Science and Technology

Teacher's Guide

Standard Seven



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Introduction

This is the fifth book in a series of five Teacher's Guides on Science and Technology for Primary Schools from Standard Three to Seven, prepared specifically for Standard Seven. The guide is prepared in line with the Pupil's Textbook as well as the 2020 Science and Technology Syllabus for Primary Schools issued by the Ministry of Education, Science and Technology. This guide consists of 10 chapters, namely Safety signs in the environment, Electrical energy, Floating and sinking, Antenna, Complex machines, Scientific experiments, Waste disposal, Body health, Nervous system, and Human respiratory system.

The guide includes the pupil's activities, teaching and learning resources as well as steps to be followed in facilitating learning. In addition, the guide provides answers for each exercise. However, you are advised to create, develop and use other appropriate teaching and learning strategies. Similarly, you are advised to use the real environment as well as improvise teaching and learning materials to enable pupils develop the needed competencies.

The Pupil's Book includes texts, illustrations, activities, experiments and exercises that facilitate learning. You are required to encourage the pupils to perform all suggested activities and experiments and do all the exercises you give them. Allow them to attempt the exercises individually and in groups. You should encourage the pupils to participate effectively per your instructions. This will enable them to develop the intended competencies.

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Chapter One

Safety signs in the environment

Introduction

Safety signs are drawn signs or images that give signals or warnings. Sometimes, safety signs are presented with texts to facilitate interpretation. They are used in all countries and are placed on items such as bottles containing chemicals or medicines. They are also placed on vehicles and vessels such as buses, airplanes and fuel tankers. In addition, safety signs are placed on transformers and high voltage electric poles. They are also placed in places with dangerous items or objects. In Standard Six, the pupil learnt about cleanliness of the environment. In this chapter, the pupil will learn about the safety signs in the environment, their interpretations and uses. The competencies gained will enable the pupil to take precautions in protecting his/her life and the lives of others. Therefore, you are supposed to use appropriate strategies to enable the pupil to gain the intended competencies.

Pupil's activities

(a) Describing safety signs found in the environment

(b) Explaining the uses of various safety signs found in the environment

Teaching and learning resources

Marker pens, manila paper, pencils and coloured pencils

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Teaching steps

1. Guide the pupils to:
   (a) Read aloud the texts about the concept of safety signs in the environment and ask them comprehension questions; and
   (b) Read the texts about the interpretations of safety signs; then, ask them comprehension questions and clarify the meaning of safety signs shown in Table 2.
2. Guide the pupils to:
   (a) Draw safety signs and answer the questions in the activity; and
   (b) Work on Exercise 1. Then, check the correctness of their answers and provide feedback.
3. Guide the pupils to:
   (a) Read aloud the texts on the uses of safety signs in the environment and ask them comprehension questions;
   (b) Discuss the uses of safety signs in the environment. Monitor the accuracy of their discussion; and
   (c) Work on Exercise 2. Then, check the correctness of their answers and provide feedback.

Answers to questions

Exercise 1

1. Safety signs are drawn signs or images that give signals or warnings. Safety signs provide information related to hazards and risks associated with given items or places.
2. In the environment, various dangerous things and places require us to take precautions.
3. Texts are included in some safety signs to ensure understanding and interpretation.

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4. **Table:** Safety signs and their interpretations

S/N.	Safety sign	Interpretation
(a)		Do not use a mobile phone
(b)		First aid
(c)		Emergency telephone
(d)		Wear gloves
(e)		Do not light a fire
(f)		Emergency assembly point

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Exercise 2

Section A

1	2	3	4	5
a	c	b	c	d

Section B

6. The following are four uses of safety signs:
   (a) Prevention of diseases;
   (b) Prevention of accidents;
   (c) To give caution; and
   (d) To give instructions.
7. Five items or equipment with danger or toxic signs are:
   (a) Transformers;
   (b) Electric poles with high voltage power;
   (c) Detergents used for toilets cleaning;
   (d) Chemicals for livestock dipping trough (acaricides);
   (e) Pesticides; and
   (f) Trucks carrying toxic or flammable substances.
8. Precautions to take when using drugs or chemicals having a toxic sign:
   (a) Use protective gear such as gloves, goggles, masks, a special cloth or overalls, gumboots, and helmet. This will prevent the toxic substance from reaching the body parts such as the eyes and skin;
   (b) Read instructions on how to use drugs or chemicals;
   (c) Use them in a well-ventilated area;
   (d) Read the caution, instructions or signs on the container or packaging;
   (e) Ensure that chemicals or drugs are correctly used and stored in safe places;

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(f) Make sure the storage area for drugs or chemicals is well ventilated and away from sunlight;

(g) Ensure the presence of emergency services nearby, such as water tap for washing or bathing in the event of an accident;

(h) Make sure the container or package is correctly labelled;

(i) Make sure the drug and chemical containers are properly closed, when are not in use;

(j) Use proper waste disposal methods for discarding wastes resulting from used chemicals or drugs;

(k) Do not use empty containers of chemical or drug to store food or water. There is a possibility of having remains of chemicals or drugs; and

(l) Observe hygiene after using the chemicals or drugs by washing your hands and face with soap and clean water. You have to do so every time you use drugs or chemicals as well as before eating and drinking.

9. Safety signs are important because they enable one to take precautions when using items with those signs. They also give precautions against dangerous environments.

10. Chemicals with irritant signs may cause irritations on the face, tongue or throat. They can also cause skin bruises or rashes, dizziness, and difficulty in breathing.

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Chapter Two

Electrical energy

Introduction

In Standard Four, the pupil learnt how to generate electricity from waterfalls, the sun, wind and fuel. In Standard Six, the pupil learnt how to generate electricity from biogas. In this chapter, a pupil will learn how water waves, water currents, and geothermal energy are used to generate electricity. The pupil will also learn about the quality of renewable energy over non-renewable energy. The competencies gained will enable the pupil to compare ways for generating electricity using water waves, water currents, and geothermal energy.

