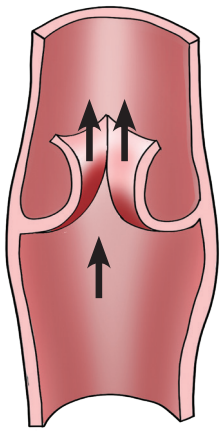

Figure 5(a): *An opened valve*

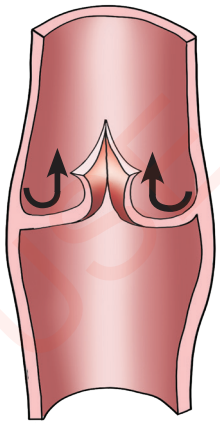

Figure 5(b): *A closed valve*

Capillaries: These are very small blood vessels connecting arteries and veins. They transport blood to every body cell. Capillaries are connected to arteries in one side and veins in the other side. Capillary walls are very thin to allow diffusion to occur. Diffusion allows movement of different materials such as water, nutrients and oxygen. It also allows movement of body waste such as carbon dioxide, urea and salts produced by the cells.

Exercise 1

Answer the following questions in your exercise book.

1. Mention the four chambers of the heart.
2. List four differences between veins and arteries.
3. What is blood circulation?
4. Why do veins have valves?

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How the blood circulatory system works

Blood from the heart is pumped to various parts of the body through the main artery called aorta. The aorta is divided into three branches. The first branch carries blood towards the heart walls. The second branch carries blood to the upper parts of the body including the arms, neck and head. The third branch carries blood towards the lower parts of the body including the trunk and legs.

These branches of the aorta are further divided into tiny blood vessels called capillaries which reach the body cells. Food and other substances enter the cells by osmosis and diffusion. Waste products and carbon dioxide gas from the cells diffuse to the capillaries. Capillaries fuse to form veins which carry blood to the heart through the vena cava.

Pulmonary artery carries deoxygenated blood towards the lungs. Carbon dioxide gas diffuses into capillaries and gets out of the body through the respiratory system. Oxygen in the lungs also diffuses into the capillaries which connect to form the pulmonary vein which carries blood towards the heart. The blood circulatory system works together with other organs like the spleen, liver, kidney and lungs as shown in the Figure 6.

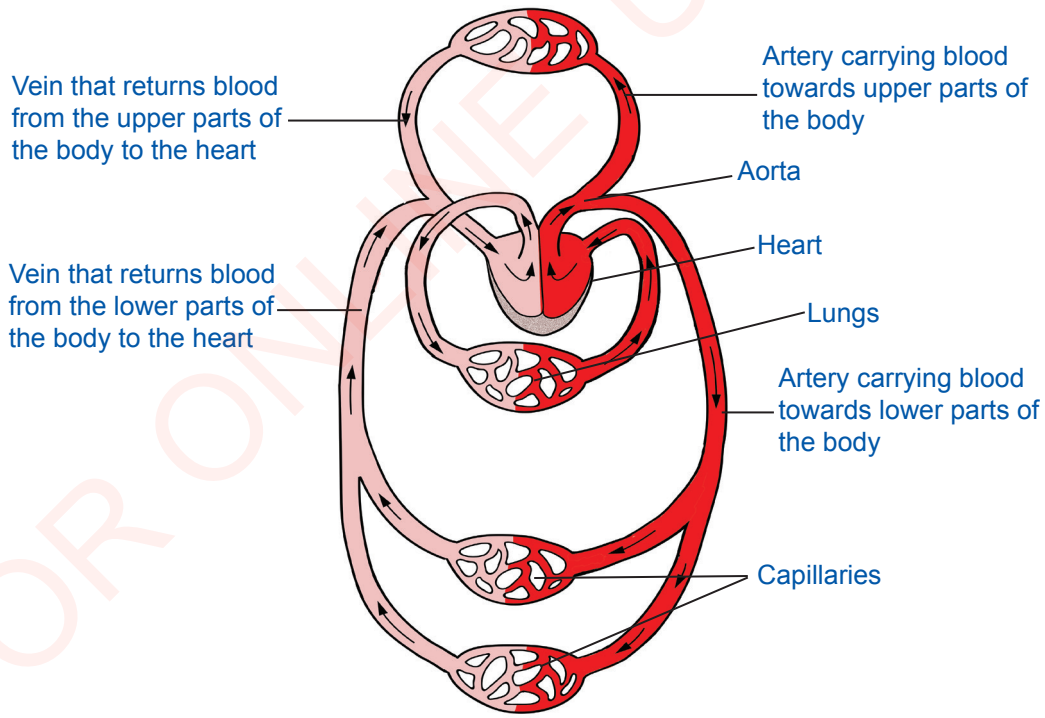

Figure 6: *Blood circulatory system*

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Relationship between the blood circulatory system and other body systems

The blood circulatory system is related to other body systems such as the digestive system, excretory system and respiratory system.

Relationship between the blood circulatory system and digestive system: Oxygenated blood enters the small intestine and carries the digested foods towards the liver through the portal vein. From the liver, the blood is carried by the hepatic vein which joins the vena cava.

Relationship between the blood circulatory system and excretory system: Oxygenated blood is carried towards the kidney through the renal artery. The blood passing through the kidney is filtered to remove urea, mineral salts and excess water. The blood from the kidneys is then carried out through the renal vein which joins the vena cava.

Exercise 2

Answer the following questions in your exercise book.

1. Mention the three branches of the aorta.
2. How is food taken from the blood into the cell?
3. List five organs which relate to the blood circulatory system.

Importance of the blood circulatory system

Distribution and regulation of body temperature: Body organs such as the liver and muscles which perform many functions produce large amounts of heat. The blood distributes that heat to different parts of the body. When the blood passes through the parts where heat is produced, it gets warmed. The heat is carried by the blood to other body parts or lost from the body. Blood makes the body temperature almost constant in all parts of the body.

Transportation of food: Transportation of food and nutrients like glucose to different parts of the body is among the important functions of the blood. This helps to ensure every cell of the body gets basic requirements for its survival.

Transportation of hormones: Blood is the only means used to transport hormones. These hormones perform different functions including growth, reproduction and assisting organisms escape from danger.

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Transportation of waste products: Blood transports waste products from where they are produced to parts where they are processed and removed from the body. For example, the blood transports nitrogenous waste from different cells to the liver and kidney.

Body defense: White blood cells in the blood protect the body against disease causing organisms that enter the body.

Transportation of gases: Blood transports oxygen and carbon dioxide. It transports oxygen from the lungs to other parts of the body. It also transports carbon dioxide from parts of the body to the lungs where is then taken out of the body through breathing.

Blood clotting: When injury occurs in the body, blood platelets produce chemicals that make a fibrous layer causing blood to clot. Blood clotting prevents further bleeding. It also prevents germs from entering the wound.

Exercise 3

Answer the following questions in your exercise book.

1. Mention six functions of the human blood circulatory system.
2. Where is heat produced in the body?
3. Mention the body wastes that are transported by blood.

Disorders of the human circulatory system

A circulatory system disorder is any condition that affects the proper functioning of the system. The disorders can arise as a result of problems with the heart, blood vessels and the blood itself. The disorders of the human circulatory system include blood pressure, leukemia, haemophilia and sickle cell anaemia. Some disorders have no treatment but their effects can be reduced.

Blood pressure

Normally the blood pressure of an adult should be 120/80 mmHg. The blood pressure depends on the size of the body. High blood pressure for example 160/90 mmHg and low blood pressure for example 90/60 mmHg cause problems. These problems include paralysis of different parts of the body, body weakness, fainting and sudden death.