Pupil's activities

(a) Describing how to generate electricity from water waves and water currents

(b) Describing how to generate electricity from geothermal energy

(c) Differentiating the quality of renewable energy as compared to non-renewable energy

Teaching and learning resources

Pictures and illustrations, basin, water and stone

Teaching steps

1. Guide the pupils in groups to:
   (a) Read aloud the explanations on electrical energy and the concept of water waves, one after another. Then, study Figures 1 and

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2. Make follow up on their study and ask them comprehension questions;

(b) Discuss the procedures for an activity on how water waves occur, perform it, and answer the question based on the results. Check the correctness of their responses and provide feedback;

(c) Read the explanations on the generation of electricity from water waves and water currents. Then, ask them comprehension questions;

(d) Study Figures 3 and 4; then, make follow up on their study by asking comprehension questions;

(e) Discuss the advantages and disadvantages of generating electricity from water waves and water currents. Make follow up on their discussion by asking questions; and

(f) Work on Exercise 1 and check the correctness of their answers and provide feedback.

2. Guide the pupils in groups to:

(a) Read the explanations on the concept of geothermal energy. Then, ask comprehension questions and monitor the correctness of their responses;

(b) Read aloud the explanations on generating electricity using geothermal energy. Then, ask them comprehension questions and monitor the correctness of their responses;

(c) Discuss featuers in Figure 5. Make follow up on their discussion by asking questions; and

(d) Work on Exercise 2. Then, check the correctness of their answers and provide feedback.

3. Guide the pupils in groups to:

(a) Read the explanations on the quality of renewable energy and ask them comprehension questions; and

(b) Work on Exercise 3. Then, check the correctness of their answers and provide feedback.

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Answers to questions

Exercise 1

1. (a) Water waves are caused by friction between the wind and the water surface.
   (b) Water waves are also caused by the gravitational attraction between the sun and the moon.
2. Turbine, generator, and transmission cables
3. The power plant for generating electricity using water waves is built where there are powerful ocean waves, normally near the shoreline. Water oscillation causes air above the surface of water to rotate the turbine that is connected to the generator that produces electricity.
4. The power plant for generating electricity from ocean currents is built on the shore. Water from the ocean enters the dam through the area where there is a turbine. Water currents rotate the turbine, which is connected to the electric generator. When the dam is full, a barrier is set. During low tides, water leaves the dam to the ocean through the area where there is a turbine. The barrier is then removed to allow water current from the dam to rotate the turbine that is connected to the electric generator.

Exercise 2

1. Geothermal energy comes from the hot magma inside the underground rocks.
2. The source is almost unlimited. Heat is generated by the earth's core.
3. Geothermal energy can be converted into electrical energy by a special power plant for generating electricity. The plant consists of a turbine rotated by high-pressure steam. Steam from underground rocks is pushed out by a pump. The steam used to run the turbine cools, changes into a liquid, and re-injected into the earth by using a pump. The turbine is connected to the generator that produces electricity.

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Exercise 3

Section A

1. Biogas, wind, water, and the sun
2. Waterfalls, water waves, and water currents
3. Solar power plant

Section B

4	5	6	7	8
FALSE	TRUE	TRUE	FALSE	FALSE

Section C

9. Two advantages from the following:
   (a) Its sources are found in our environment.
   (b) It is extracted from natural sustainable resources.
   (c) It is reliable.
   (d) It has no harmful effects on living organisms and the environment.

10. The differences between renewable and non-renewable energies

Renewable energy	**Non - renewable energy**
Alternative energy produced from natural resources which are self-replenishing. This energy is not harmful to living organisms and the environment. Examples are hydroelectric energy and solar energy	The energy that is produced from natural resources, which cannot be replenished. This energy is harmful to living organisms and the environment. Example of it is electrical energy generated from fossil fuels

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11. The differences between solar energy and geothermal energy

Solar energy	Geothermal energy
Its source is the sun	Its source is the heat preserved in underground rocks
Uses panels to generate electricity	Uses steam turbines to generate electricity
The costs of installing solar panels are cheap	The costs of installing geothermal energy plants are high

12. Renewable energy is sustainable because its resources are continuously replenished. Hence, it can be used by present and future generations without running out.
13. The pupils' answers will depend on the type of resources which are used in their environment. Check the correctness of their answers.
14. The advantages of the electrical energy generated from ocean waves
    (a) Electricity from ocean waves is sustainable.
    (b) Its source is cheap.
    (c) This electricity is environmentally friendly.

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Chapter Three

Floating and sinking

Introduction

In Standard Three, the pupil learnt about matter and its properties. The pupil also learnt about floatation of matter in the air. In this chapter, the pupil will learn about the characteristics of objects which float on water or sink in water. The pupil will also learn the law of floatation and its application to marine transport. In addition, the pupil will make models of objects which float and objects which sink in water. The competencies gained will enable the pupil to construct models of vessels used in water transport.

Pupil's activities

(a) Analysing the properties of objects which float on water and objects which sink in water
(b) Relating the principle of floatation of objects and how marine vessels operate
(c) Constructing models of sinking or floating objects for demonstrating the application of the law of floating

Teaching and learning resources

Pictures and illustrations, basin, two beakers or glasses, water, various objects that float and those which sink in water such as a leaf, a piece of wooden block, metal spoon, balls or table tennis ball, eraser, pencil, sharpener, stones, and a spring balance

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Teaching steps

1. Guide the pupils in groups to:
   (a) Answer a question on objects which float on water and objects which sink in water and monitor the accuracy of their responses;
   (b) Read aloud the explanations on the characteristics of objects that float on water or sink in water. Then, ask them comprehension questions. Monitor the accuracy of their reading and responses;
   (c) Discuss Figure 1 and identify the relationship between the upthrust force and the gravitational force. Then, monitor the correctness of their discussion and practices;
   (d) Discuss Figure 2 and ask the pupils to find the weight of a body by using acceleration due to gravity;
   (e) Perform Activity 1 by recording the results in their exercise books as shown in Table 1. Then, monitor the correctness of their responses.
   (f) Discuss the objects which floated and those which sank in water using the results of Activity 1 and Figure 3. Monitor the correctness of their responses and provide feedback; and
   (g) Work on Exercise 1. Then, check the correctness of their answers and provide feedback.
2. Group the pupils and guide them to:
   (a) Read aloud the explanations on Archimedes' principle, then discuss Figure 4. Ask them comprehension questions and monitor the accuracy of their responses;
   (b) Discuss an example about the weight of an object when in the air and when it floats on or sinks in water. Then, monitor the accuracy of their discussion;
   (c) Discuss the procedure for Experiment 1 and conduct it to verify the Archimedes principle. Then, monitor the correctness of their discussion and practices;

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(d) Read the explanations about the law of floatation. Ask them comprehension questions and monitor the correctness of their answers;

(e) Discuss the procedures for Experiment 2, perform the experiment to find the apparent weight of an object floating on water, and verify the Archimedes principle. Monitor the correctness of their discussion and responses;

(f) Read aloud the explanation on the application of the law of floatation in transport vessels, one after another and then observe Figure 7. Ask them questions and monitor the correctness of their answers;

(g) Discuss Activity 2. Give the pupils time to practise and choose the type of the model that they will construct, identify the materials to be used, write the procedure, draw the diagram, and construct the model. Then, present their models, conduct gallery walk for their models. Monitor the correctness of constructed models; and

(h) Work on Exercise 2, then check the correctness of their answers and provide feedback.

Answers to questions

Exercise 1

Section A

1.

a	b	c	d	e	f
Sinks	Floats	Sinks	Floats	Floats	Floats

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Section B

2. Density is the mass of a unit volume of a substance.
3. The average density of a ship is less than the density of water. The needle sinks into the sea because its density is greater than the density of water.
4. Two characteristics from the following:
   (a) The gravitational force is equal to the upthrust force.
   (b) The density of an object is less than the density of water.
   (c) Hollow objects filled with air.

Exercise 2

Section A

1	2	3	4
c	b	d	b

Section B

5. An object floats on water if its density is less than that of water and sinks if its density is greater than that of water.
6. The weight of a floating object is equal to upthrust.
7. Archimedes' principle states: *When an object is partially or completely immersed in a fluid, it experiences an upthrust which is equal to the weight of the fluid displaced by the object.*
8. The law of floatation states: *A floating object displaces a weight of fluid equal to its own weight*. Thus, the large air space in a ship enables it to displace water with a weight equal to its weight.
9. Their weights are similar.
10. Density = 2 kg/m^3
11. Volume = 3 m^3

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Chapter Four

Antenna

Introduction

In Standard Four, the pupil learnt how to use and take care of a radio and television. Likewise, in Standard Six, the pupil learnt about the concept of the Internet, which is one of the communication networks. In this chapter, the pupil will learn about the concept of the antenna, the types of antennas, the quality and materials used in fabrication of antennas. The competencies gained will enable the pupil to fabricate and choose the right antenna.

Pupil's activities

(a) Describing the concept of the antenna
(b) Identifying the types of antenna used on various devices
(c) Assessing the quality of antenna used on various devices
(d) Explaining the importance of the materials used to make an antenna
(e) Fabricating an antenna

Teaching and learning resources

Copper wire, straight dry pole, nuts, pegs, screws, aluminium pipe, a thick metal rod and a communication receiver such as a television or radio

Teaching steps

1. Guide the pupils to:
   (a) Read aloud and discuss the concept of the antenna. Then, ask them comprehension questions;

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(b) Attempt Exercise 1. Then, check the correctness of their answers and provide feedback.

2. Guide the pupils to:
   (a) Read aloud, one after another, the text on wire antennas, aperture antennas, and array antennas as well as discuss the advantages and disadvantages of using such antennas;
   (b) Study Figures 1 and 2 to identify the components of the antenna;
   (c) Read the text on the reflector antenna and the microstrip antenna, the advantages and disadvantages of using the antenna. Then, ask them probing questions;
   (d) Study Figures 4, 5 and 6. Then, ask questions to gather information regarding their understanding;
   (e) Attempt Exercise 2. Then, check the correctness of their answers and provide feedback; and
   (f) Discuss Activity 1. Then, check the correctness of their discussion.

3. Guide the pupils to:
   (a) Read the text on the quality of the antenna and the steps for fabricating the antenna. Then, ask comprehension questions;
   (b) Discuss the steps for performing Activity 2. Then, make antennas by referring to Figure 9; and
   (c) Attempt Exercise 3. Then, check the correctness of their answers and provide feedback.

4. Ask the pupils to:
   (a) Read a text on the use of antennas on communication devices and ask them comprehensive questions;
   (b) Attempt Exercise 4. Then, check the correctness of their answers and provide feedback.

Note: This section enables you to find out how the Yagi-Uda antenna's measurements can be obtained. This information will allow you to plan your work on designing a Yagi-Uda antenna based on the dimensions of the materials you have in your environment.