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Causes of high blood pressure: There are many causes of high blood pressure. One of the causes is excess fats in the blood vessels and the heart. This causes blood to be pumped with a lot of force by the heart leading to increased blood pressure. High blood pressure is also caused by high levels of salts in the blood. Furthermore, the presence of large amounts of hormones increases heartbeats and can cause high blood pressure. Similarly, the use of drugs or alcohol can cause low or high blood pressure.

Behaviours that contribute to problems of blood pressure: Among the behaviours that contribute to problems of blood pressure are lack of enough physical exercises, stress and fear. Other behaviours include alcoholism, consumption of high-fat foods, extended consumption of medicines, excess intake of salt and sugar. In addition to these behaviours, kidney diseases, diabetes, heart and hormonal changes or shock may lead to problems in blood pressure.

Symptoms of high blood pressure: Symptoms of high blood pressure include headache, difficulty in breathing and general body weakness. Other symptoms include abnormal heartbeats and chest pains especially on the left side of the body. High blood pressure can also be accompanied with excessive sweating, dizziness and even fainting.

Prevention of high blood pressure: There are various ways of preventing high blood pressure. Physical exercise and reducing the amount of salt in diet help to prevent high blood pressure. Other measures include reducing the use of uncooked salt. Avoiding smoking and drinking too much alcohol prevents high blood pressure. Reducing eating foods containing large amounts of carbohydrates and fats is another way to prevent high blood pressure. It is also advised to avoid stress as much as possible.

Deficiency of blood (Anaemia)

Anaemia can be caused by genetic disorders which can be inherited. It can also be caused by excessive bleeding or low production of red cells. Other causes of anaemia include chronic diseases, diets with little iron, folic acid and vitamin B_{12}.

Symptoms of anaemia: Victims of anaemia have blood levels below average, leading to various problems. Such problems include general body weakness, dizziness and difficulty in breathing. Other symptoms include

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development of sores on the tongue and mouth and paleness in the eyes. Anaemic persons have also a dry skin, severe headaches and their feet and hands become very cold.

Behaviours that cause anaemia: Behaviours that cause deficiency of blood include poor feeding especially taking meals with no vegetables and fruits. The other behaviour is lack of immediate medical treatment for a person suffering from diseases like malaria which lead to anaemia. Female genital mutilation makes a woman to lose a lot of blood during the mutilation and delivery, these can also lead to anaemia.

Prevention of anaemia: Anaemia can be prevented by proper feeding and eating balanced diet. A balanced diet provides a person with iron minerals, vitamin C and B_{12} in the body. In addition, people should avoid bad traditions such as female genital mutilation that cause excessive bleeding during the process of mutilation and when the victim is giving birth. People suffering from anaemia should be provided with medicine containing the required minerals or undergo blood transfusion when necessary.

Leukemia

This is a type of blood cancer which affects bone marrow tissues. It is a condition which affects tissues responsible for the production of white blood cells. The function of white blood cells is to protect the human body against various diseases. The body tissues which are affected by leukemia are bone marrow and lymphatic system. The affected tissues produce many cells with abnormal shapes. The abnormal shapes of these cells prevent them from performing their functions. The real cause of leukemia is not yet known although many times it is associated with inheritance of defected genes. However, other causes are environmental changes after birth. An individual who had treatment of another cancer using powerful radiations or strong chemicals might develop leukemia. Other causes can be due to smoking or the use of chemicals that affect genes. Such chemicals include cosmetics containing mercury or other hazardous chemicals.

Symptoms of leukemia: The symptoms of this disease include fever, fatigue and body weakness, and regular blood infections. Patients can also lose weight, and have swollen thyroid glands and spleen. Other symptoms include inflammation of the liver, bleeding and frequent bruises. Likewise, a

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patient can experience blood clotting under the skin and excessive sweating especially during the night. Also, the patient can feel pains in the bones and experience frequent blood deficiency.

Prevention of leukemia: Leukemia can be prevented by avoiding the use of hazardous chemicals that affect genes. These include cosmetics containing dangerous chemicals like mercury, 'hydroquinone' or 'benzene'. It is also advised to limit the use of harmful radiations from X-rays, uranium, ultraviolet (UV) rays.

Other disorders of the blood circulatory system: Other disorders of the blood circulatory system include haemophilia and sickle cell that you learnt in Chapter Fourteen of this book.

Exercise 4

Answer the following questions in your exercise book.

Section A

Answer the following questions by choosing the letter of the correct answer.

1. (i) What is the cause of blood deficiency in human beings?
   - (a) Deficiency of white blood cells, vitamin A and iron minerals
   - (b) Vitamin B deficiency, protein deficiency and plasma deficiency
   - (c) Too much water in the body, deficiency of proteins and iron minerals
   - (d) Deficiency of iron minerals and vitamins in the body

   (ii) Which of the following makes up a large percentage of blood?
   - (a) White blood cells
   - (b) Mineral salts
   - (c) Red blood cells
   - (d) Plasma

   (iii) What is the name of the smallest blood vessels?
   - (a) Capillaries
   - (b) Bronchioles
   - (c) Veins
   - (d) Valves

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(iv) The importance of haemoglobin is to manufacture_____.
- (a) white blood cells
- (b) red blood cells
- (c) blood plasma
- (d) blood platelets

(v) The blood circulatory system has three main parts, which are_____.
- (a) veins, arteries and capillaries
- (b) heart, aorta and veins
- (c) blood, blood vessels and heart
- (d) blood vessels, heart and valves

Section B

2. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.
   - (a) Veins and arteries are the two types of capillaries. _____
   - (b) The blood of a grasshopper has the same function as human blood. _____
   - (c) The function of a valve is to prevent the back flow of blood. _____
   - (d) All animals have a four-chambered heart. _____
   - (e) Doing physical exercise during cold weather may minimise the risk of getting high blood pressure. _____
   - (f) Very strong X-ray radiations can cause blood cancer (leukemia). _____

Section C

Fill in the blanks.

3. All arteries carry oxygenated blood except_____.
4. The three types of blood vessels are_____, _____ and_____.
5. Four disorders of the blood circulatory system are _____, _____, _____ and _____.

Section D

Answer the following questions:

6. What is blood?
7. Leukemia is a blood circulatory system disorder. Explain.

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8. Mention the components of the human blood circulatory system.
9. Mention three body systems which have direct relationship with the blood circulatory system.
10. Why are the muscles of the left ventricle thicker than those of the right ventricle?
11. Which blood vessel is responsible for transporting food/nutrients from the digestive system to the liver?
12. What is the relationship between the blood circulatory system and other human body systems?
13. Briefly explain the importance of the blood circulatory system.
14. Draw a diagram of the internal structure of the mammalian heart and label at least nine parts.
15. Give five differences between white blood cells and red blood cells.

Vocabulary

Biconcave	a shape with an inward curved disc on both sides
Deoxygenated blood	the blood with less oxygen and high concentration of carbon dioxide gas
Oxygenated blood	the blood with plenty of oxygen

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Chapter Seventeen

Puberty and adolescence

Introduction

In Standard Five, you learnt about parts and functions of male and female reproductive systems in humans. Those reproductive organs become mature and fully functional at puberty. In this chapter, you will learn about the meaning of puberty, changes which occur during adolescence and the ways of controlling those changes. The acquired knowledge and skills from this chapter will help you to understand the changes which take place in your body at puberty. You will also be able to control the body and behavioural challenges which will occur during adolescence. Lastly, you will have the ability to avoid problems associated with puberty such as early pregnancy and sexually transmitted diseases such as HIV/AIDS, syphilis and gonorrhoea.