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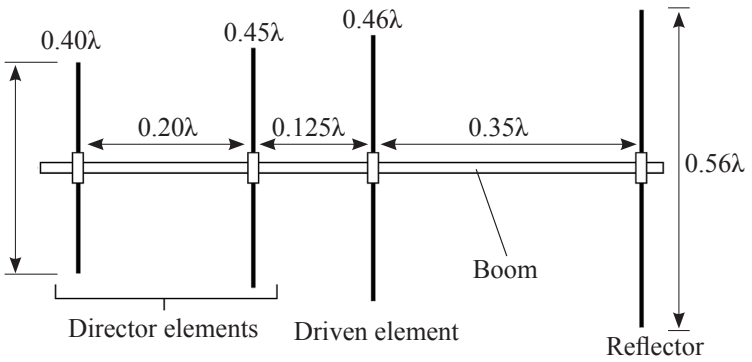
The lengths of the pieces used to fabricate the Yagi-Uda antenna and the spaces between them depend on the wavelength (λ). The following table shows the appropriate dimensions for fabricating the antenna.

Table: *Dimensions of the length and position of antenna elements*

Components of the Yagi-Uda antenna	Dimensions
Driven length	0.458λ - 0.5λ
Reflector length	0.55λ - 0.58λ
Director length 1	0.45λ
Director length 2	0.40λ
Director length 3	0.35λ
Distance between director elements	0.20λ
Distance between reflector and driven elements	0.35λ
Distance between driven and director element	0.125λ



Formula

$$\text{Wave length } (\lambda) = \frac{\text{Velocity of propagation}(\text{m/s})}{\text{Carrier frequency in Hz}}$$

$$\lambda = \frac{v}{f}$$

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The SI unit of $\lambda = \frac{m/s}{s^{-1}} = m$

Yagi - Uda antennas operate at the frequencies between 30 MHz - 3 GHz. The speed of the electromagnetic wave is similar to the speed of light which is three hundred million meters per second. The wavelength depends on the frequency.

Example: Find the required distance between the reflector element and the driven element when making the Yagi-Uda antenna that operates at 200 MHz. The distance can be obtained as follows:

The distance between the reflector element and the driven element is 0.35 λ as shown in Figure 9 in the Pupil's Book.

$$\lambda = \frac{\text{Wave motion}}{\text{Wave frequency}} = \frac{\text{Velocity of light}}{\text{Wave frequency}}$$

$$0.35\lambda = 0.35 \times \frac{\text{Velocity of light}}{\text{Wave frequency}}$$

$$0.35\lambda = 0.35 \times \frac{3 \times 10^8 \text{ m/s}}{200 \times 10^6 \text{ Hz}}$$

$$0.35\ \lambda = 0.525 \text{ m} = 52.5 \text{ cm}$$

The distance between the reflector element and the driven element is 52.5cm.

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Answers to questions

Exercise 1

1. The antenna is a device that receives and transmits electromagnetic waves.
2. They enable wireless devices to communicate.
3. A pupil should mention three devices out of these: ships, cars, radar, televisions, mobile
   phones, radios and any correct responses from the pupils.
4. It will help the pupil to know how to use, select, and fabricate antennas.
5. Cell phone towers, cell phones, radar, aeroplanes, ships, and satellites

Exercise 2

1. Reflector antennas, wire antennas, aperture antennas and microstrip antennas
2. The loop antenna is made of wire while the parabolic reflector antenna is made of a curved tin plate or a coil of wire. The loop antenna is easier to build and maintain than the parabolic reflector antenna. The loop antenna is easier to move than the parabolic reflector antenna. Similarly, the loop antenna is less susceptible to noise or light than the parabolic reflector antenna.
3. (a) The microstrip antenna: It is used when a communication device requires small, portable and cheap antennas such as cell phones.
   (b) The parabolic reflector antenna: It is used when transmitting and receiving waves at long distances and where wire cannot be used, as in receiving weather forecasting signals.
   (c) The Yagi-Uda antenna: It is used in areas where signals are weak and in communication devices such as radio and television, which require higher frequencies.

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4. (a) It needs an antenna receiver to work properly.
   (b) Some of the signals from the antenna receiver may interfere with those of the main dish.
   (c) The antenna receiver needs to be correctly positioned, facing the main antenna so that it can capture the signals. The designing process and its installation are complex.

Exercise 3

1. (a) They can conduct electricity;
   (b) They resist rust; and
   (c) They are durable.
2. Aluminium is lighter and cheaper than copper.
3. The director elements of the Yagi-Uda antenna are fixed in front of the driven element to get the directions of the broadcasting station.

Exercise 4

Section A

1	2	3	4	5	6
c	d	b	c	c	a

Section B

7. Radar, ships, airplanes, televisions, satellites, radios and cell phones
8. Meteorological stations, space communications centers, Global Positioning System (GPS) and cell phone companies' towers.
9. The microstrip antenna
10. The Yagi-Uda antenna, reflector antenna and loop antenna
11. (a) It can receive and transmit higher frequencies.
    (b) It can be made in different ways.
    (c) It is cheaper to manufacture and effective.

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Chapter Five

Complex machines

Introduction

In Standard Six, the pupil learnt about the meaning, types, and applications of pulleys. The pupil also learnt about the meaning and importance of complex machines. Similarly, the pupil learnt about work in science and its applications. In this chapter, the pupil will learn about the structure of complex machines such as mortise locks, sewing machines, bicycles, grain milling machines and juice making machines. The pupil will also learn about the uses and maintenance of complex machines. The competencies gained will enable the pupil to use machines to simplify work. In addition, the pupil will be able to maintain machines so that they last longer.