Meaning of puberty and adolescence

Puberty is the time in life when a boy or a girl becomes sexually matured for reproduction. Onset of puberty marks the beginning of adolescence period from around 12 to 19 years. Adolescence is a period of rapid mental, morphological, relational, psychological, social and moral changes. These changes that occur during adolescence are controlled by hormones. For most boys, puberty occurs between the age of 12 years to 13 years, while for girls it occurs between 11 and 12 years. However, puberty can occur earlier or later for both girls and boys depending on factors such as food and environmental conditions. Both girls and boys show some physical changes after puberty.

Morphological changes in girls during adolescence

The morphological changes that occur in a girl make her to have a body like in Figure 1. These changes results into the following physical changes:

1. Development and increase of breast size.

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2. Development of sweat glands.
3. Increase in secretion of mucus in the vagina.
4. Beginning of ovulation and menstruation.
5. Development of pubic hair in the armpits and areas surrounding the vagina.
6. Increase in height and weight.
7. Development of a soft and sharp voice.
8. Development of pimples in some girls.
9. Increase in hip size.

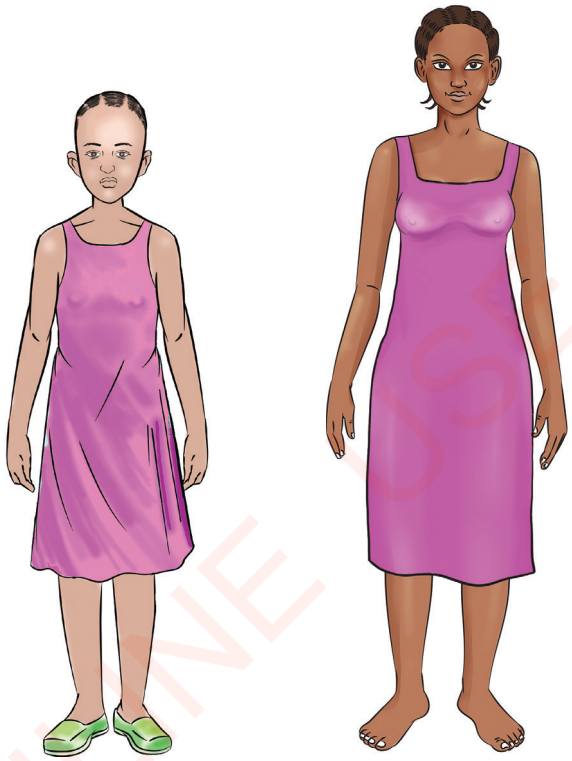

Figure 1: *Morphological changes of a girl during adolescence*

Menstrual cycle

Menstruation is the condition of discharging blood and mucus from the lining of the uterus through the vagina. The beginning of menstruation indicates that a girl has entered puberty. Menstrual cycle is the period between the first day of menstruation in a month and the first day of menstruation in the following month. Normally, the menstrual cycle has 28 days as it has been shown in Figure 2. However, there are some females who have a menstrual cycle of 21 and some up to 32 days. Usually, only one ovum ovulates in every menstrual cycle.

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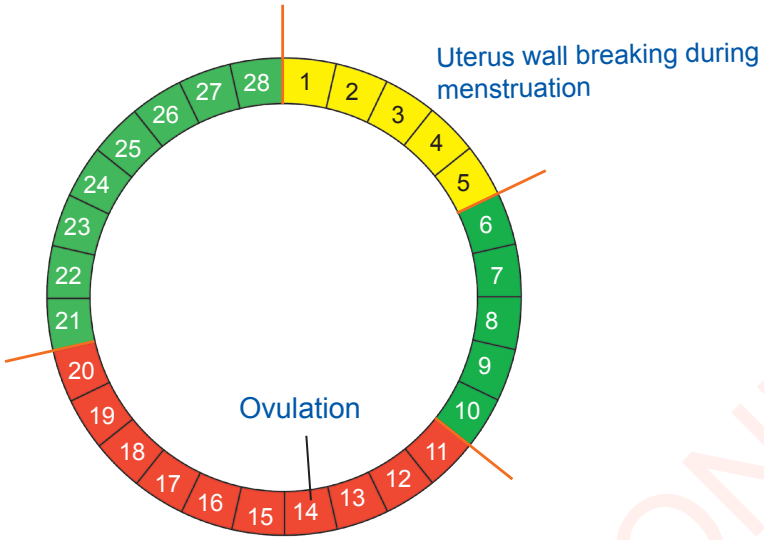

Figure 2: *Menstrual cycle calendar*

In some females, more than one ovum may ovulate in each menstrual cycle. In such cases, there is a possibility of giving birth to twins if both ova are fertilised in that month. Females experience menstruation every month except during pregnancy. Most women reach menopause between ages of 45 to 55 but it may occur as early as 40 or may not occur until a woman reaches her 60s. This is because of menopause that marks the end of the menstrual cycle. The beginning of menstruation indicates the breakdown of the uterine wall which had been developed ready for receiving the zygote after fertilisation. The duration of menstruation differs among females. Normally, the menstrual period is between 3 to 5 days. However, some females may have less or more than 5 days of menstruation.

Problems associated with the menstrual cycle

In every menstrual cycle the uterine wall develops and prepares itself for receiving a zygote. The zygote forms when a female gamete combines with a male gamete during fertilisation. If fertilisation does not take place, the uterine wall will breakdown and be removed together with mucus through the vagina as menses. In some cases, problems associated with the menstrual cycle include discomfort, missing menstruation, heavy abdominal pains and heavy bleeding.

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Discomfort during the menstrual period: Discomfort may make an individual fail to perform her work efficiently. The discomfort may be for a few hours to a number of days. In some cases, the discomfort may be so severe that it requires medical treatment. Feeling of discomfort is accompanied with anger, stress, stomach upset, headache, fainting and increased heart beat rate. It may also be associated with loss of appetite, swelling of legs, arms and fingers. It is advised that the victim should perform physical exercise at least 3-5 times per week in order to reduce these problems. Other strategies include taking a balanced diet, relaxing and having enough sleep.

Amenorrhea: This is a condition of missing menstruation for more than three months. There are two types of amenorrhea which are primary and secondary amenorrhea. Primary amenorrhea is a condition which happens to a girl who has reached the age of puberty and had already experienced some physical changes but does not start menstruation. Secondary amenorrhea, happens to a woman who has already experienced menstruation but her menstrual cycle stops although she is not pregnant or breastfeeding. This woman is also not using contraceptives and she is not at menopause phase. In order to understand the causes and treatment of amenorrhea, it is important to consult a health specialist.

Severe pain during menstruation: Some females experience severe pains during their menstrual period. These pains may either occur when the girl enters puberty or may occur some days later. The pains which occur during this period of puberty are caused by the shrinking of the wall of the uterus. Shrinking of the uterus is due to hormonal imbalance or changes. Other reasons for painful menstruation include cervical infections and fibroids. These problems may happen to any female. However, the problems are more likely to affect females who are smokers and alcohol users than others. They may also happen to overweight females and those who entered puberty before age 11.

Prolonged heavy bleeding: This is a condition of over-bleeding or bleeding for longer than the expected period. Many females get this problem. Sometimes heavy menstrual flow may make an individual fail to perform her daily activities. The heavy blood flow may be caused by failure of blood to

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clot at the required time. This in turn may lead to loss of so much blood that blood transfusion may be required. Hormonal imbalance is another cause of over-bleeding during the menstrual period.

Morphological changes in boys during puberty

When a boy enters puberty, his body morphology looks like the picture shown in Figure 3.

The following changes take place in boys during puberty:

1. Enlargement of testes and penis.
2. Development of sweat glands.
3. Growth of hair in the armpits, around the reproductive organs, chest, abdomen and beard for some boys.
4. Increased height and weight.
5. Development of a deep and coarse voice.
6. Development of facial pimples in some boys.
7. Wet dreams.
8. Muscle development on chest and shoulders.

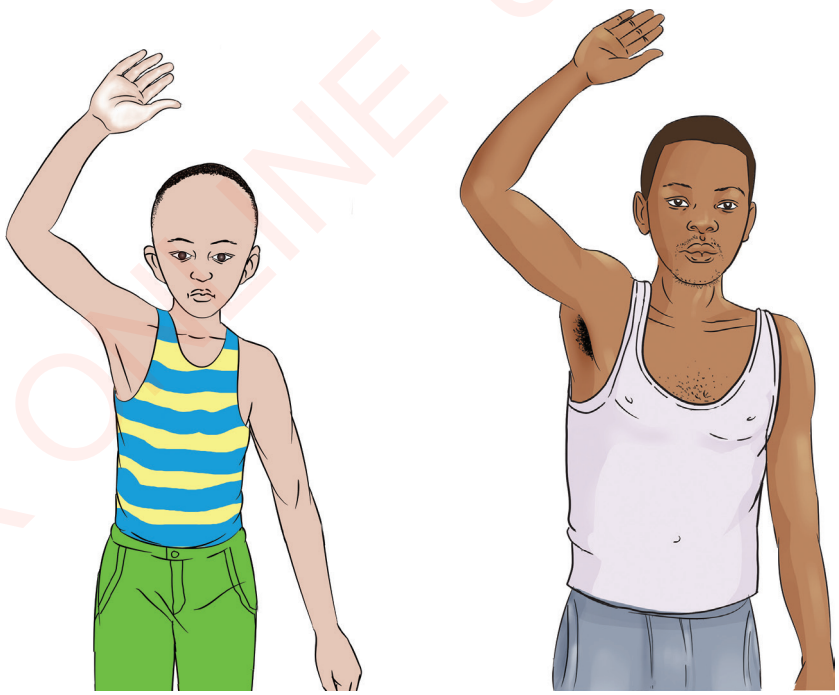

Figure 3: *Morphological changes of a boy during adolescence*

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Exercise 1

Answer the following questions in your exercise book.

1. (a) Explain the meaning of puberty.
   (b) Explain the changes which occur in girls and boys during puberty.
2. (a) Explain the meaning of menstruation.
   (b) Summarise what takes place when a female enters her menstrual period.
3. List down four problems associated with the menstrual cycle.

Social changes

During adolescence there are several social changes which occur in boys and girls, as explained in the following sections.

Developing sexual identify: In the adolescence period, youths start to identify themselves as girls or boys. They start to build relationships with strong feelings towards members of the opposite sex.

Seeking social identity: In this period, youths struggle in order to be identified. They seek identification of their positions in the society and in the world as a whole. This struggle may be affected by gender, age group, culture and expectations of the family.

Seeking more freedom: Youths want to be free in making their own decisions without being interfered by their parents or guardians. This causes frequent conflicts between them and their parents or guardians. Parents or guardians have the role of directing their youths. However, the youths feel that they are free to make their decisions on solving their own matters. Youths are supposed to understand the position of their parents or guardians. They are supposed to understand that there is no freedom without responsibility.

Interest to learn new things: When girls and boys reach the puberty period, they become very interested to learn new things and they want to try to do several things. Although it is important for the youth to learn new things, sometimes it makes them acquire a risky behaviour in their life. In this period

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youths prefer to learn different skills like driving cars and riding motorcycles. Some youths begin to smoke cigarettes or abuse drugs. The behaviour of trying everything makes some of them engage in unprotected sex which can lead to unplanned pregnancies. They may also be at the risk of acquiring HIV/AIDS and other sexually transmitted diseases.

Mental changes

During the adolescence period, girls and boys undergo rapid mental changes. These changes make them to have the following behaviour:

1. Increased ability to identify reality of things which are surrounding them.
2. Increased ability to solve difficult and controversial problems.
3. Increased ability to understand others' thoughts.
4. Risking and ignoring the effects of their deeds.

Changes in relationships

During adolescence, girls and boys show changes in their relationships with their societies. These changes are illustrated below.

Spending less time with family than with friends and peers: During adolescence, youths may think that their friends are more important than their parents. They might think that their friends understand them better because they are undergoing the same experience. Therefore, they feel more comfortable to stay with their peers rather than their parents, guardians or relatives.

Different perceptions from those of their elders: Adolescents develop their own perceptions and question everything which they see or hear. They decide to solve their problems as they see it fit. Normally, their perceptions lead to frequent misunderstandings between them and their parents, guardians and relatives. However, these misunderstandings cannot break down the adolescent-parent relationships. This is because adolescence changes are only transitional, occurring between puberty and adulthood between 12-19 years.

Becoming argumentative: During puberty, adolescents become defensive and like to argue. They tend to argue and challenge their parents, guardians and siblings. This behaviour makes them seem disrespectful as they choose

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their own way. They like to be seen doing well in all aspects all the time. They like to be seen as role models.

Emotional changes

The emotional changes which occur in youths during adolescence are explained below.

Strong feelings: Moods change frequently during adolescence. Even minor issues can make them change their moods significantly such as crying or becoming very angry. Changes in mood is normal in adolescents. This problem may create more misunderstandings in their families and societies. The society may also not understand them and how to treat them. This occurs when adolescents expect to be treated like adults instead of being treated as children by their parents.

Self-consciousness: During adolescence, youths develop a sense of self-awareness and self-consciousness such as feelings of guilt. They may also have a sense of pride, embarrassment and a variety of emotions. They like to be seen as having a good body structure and being well dressed. They may compare their bodies with those of friends and peers. This is why most youths mimic other famous people in the way they dress, walk and shave their hair.

Activity

In pairs, discuss the changes which appear in girls and boys after puberty. List down their effects and ways to overcome the challenges of those changes.

Ways of coping with the changes during adolescence

Changes which occur after puberty in a girl or a boy cannot be avoided. There are several strategies which can be used to reduce the effects of these changes. The adolescent is advised to do the following things in order to reduce the effects during adolescence.

Exercising: After puberty, youths grow and increase in weight rapidly. This makes them to have more energy. Doing exercise helps blood and oxygen to circulate easily in the body. This in turn helps adolescents to be active and stress-free that makes them become healthy and happy.

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Having enough sleep and eating balanced diet: Enough sleep helps to remove tiredness and stress during adolescence. After puberty, the body grows rapidly and therefore balanced diet is highly required for body and mental health.

Avoiding alcohol, tobacco and other abuse of drugs: Chemicals which are found in alcohol, tobacco and drugs affect the nervous system. They affect the ability of an individual to make good decisions. During adolescence, youths fail to make correct decisions. The use of these illegal drugs and alcohol makes this problem even worse. It is therefore advised that adolescents should avoid the use of alcohol and illegal drugs in order to guard themselves against making poor decisions. They should also avoid using improper language, and show proper respect to their elders.

Sharing challenges with friends and relatives: After puberty, all adolescents, even the well nurtured ones, experience some behavioural challenges. In some cases, a youth may think that he/she is the only one who is going through the challenges. These feelings increase worries, emotional instability and loss of confidence. Sharing challenges with other people helps to get guidance and counselling on how to overcome such challenges.