Pupil's activities

(a) Analysing the structure of a complex machine
(b) Using complex machines and applying the skills in operating other complex machines
(c) Demonstrating the procedures for maintaining complex machines

Teaching and learning resources

A real device, a picture or model of a mortise lock, a sewing machine, a bicycle, a grain milling machine, a juice making machine, and a screwdriver

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Teaching steps

1. Guide the pupils to:
   (a) Read, one after another, the text about complex machines and the structure of the mortise lock. Then, ask them comprehension questions;
   (b) Study the real door mortise lock, its picture or model, relate it to Figure 1 and ask questions about parts of the mortise lock. Monitor the correctness of their responses;
   (c) Read aloud the text on how the mortise lock works. Then, ask them comprehension questions;
   (d) Perform Activity 1 on examining the structure of the mortise lock and how it works. Then, monitor the accuracy of the activities in each step and ask questions;
   (e) Read the text on handling the mortise lock and ask them questions; and
   (f) Work on Exercise 1. Then, check the correctness of their answers and provide feedback.

2. Guide the pupils to:
   (a) Read, one after another, the text on the sewing machine. Then, ask them comprehension questions;
   (b) Read aloud the text on the structure of the sewing machine and study Figure 2. Monitor the correctness of the reading and studying;
   (c) Read aloud the text on how the sewing machine works. Then, ask them comprehension questions;
   (d) Perform Activity 2 on examining the structure of the sewing machine and how it works. Then, monitor the accuracy of the activities at each step and ask them questions;
   (e) Read the text on handling the sewing machine and ask them questions; and
   (f) Work on Exercise 2. Then, check the correctness of their answers and provide feedback.

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3. Guide the pupils to:
   (a) Read, one after another, the text on the bicycle and ask them comprehension questions;
   (b) Read aloud the text on the structure of a bicycle and study Figure 3. Then, monitor the accuracy of their reading and studying;
   (c) Read aloud the text on how the bicycle works and ask them comprehension questions;
   (d) Perform Activity 3 on examining the structure of a bicycle and how it works. Monitor the accuracy of the activities in each step and ask them questions;
   (e) Read the text on handling a bicycle. Then, ask them questions; and
   (f) Work on Exercise 3. Then, check the correctness of their answers and provide feedback.

4. Guide the pupils to:
   (a) Read the text on a grain milling machine, one after another, and ask them comprehension questions;
   (b) Read aloud the text on the structure of the grain milling machine and study Figure 4. Monitor the accuracy of their reading and studying;
   (c) Read aloud the text on how the grain milling machine works. Then, ask them comprehension questions;
   (d) Perform Activity 4 on studying the structure of the grain milling machine, monitor the accuracy of the activities in each step, and ask them questions;
   (e) Read the text on the handling of the grain milling machine and ask them questions; and
   (f) Work on Exercise 4. Then, check the correctness of their answers and provide feedback.

5. Guide the pupils to:
   (a) Read one after another, the text on the juice making machine. Then, ask them comprehension questions;

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(b) Read aloud the text on the structure of the blender and study Figure 5. Then, monitor the accuracy of their reading and studying;
(c) Read aloud the text on how the blender works and ask them comprehension questions;
(d) Perform Activity 5 on studying the structure of the blender and how it works. Then, monitor the accuracy of the activities in each step and ask them questions;
(e) Read the text on blender handling and ask them questions; and
(f) Work on Exercise 5. Then, check the correctness of their answers and provide feedback.

Answers to questions

Exercise 1

1. Levers, the latch spring, latch bolt, and deadbolt
2. (a) Levers - to prevent the bolt from moving, thus locking or unlocking the mortise lock
   (b) Latch springs - to pull and release the latch bolt in the mortise lock
   (c) Deadbolt - to enter or exit the socket on the door casing when rotating the key
   (d) Latch bolt - to allow the door open when the handle of the mortise lock is turned down
3. The mortise lock is a complex machine because it is made up of more than one simple machine. These machines are levers, the latch spring, latch bolt and deadbolt.

Exercise 2

1. Wheel and axle, pulley and lever
2. The sewing machine will not work because the axle, which rotates the needle, will not rotate.

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3. The sewing machine is a complex machine because it is made up of more than one simple machine.
4. It will not rotate properly; it will rust; the metals will erode and it will degrade.

Exercise 3

1. Wheel and axle, pulley and lever
2. The chain slips. Hence, the pedal will not transmit force to the bicycle wheels properly.
3. It helps to reduce friction and corrosion on the rotating parts. Also, it prevents the chain from getting rust.

Exercise 4

1. Wheel and axle, pulley, and an inclined plane
2. An inclined plane, a mill, and a flour outlet
3. Pulley in a grain milling machine gets the force from the motor or engine and sends it to the mill.

   The bicycle pulley picks up the force from the pedal (fuel or electric motor) and turns the back wheel.
4. The grain milling machine will not work because the mill will fail to grind the grain as no energy will be coming from the motor or engine.

Exercise 5

Section A

1	2	3	4	5
c	b	a	a	d

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Section B

6. (a) To lubricate the moving parts to make the machine run smoothly and prevent it from rust
   (b) To cover it with a clean cloth when not in use
   (c) To use clean threads to prevent dust from entering the sewing machine
   (d) To clean dust after use
7. (a) Chain
   (b) Ball bearings
   (c) Axle

Section C

8	9	10	11	12
TRUE	FALSE	FALSE	FALSE	TRUE

Section D

13. Monitor the accuracy of the pupil's responses based on the complex machines available in their environment.
14. Simple machines are basic mechanical devices for applying a force and doing work. Examples are a spade, hammer and scissors. Complex machines are machines containing more than one simple machine such as a bicycle, sewing machine and blender.
15. A pedal on a bicycle is the lever. This lever receives force from the operator's foot. The force is transported by the chain to a small pulley's wheel connected by an axle. The wheel rotates the back wheel.
16. The mortise lock is kept by wiping it with a clean, dry cloth and lubricating it with special oil.

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Chapter Six

Scientific experiments

Introduction

Scientific experiments are conducted to answer questions that need scientific answers. The contents prepared in those experiments stimulate or motivate the pupil to develop an inquisitive mind. When scientific experiments are carried out carefully and accurately, they give correct results. In Standard Five, the pupil conducted experiments on measuring the human body temperature and the expansion and contraction of solid materials, liquids, and gases.

The pupil also conducted experiments on the transfer of heat in solid materials, liquids, and air as well as how to reduce heat loss. In this chapter, the pupil will learn how to prevent and extinguish fires of various classes, such as A, B, C, D, and F, and fires due to electrical faults. The pupil will conduct experiments on how to extinguish Classes A and B fires. The pupil will also conduct experiments to examine the properties of acids and bases. Similarly, the pupil will conduct experiments to examine the causes of rust and how to prevent it.

The competencies gained will help to protect the pupil from fire accidents and keeping iron materials free from rusting. The pupil will also be able to take precautions when using substances with acidic or basic properties. You are reminded to make adequate preparations to facilitate the intended experiments. You are also advised to use various techniques depending on the environment to enable the pupil gain the intended competencies.

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Pupil's activities

(a) Carrying out experiments on firefighting
(b) Carrying out experiments to identify the properties of acids and bases
(c) Carrying out experiments to identify necessary conditions for rusting and how to prevent it

Teaching and learning resources

Pieces of paper, a match box, a bucket of water, kerosene, diesel, oil, dry sand, heavy blankets, carbon dioxide gas, white plain paper, hibiscus flowers, pair of scissors, ruler, two bowls, lemon, unripe oranges, unripe mangoes, yoghurt, knife, blue litmus paper, red litmus paper, filter, test tube, crusher, mortar and pestle, ashes, a piece of soap, chalk or lime, gallbladder, glass or plastic bottle, beef fats, filter paper, new iron nails, a piece of iron rod, two pieces of iron sheets, a lead oxide paint, green paint, blue paint or red paint, brush, bucket, stainless steel or brass keys, sandpaper, steel wire, a piece of plastic material, stainless steel spoons or brass, cooking oil or grease, heat source and three 'sufuria' or beakers of 250 millilitres.

Teaching steps

1. Guide the pupils to:
   (a) Read aloud the text on the concept of fire, the classes of fire, and the procedures for firefighting. Then, ask them comprehension questions;
   (b) Perform the following experiments and write the results and conclusions in their exercise books. Check the correctness of their results and conclusions;
      (i) **Experiment 1:** To examine whether a Class A fire can be extinguished by water

      Results: The fire caused by burning paper was extinguished after pouring water on it.

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Conclusion: The Class A fire is extinguished by water. Water reduces the heat of the burning materials. Thus, the fire is extinguished.

(ii) **Experiment 2:** To examine whether a Class B fire can be extinguished by dry sand.

Results: The fire was extinguished after pouring dry sand on it.

Conclusion: The Class B fire is extinguished by dry sand which inhibits the required oxygen to support combustion.

(c) Work on Exercise 1, then check the correctness of their answers and provide feedback.

2. Guide the pupils to:
   (a) Read aloud the text and discuss the concept of acids and bases. Monitor the accuracy of their discussion;
   (b) Read the text on indicators of acids and bases, then ask them comprehension questions;
   (c) Make a litmus paper indicator using hibiscus flowers. Monitor the accuracy of their results; and
   (d) Perform the following experiments and record the results and conclusions in their exercise books.
      (i) **Experiment 3:** To examine the properties of acids using litmus paper and discuss the results and conclusion of the experiment. Check the correctness of their results and conclusions.
      (ii) **Experiment 4:** To examine the properties of bases using litmus paper and beef fat. Check the correctness of their results and conclusions.
   (e) Work on Exercise 2. Then, check the correctness of their answers and provide feedback.

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3. Guide the pupils in groups to:
   (a) Read the text on the concept of rust and ask them comprehension questions;
   (b) Perform the following experiments:
      (i) **Experiment 5:** To examine substances which rust and those which do not rust: Check the correctness of the conclusion.
      (ii) **Experiment 6:** To examine the conditions necessary for rusting: Make sure they get the following results:

Beaker/ 'Sufuria' A	Beaker/ 'Sufuria' B	Beaker/ 'Sufuria' C
No rusting of iron nails observed because in a beaker or 'sufuria' A, all the dissolved oxygen gas in the water was removed by boiling the water. The layer of oil prevented oxygen gas from dissolving in the water, therefore, there was no oxygen gas.	Rusting of iron nails was observed. Although the water was boiled to remove oxygen gas, the absence of oil allowed oxygen gas to re-enter the water.	No rusting of iron nails was observed because beaker or 'sufuria' C had oxygen gas only and lacked water.

Conclusion for Experiment 6

Water and oxygen gas are the necessary conditions for rusting of iron nails. Water or oxygen gas alone cannot cause rust on the iron nails. The presence of both water and oxygen gas allows rust to occur on iron materials.

      (iii) **Experiment 7:** To examine whether painting can prevent rust. Check the correctness of their results and conclusion.

   (c) Work on Exercise 3. Then, check the correctness of their answers and provide feedback.

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Answers to questions

Exercise 1

1. (a) water, sand, fire blankets
   (b) dry sand, fire blankets, carbon dioxide gas or dry powder
   (c) carbon dioxide gas or dry powder
2. (i) Oxygen gas (ii) Heat (iii) Fuel
3. Oil is less dense than water; thus, it floats and spreads. This condition increases the speed and extent of the fire instead of extinguishing it. Also, the temperature of the fire caused by petrol is high. It causes the water to be lost before extinguishing the fire.