Seeking help from trustworthy people: In some cases, adolescents get many challenges and find it difficult to overcome them. It is important to seek help from experienced adults like parents, guardians, teachers and others they trust, in order to get guidance and counselling. Adults are alternative guides and counsellors to adolescents.

Abiding to general body cleanliness: Body cleanliness is very important during puberty. It includes taking bath, washing clothes, ironing clothes and shaving. In girls it is important to frequently change the towels used during the menstrual period.

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Exercise 2

Answer the following questions in your exercise book.

Section A

Choose the correct answer from the given alternatives.

1. One of the changes which takes place during adolescence in girls is _____
   (a) wet dreams.
   (b) growing of facial hairs.
   (c) starting the menstrual period.
   (d) deep voice.
2. Normally the menstrual cycle takes _____
   (a) 20 days.
   (b) 30 days.
   (c) 28 days.
   (d) 40 days.
3. Changes which involve mental state, body structure, behaviour and emotions are called _____
   (a) adolescence.
   (b) growth.
   (c) self-consciousness.
   (d) loving themselves.
4. A sign of puberty for both a girl and a boy is _____
   (a) growth and breast development.
   (b) growing facial hairs.
   (c) growing hair in the armpits.
   (d) having a smooth voice.
5. One way of overcoming challenges of adolescence is _____
   (a) avoiding the use of alcohol.
   (b) sleeping for the whole day.
   (c) watching cinema.
   (d) doing exercise without resting.

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Section B

6. Match the words from **List A** with the correct statements from **List B**.

List A	List B
(i) Muscle expansion	(a) Sign of puberty for girls and boys
(ii) Enjoying competition	(b) Social changes after puberty
(iii) 28 days	(c) Normal menstrual cycle
(iv) 12-13 years	(d) Mental changes after puberty
(v) Ability to solve problems	(e) Morphological changes to girls after puberty
(vi) Showing deep emotions	(f) Changes in emotions during adolescence
(vii) Seeking help	(g) One way of overcoming adolescence challenges
(viii) Developing a soft voice	(h) One way of overcoming challenges of pregnancy
(ix) 11-12 years	(i) Average years for puberty in boys
(x) Using alcohol	(j) Average years for puberty in girls
	(k) Behaviour which increases challenges during adolescence
	(l) One sign of infertility
	(m) Menopause
	(n) Morphological changes to a boy during adolescence

Section C

7. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.

(a) Changes occurring during adolescence are caused by hormones. ____

(b) A girl may get pregnant before puberty. ____

(c) Parents and guardians should help their youths in overcoming the challenges of adolescence. ____

(d) Youths are supposed to make their own decisions on matters affecting them when they reach adolescence. ____

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(e) The best way for guiding the youth during adolescence is corporal punishment. ____

(f) There is no way of overcoming challenges of adolescence. ____

(g) Doing exercise is one of the ways of overcoming challenges during adolescence. ____

(h) Girls enter puberty earlier than boys. ____

(i) Delay in entering puberty in some girls and boys is normal. ____

(j) Being interested with everything during adolescence is a good behaviour. ____

Section D

Answer the following questions:

8. Mention sociological changes occurring during adolescence.
9. Explain the ways of overcoming challenges of adolescence.

Vocabulary

Age group — a segment of population that is within a specific range of age and shares similar characteristics

Menopause — the period in a woman's life, normally between the age of 45 and 50 years when her menstruation cycle stops

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Chapter Eighteen

Reproductive system

Introduction

In Standard Five, you learnt about the parts of female and male reproductive systems and their roles. In chapter seventeen you also learnt about puberty and changes that occur during puberty. In this chapter, you will learn about male and female reproductive systems and their possible disorders. You will also learn about signs of pregnancy, labour and growth. Lastly, the chapter will provide you with the meaning and importance of family planning. The knowledge and skills acquired will enable you to take precautions and avoid challenges associated with the reproductive system.

Female reproductive system

The female reproductive system is made up of internal and external organs as shown in Figure 1. Both of these organs are involved during the reproduction process.

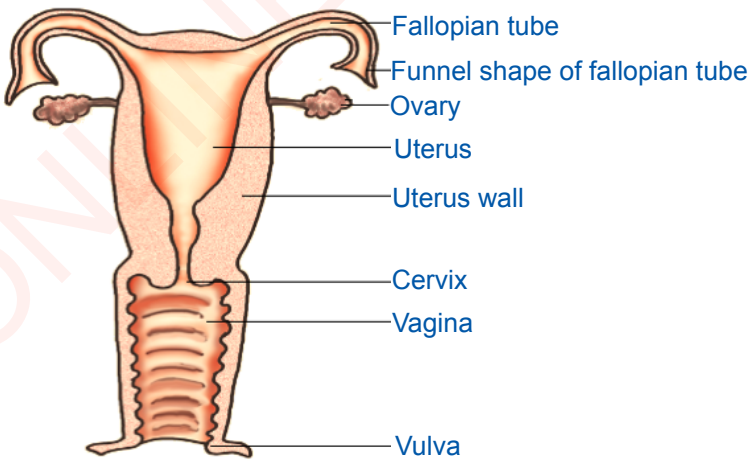

Figure 1: *Parts of the female reproductive system*

The internal organs include the uterus, fallopian tube and ovaries. External organs include parts of the vulva which are the labia, clitoris and vaginal

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opening. The function of the uterus or womb is to nurture the growing embryo after fertilisation. The uterus also produces uterine secretions which assist movement of sperms to the fallopian tube. There are two ovaries in the reproductive system which produce ova. The fallopian tubes allow an ovum to pass from the ovary to the uterus.

Male reproductive system

When you look at the diagram of the male reproductive system you will find that this system comprises external parts which are penis and testes. The system also includes inner parts which are vas deferens, prostate gland, Cowper's gland and seminal vesicles as shown in Figure 2.

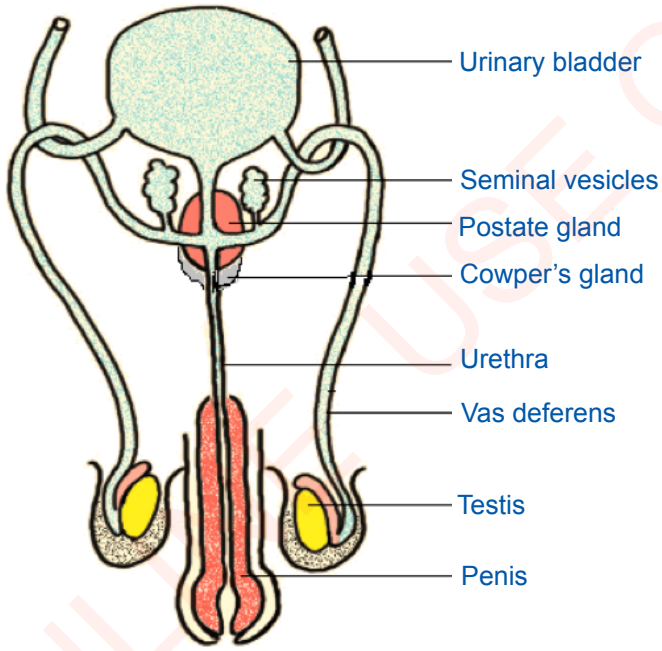

Figure 2: *Parts of the male reproductive system*

The prostate gland produces a thick mucus fluid. This fluid contains nutrients which make sperms survive and energises the sperm to reach the ovum for fertilisation. It also neutralises the acidity of the vagina which may kill the sperms. The Cowper's gland secretes alkaline mucus which neutralises the acidity left by urine in the urethra. Testis is the main part of the male reproductive system that produces sperms. When sperms mature, they are transported through the vas deferens to the prostate gland. The penis is an organ with muscles and many blood vessels. Its role is to transmit sperms to the female reproductive system during sexual intercourse.