Exercise 2

1. (a) Car battery liquids, vinegar, lemon, yoghurt, pineapples and unripe oranges
   (b) Bile, ashes, unripe bananas, soap, and lime
   All items listed can be tested using the litmus paper indicator.
2. (a) Burning and
   (b) Changing the colour of blue litmus paper to red
3. (a) Acids are used in making (i) battery liquids, (ii) pesticides, (iii) paints and dyes (iv) cleaning chemicals, (v) fertilizers, (vi) ink, (vii) food flavour, and (viii) are used for laboratory investigations.
   (b) Bases are used (i) in making medicines , (ii) to make soap, (iii) to break down animal fats, (iv) to reduce the level of acid in the body; and (v) for laboratory investigations.
4. (a) The following are the properties of acids:
   (i) Have a sour taste.
   (ii) Change blue litmus paper to red.
   (iii) Burn or erode when in a concentrated state.
   (b) The following are the properties of bases:
   (i) Have a bitter taste.
   (ii) Change red litmus paper to blue.

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(iii) Burn or erode when in a concentrated state.
(iv) They are slippery like soap.
(v) Break down fats in animal bodies.

5. Using the litmus paper indicator, tomato juice will change the blue litmus paper to red. A soap solution will change red litmus paper to blue.

Exercise 3

Section A

1	2	3	4	5
c	b	d	c	a

6. (a) TRUE (b) FALSE (c) FALSE (d) TRUE (e) TRUE

Section B

7. Some substances rust because of the presence of water, air (oxygen) and materials that contain iron substances.
8. Rusting and non-rusting substances

	(a) Rusting substances	**(b) Non-rusting substances**
(i)	Iron nails	Plastic
(ii)	Piece of iron sheet	Stainless steel spoons
(iii)	Hoe	Glass
(iv)	Axe	Aluminium
(v)	Pick-axe	Bones
(vi)	Piece of iron rod	Timber

Note: The pupil can name other substances besides the listed ones. Check the correctness of all the mentioned items.

9. The following are the effects of rusting on the environment:
   (a) It destroys iron sheets,
   (b) It destroys machine spare parts,
   (c) It destroys working tools,
   (d) It spreads diseases such as tetanus, and
   (e) It reduces the efficiency of machines.

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Chapter Seven

Waste disposal

Introduction

Waste disposal is important in conserving the environment. Various methods are used for waste disposal, including the use of incinerators. Using incinerators is one of the most useful methods of controlling wastes and their effects. In Standard Six, the pupil learnt about the sources, types and effects of wastes and the proper management of wastes. In this chapter, the pupil will learn about the concept of waste disposal as one of the methods of waste management, the importance of waste disposal, and the steps to follow in disposing wastes. The pupil will also learn about the structure of the incinerator and the characteristics of an area suitable for constructing it. The competencies gained will enable the pupil to use proper methods of waste disposal to conserve the environment.

Pupil's activities

(a) Explaining the concept of waste disposal

(b) Explaining the importance of waste disposal

(c) Describing the steps to follow in waste disposal

(d) Explaining the concept of an incinerator

(e) Explaining the characteristics of a suitable area for constructing an incinerator

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Teaching and learning resources

Pictures of incinerators, clay, sticks, rope or threads and diagrams showing parts of an incinerator

Teaching steps

1. Guide the pupils to:
   (a) Read the text on the concept of waste disposal and ask them comprehension questions;
   (b) Discuss the advantages of waste disposal and read the text about that section, one after another; and
   (c) Attempt Exercise 1. Then, check the correctness of their answers and provide feedback.

2. Guide the pupils in groups to:
   (a) Discuss the steps to be followed during waste disposal and read the text to verify their answers;
   (b) Discuss the importance of sorting and grouping wastes before disposing them and present their work. Conclude by providing feedback based on their presentation;
   (c) Discuss how they dispose wastes in their environment at home and at school and then present their work. Provide feedback based on their presentation; and
   (d) Discuss the importance of following each step during waste disposal and present their work. Read the text to verify their answers.

3. Guide the pupils to:
   (a) Read aloud, one after another, the text on the methods of waste disposal by crushing or grinding and landfilling, burning, chemical treatments and incineration. Then, ask them comprehension questions;
   (b) Discuss in groups the advantages and disadvantages of each method of waste disposal and present their work. Make a conclusion by providing feedback on their presentation;

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(c) Discuss in groups the types of waste disposed by each method. Ask them comprehension questions and provide feedback based on their presentations; and
(d) Attempt Exercise 2. Check the correctness of their answers and provide feedback.

4. Guide the pupils to:
   (a) Read the text on the structure of an incinerator and ask them comprehension questions;
   (b) Visit places which dispose wastes using an incinerator to investigate how it works. Then, ask them questions and provide feedback;
   (c) Discuss in groups the effects of not using an incinerator to dispose waste. Monitor the accuracy of their discussion;
   (d) Perform the activity on constructing the model of an incinerator. Then, monitor the accuracy of the activity.
   (e) Attempt Exercise 3. Then, check the correctness of their answers and provide feedback.

5. Guide the pupils to:
   (a) Discuss in groups a suitable area for constructing an incinerator and then present their work. Make conclusions by providing feedback based on their presentations;
   (b) Read aloud, one after another, the text on the characteristics of the suitable area for constructing an incinerator. Then, ask them comprehension questions;
   (c) Discuss in groups the characteristics of an area suitable for constructing an incinerator and then present their work. Make conclusions by providing feedback based on their presentations; and
   (d) Attempt Exercise 4. Check the correctness of their answers and provide feedback.

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Answers to questions

Exercise 1

1. Waste disposal is the process of removing or destroying wastes to prevent their effects on organisms such as human beings and on the environment.
2. The accidents are as follows;
   (a) bites from dangerous organisms such as scorpions, centipedes, and snakes; and
   (b) being injured by sharp objects such as broken pieces of glass, bottles, and nails.
3. Waste disposal frees a large part of the land previously used to keep waste. After the disposal, only a small quantity of waste remains as ash or compacted waste. Thus, the land can be used for other activities.