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Disorders of the reproductive system

There are several disorders which may occur in male and female reproductive systems. These disorders may cause infertility in both males and females.

Disorders in the male reproductive system

One of the disorders in the male reproductive system is infertility. Infertility is inability of a man to impregnate a fertile woman. It can be caused by several factors including low sperm production. The low sperm production reduces the possibility of sperms to reach the ovum. Production of weak sperms is another reason for infertility. Weak sperms are unable to swim and reach the ovum. Abnormality of sperms produced is another cause of infertility. An abnormal sperm either lacks a tail, has two tails, lacks a head or has abnormal shape. Body immunity can also attack sperms and reduce their amount. Likewise, the testis can fail to produce sperms due to diseases or insufficiency of hormones. This is also a cause of infertility. Lastly, blockage of the vas deferens is another reason for infertility. This is basically a result of the effects of sexually transmitted diseases like gonorrhoea and syphilis.

The second disorder that can affect the male reproductive system is impotence. Impotence is the inability of a man to develop and maintain an erection of the penis for sexual intercourse. This disorder can be caused by aging and diseases like diabetes and hypertension. Another cause of this disorder is stress, improper circumcision, psychological problems and insufficient production of testosterone hormone. Injury of the lower part of the backbone and paralysis can also lead to impotence.

Disorders in the female reproductive system

Like in males, there are also several disorders in the female reproductive system. One of the disorders in the female reproductive system is infertility. Infertility in females is inability to conceive which is caused by various factors. Among them is failure of ova to mature. This is caused by problems in releasing hormones. Failure of the pituitary gland to release its hormones can lead to hormonal imbalance. Hormonal imbalance causes infertility as it disrupts ovulation, preventing thickening of the uterine wall and preventing progress from being initiated. Failure of the ovary to release sufficient oestrogen or progesterone hormones also contributes to infertility. Infertility can also be caused by blockage of fallopian tubes due to sexually transmitted diseases like gonorrhoea, syphilis and chancroid.

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These diseases tend to narrow the fallopian tubes or cause scars which can prevent ova to pass through. Likewise, infertility in females can be caused by inflammation in the uterus due to fibroids which prevent the zygote's proper implantation. Failure of implantation usually results into miscarriage. The cervix can also be affected by problems related to reproductive practices such as abortion. This leads to constriction, dilation or failure of the cervix to secrete mucus. The function of this mucus is to help sperms to penetrate and reach the ovum. Hence, the absence of this mucus causes infertility.

Corrections to disorders of the reproductive system

Many disorders of the male or female reproductive system can be treated. This is when a person goes to hospital early to get medical checkup and counselling from health practitioners. Psychological problems as a result of being infertile can be treated through counselling. Hormonal imbalance can be corrected by eating balanced diet and controlling weight. Other ways include administering hormonal therapy for the hormones that are inadequately produced.

Exercise 1

Answer the following questions in your exercise book.

1. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.
   (a) Infertility occurs in females only. _____
   (b) Failure of the penis to erect is not an inherited disorder. _____
   (c) Some of the sexually transmitted diseases can cause infertility. _____
   (d) The vagina has an alkaline medium. _____
   (e) Normally a sperm has many tails. _____
2. Mention two external parts of the male reproductive system.
3. Mention four internal parts of the male reproductive system and explain their roles.
4. Explain disorders that can occur in the female and male reproductive systems.

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Fertilisation

Fertilisation is a process whereby male and female gametes fuse to form a zygote. During sexual intercourse, the male ejaculates semen which contains sperms from the testes. The sperms pass through the vas deferens to the urethra. The semen with sperms is then introduced to the vagina during sexual intercourse. The female releases an ovum from the ovary into the fallopian tube. If one of the sperms meets the ovum they fuse together to form a zygote (See Figure 3). When one sperm fuses with an ovum, the millions of sperms are prevented from fusion. Hence, there is no possibility of a single ovum being fertilised by two or more sperms. The zygote then grows and forms an embryo which passes down the fallopian tube to the uterus. The embryo implants in the uterine wall where it starts to grow and form a foetus.

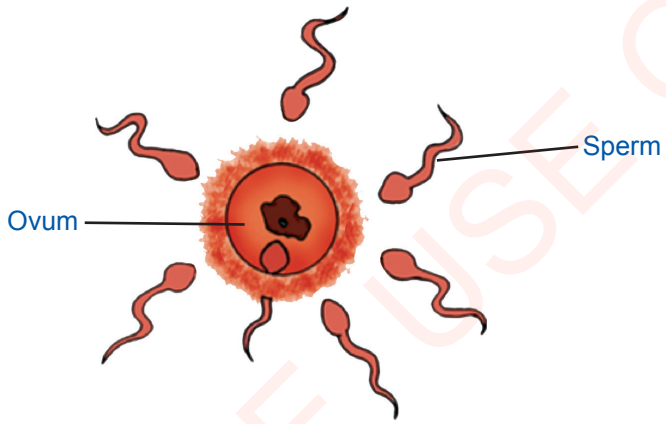

Figure 3: *Fertilisation*

Fertilisation leading to multiple embryos

Normally a female gives birth to a single child for each pregnancy. However, in some cases the female can give birth to two or more children in a single pregnancy. When the female gives birth to two children in a single pregnancy, these children are called twins. If a female gives birth to three children in a single pregnancy, these children are called triplets. Twins can either be identical or fraternal.

Identical twins: These are twins that come from the division of a single ovum fertilised by a single sperm. In this case, a fertilised egg splits and forms two zygotes. Since these zygotes come from a single egg, the twins who will be born will resemble in almost all cases including sex. These twins develop in the same uterus and share the placenta. They are of the same sex as shown in Figure 4(a) and 4(b), and have similar behaviour.

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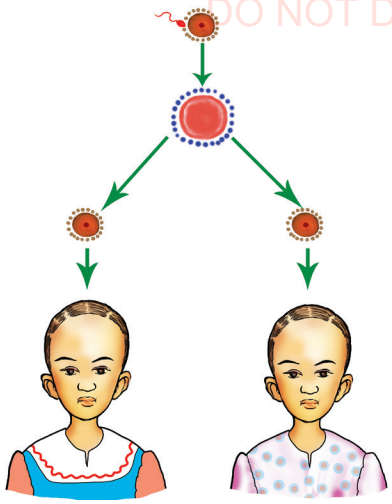

Figure 4(a): *Female identical twins*

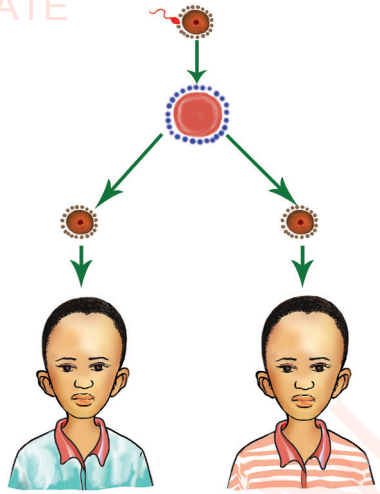

Figure 4(b): *Male identical twins*

Fraternal twins: These are twins who come from two ova, each fertilised by a different sperm. These twins occur if each ovary releases a single or several ova. Each egg is fertilised by its own sperm. These zygotes implant independently in the uterus and each one grows on its own independent placenta, unlike identical twins. The resulting children will not necessarily resemble each other. They can be all males, females or one male and the other a female, as shown in Figure 5.

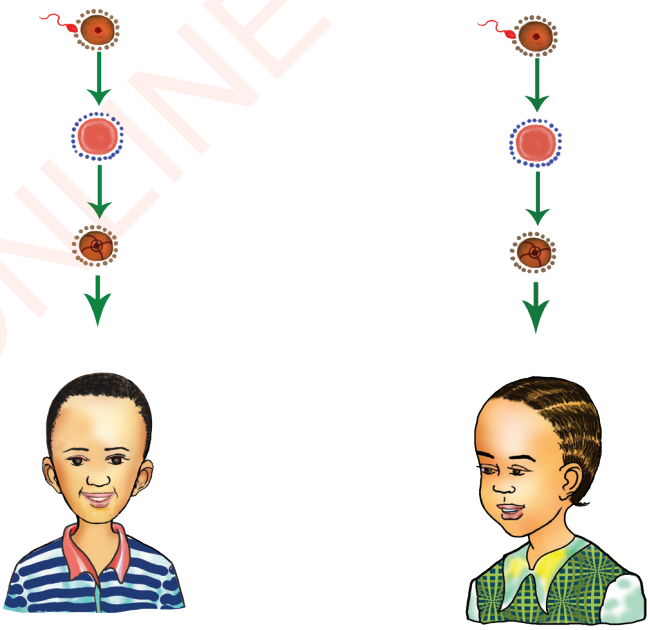

Figure 5: *Fraternal twins*

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Sex determination

The sex of a baby is determined at the time of fertilisation. The ova from the ovary carries chromosomes of the same type called X. Therefore, each ovum released for fertilisation carries X chromosomes. Sperms carry either X or Y chromosomes. Normally, males typically have X and Y chromosomes (XY) while females have two X chromosomes (XX). If chromosome X from the sperm fertilises an ovum with X chromosome, the sex of the child will be female that is XX. If chromosome Y from the sperm fertilises an ovum with X chromosome, then the sex of the child will be a male that is XY. Therefore, the one who is involved in sex determination in human beings is the father.

Signs of pregnancy

A woman who has conceived begins to show the following signs:

1. The menstrual cycle stops.
2. Nausea or vomiting early in the morning during early months of pregnancy (2-3 months).
3. Frequent urination.
4. Breasts increase in size.
5. Protruding stomach as pregnancy grows.
6. Facial pimples develop in some women.
7. After four months of pregnancy, the woman starts to feel movements of the child inside the uterus.

Steps in pregnancy growth

1. After fertilisation the resulting zygote develops into an embryo and starts to move slowly towards the uterus for implantation.
2. After implantation, the embryo grows and becomes a foetus. The placenta is also formed at this period. The placenta attaches itself to the upper part of the uterine wall. The placenta allows the passage of oxygen and nutrients from the mother to the foetus. It also allows the passage of waste products from the foetus to the mother (Figure 6).

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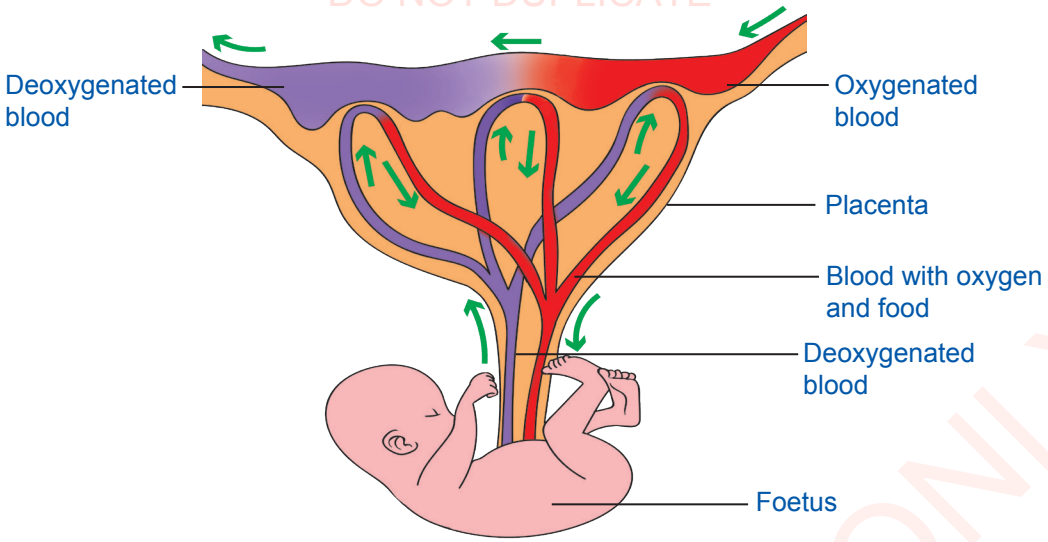

Figure 6: *Digestive and gaseous exchange system*

3. After five weeks, the heart of the foetus is formed. The heart then begins to push blood in the body of the foetus.
4. After two months, the foetus resembles a child as shown in Figure 7.

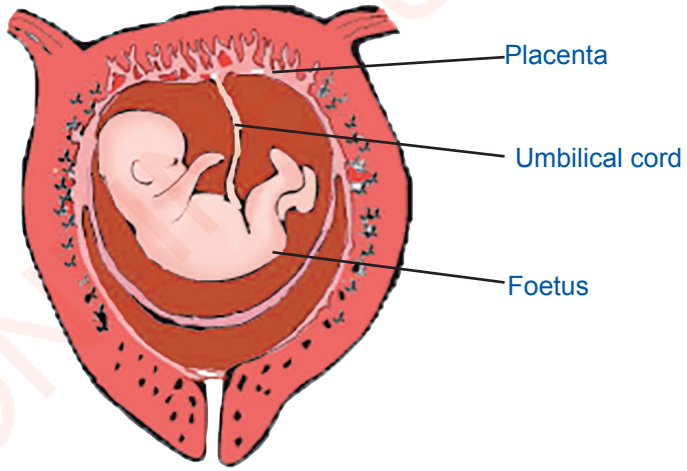

Figure 7: *Foetus implanted in the uterus*

5. The foetus continues to grow inside the mother's womb. The uterus continues to expand so as to make enough space for the foetus as indicated in Figure 8. The foetus continues to grow to nine months when the baby will be born as shown in Figure 8.

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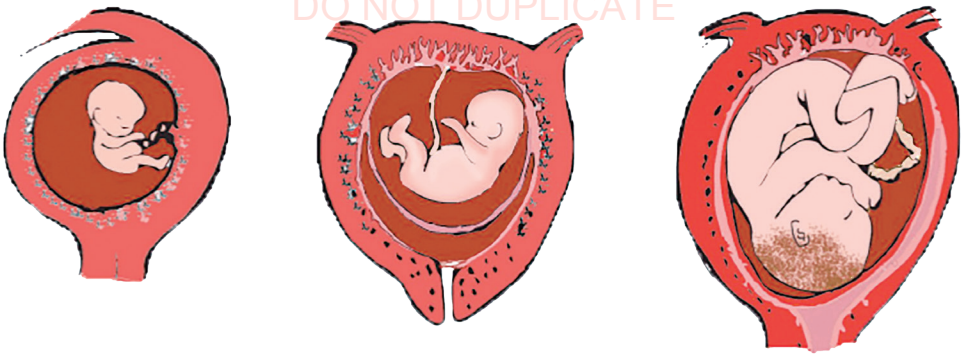

Figure 8: *Foetus developmental stages*

Signs and steps of birth

Few days before birth, the foetus turns its head downwards towards the cervix. The circular muscles of the uterus begin to contract and relax frequently. The following signs indicate that the pregnant mother is approaching delivery:

1. Labour pains due to contraction and relaxation of uterus muscles. Pains begin slowly and increase with increase in contraction and relaxation of uterus muscles.
2. Discharging of a watery fluid mixed with blood through the vagina.

During the process of birth, the child is pushed from the uterus through the vagina. Usually the head comes first. When the child is out, the umbilical cord is cut to separate the child from the mother. The child has its first breath after birth. Soon after delivery the child cries for the first time, which is a good indicator that the child is alive. After delivery, the placenta is pushed out as after-birth through the vagina. If the placenta remains in the mother's uterus, it causes life threatening complications including infections and excessive blood loss.

Exercise 2

Answer the following questions in your exercise book.

1. Explain how pregnancy is formed.
2. Mention six signs of a pregnant woman.
3. List three signs of a woman who is about to give birth.
4. Why do some twins resemble while the others do not?

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Family planning

Family planning is a process of controlling the number and interval of children one wishes to have. Family planning is important due to the following reasons:

1. It enables a person to plan for the number of children he/she can be able to raise.
2. It helps the mother to have enough resting time and body repair after giving birth.
3. It makes children have good health.
4. It enables parents to provide their children with basic needs like education, food, clothes and shelter.

Methods of family planning

Family planning methods are techniques used to prevent a woman from getting unplanned pregnancy. Family planning methods have their own advantages and disadvantages. Natural methods are those which do not use drugs or special instruments to prevent a woman from getting pregnant. Artificial methods are those which use drugs or special instruments to prevent a woman from getting pregnant. Health reproductive practitioners provide counselling to couples about the proper methods of family planning they can apply. Their advice is important because the methods of family planning have different side effects to women.

Some artificial methods prevent transmission of sexually transmitted diseases and HIV. Abstinence is the only method which is 100 per cent perfect and with no side effects. It is insisted that pupils and children under 18 years old should abstain from sexual intercourse. This will prevent them from early pregnancies and contracting sexually transmitted diseases and HIV.

Activity

1. In groups, visit a nearby health centre and seek information about the modern methods of family planning it provides.
2. Write the methods in (1) in your exercise book.

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Exercise 3

Answer the following questions in your exercise book.

Section A

Choose the correct answer in the following questions.

1. There are _____ main methods of family planning.
   (a) four
   (b) three
   (c) many
   (d) two

2. _____ produce sperms.
   (a) Ovaries
   (b) Testes
   (c) Prostate glands
   (d) Fallopian tubes

3. A safe method of family planning which has no side effects is _____.
   (a) abstinence from sexual intercourse
   (b) having sexual intercourse
   (c) artificial family planning
   (d) all methods of family planning

4. _____ is a disorder in the reproductive system.
   (a) Twins
   (b) Infertility
   (c) HIV and AIDS
   (d) Sexually transmitted diseases

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Section B

5. Match words in **List A** and their correct explanation from **List B**

List A	List B
(i) Vagina	(a) Transports air and nutrients from mother to the child.
(ii) Different sex	(b) To pass a baby during birth.
(iii) Nine months	(c) The results of fusion of male and female gametes.
(iv) Zygote	(d) A period from fertilisation to birth.
(v) Identical twins	(e) Results from division of a fertilised ovum.
(vi) Four months	(f) The child begins movements in the uterus.
(vii) Placenta	(g) Prevent pregnancy, HIV and sexually transmitted diseases.
	(h) Among the characteristics of identical twins.
	(i) The part in which fertilisation takes place.
	(j) Among the signs of pregnancy.
	(k) Disorder in the male reproductive system.
	(l) Among the characteristics of fraternal twins.

Section C

6. Write **TRUE** for a correct statement and **FALSE** for an incorrect statement.

(a) Infertility is a disorder of the male and female reproductive systems. _____

(b) All twins resemble each other. _____

(c) Abstinence is a good behaviour. _____

(d) Family planning makes children have good health. _____

(e) Having sexual intercourse causes early pregnancies. _____

(f) A foetus starts movements in the uterus after seven months of pregnancy. _____

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(g) A male gamete contains X and Y chromosomes. _____

(h) A female child is formed when X and Y chromosomes fuse together. _____

(i) An embryo grows to become a zygote. _____

(j) Normally, a woman gives birth to a single child for each pregnancy. _____

Section D

Answer the following questions:

7. How many sperms fertilise one ovum?
8. Explain two effects of having sexual intercourse under the age of 18 years.
9. (a) Mention two roles of the uterus.
   (b) Mention two roles of testes.
10. Explain how pregnancy occurs.
11. (a) Explain four signs of a pregnant woman.
    (b) What is the duration of pregnancy in a human being?
12. How do identical twins get formed?
13. Briefly explain the causes of infertility in men.
14. (a) Draw and label five parts of the female reproductive system.
    (b) Draw and label six parts of the male reproductive system.

Vocabulary

Foetus	early pregnancy of more than eight weeks
Infertility	inability of a woman to conceive or inability of man to make a fertile woman pregnant
Placenta	the organ which connects the child with the mother during pregnancy
Zygote	a cell formed when a sperm and ovum fuse

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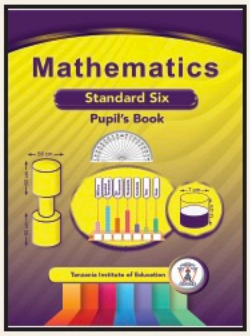

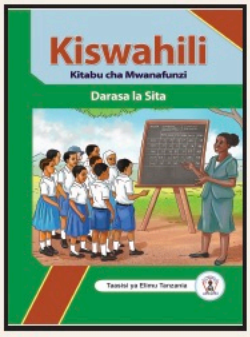

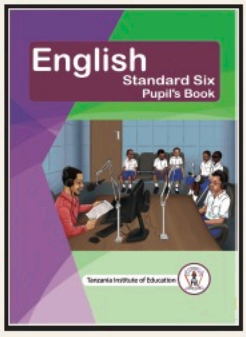

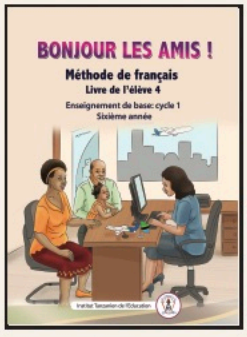

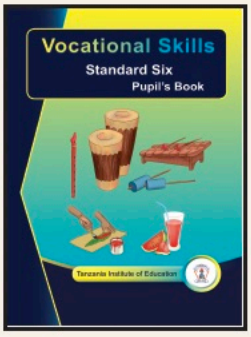

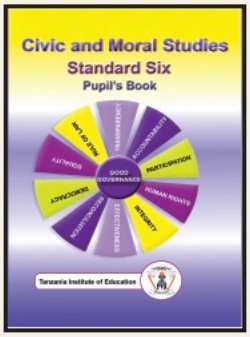

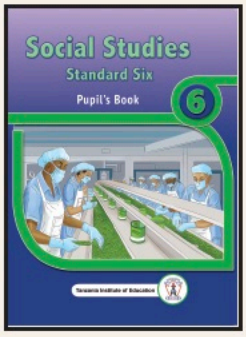

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