Exercise 2

1. Chemical wastes such as expired laboratory chemicals and cosmetics.
2. Hazardous wastes are wastes that have been proven to be harmful to human and other living things. Examples of these wastes are used batteries, expired medicines, and radioactive wastes.

   Safety precautions should be taken during their disposal.
3. Advantages of sorting and segregating wastes are:
   (a) reducing waste disposal cost;
   (b) preventing the possibilities of occurring accidents and explosions;
   (c) simplifying the recycling of wastes for recyclable wastes; and
   (d) simplifying waste disposal based on the type of wastes and the specific methods of its disposal.

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4. The advantages of burning wastes are
   (a) low costs, and
   (b) preventing the spread of pathogens found in the waste.

   The disadvantages of burning waste are:
   (a) reducing soil fertility by killing organisms found in the soil, including soil worms;
   (b) emitting smoke which pollutes the environment and affects the respiratory system;
   (c) causing fire accidents such as burning houses and farms; and
   (d) production of toxic chemicals by some of the wastes.

Exercise 3

1. An incinerator is a furnace or special unit which uses high temperature to burn wastes.
2. Hospitals or health centres, industries, schools and other government and private institutions
3. The functions of the parts of the incinerator are
   (a) **Air inlet and ash vent:** This part allows air to enter. The oxygen gas contained in air helps to burn wastes. The vent is also used to remove out the ashes after burning wastes;
   (b) **Combustion chamber:** Wastes to be burnt are placed in this part. It is also used to mix or turn wastes when burning; and
   (c) **Chimney:** This part allows smoke and gases to get out of the incinerator after wastes have been burnt.

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Exercise 4

1	2	3	4
b	d	a	c

5.

a	b	c	d	e
TRUE	TRUE	FALSE	FALSE	FALSE

6. Methods of waste disposal are
   (a) burning of wastes;
   (b) incineration;
   (c) crushing of wastes using machines and landfilling; and
   (d) treating wastes with chemicals.

7. The area suitable for constructing an incinerator should be
   (a) away from human settlements,
   (b) accessible,
   (c) away from electric lines to avoid accidents and explosion, and
   (d) away from water sources to avoid water pollution.

8. The effects include
   (a) spreading of smoke in the environment, hence affecting people;
   (b) accumulation of ashes, preventing air from passing through: The incinerator may stop working if the ashes are not removed. Also, wastes cannot be burnt. Even if other methods will be used to initiate fire, the fire will soon turn off because there will be no air containing oxygen gas to support combustion.

9. It helps to ensure that wastes are properly burnt. It also helps to recognize if there is any problem in the types of wastes being burnt and solve it.

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10. Disadvantages of constructing an incinerator near human settlements:
    (a) unpleasant smell and smoke or gases reach human settlements and offices;
    (b) reduces oxygen gas, hence affects lives of living things; and
    (c) may cause fire accidents in residential buildings.
11. Importance of using an incinerator to dispose wastes:
    (a) prevents the spread of diseases;
    (b) prevents unpleasant smells;
    (c) keeps the environment clean;
    (d) prevents accidents such as being hurt by sharp objects or bitten by dangerous organisms such as snakes and scorpions;
    (e) prevents contamination of water sources; and
    (f) simplifies the disposal of hazardous wastes.
12. Yes, it is possible because large quantities of wastes are produced every day in Tanzania.
13. Because the sizes of the incinerators depend on the quantities of the wastes to be disposed. For example, an incinerator used to dispose sanitary pads at school is smaller than the one used to dispose hospital wastes.

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Chapter Eight

Body health

Introduction

Adhering to health principles is important for one to be healthy. Good health can be improved by eating properly and doing physical exercise. In Standard Six, the pupil learnt about health services provided to various groups of people and the characteristics of each group. In this chapter, the pupil will learn about the concept of a balanced diet and meals for various groups of people. They will also learn about the importance of doing physical exercise and the effects of not doing physical exercise on various groups of people. The competencies gained will enable the pupils to build good health and protect themselves from diseases.

Pupil's activities

(a) Explaining the concept of a balanced diet
(b) Differentiating meals for various groups of people based on their needs
(c) Explaining the importance of doing physical exercise for various groups of people
(d) Identifying the effects of not doing physical exercise

Teaching and learning resources

Fliers, charts and various articles on a balanced diet and physical exercise for various groups of people, skipping rope, sports shoes and clothes, and balls for football and netball.

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Teaching steps

1. Guide the pupils to:
   (a) Read aloud, one after another, the text on the concept of a balanced diet and its importance in the body. Then, ask them comprehension questions.
   (b) Work on Exercise 1. Then, check the correctness of their answers and provide feedback.
2. Guide the pupils in groups to:
   (a) Read the text about meals for children under five years and discuss it. Then, monitor the accuracy of their discussion; and
   (b) Discuss and perform Activity 1 about planning a day's balanced meal for a four-year old child. Then, monitor the accuracy of their discussion.
3. Guide the pupils to:
   (a) Read the text about a meal for youths and ask them comprehension questions, and
   (b) Perform Activity 2 about planning a day's balanced meal for youths. Then, monitor the accuracy of their discussion.
4. Guide the pupils to:
   (a) Read the text about a meal for manual workers, sedentary workers, and pregnant women. Then, ask them comprehension questions; and
   (b) In groups, perform Activities 3, 4 and 5 about planning a balanced meal for manual workers, sedentary workers, and pregnant women respectively from morning to evening. Monitor the accuracy of their responses.
5. Guide the pupils to:
   (a) Read the text about the meals for sick people and the elderly. Then, ask them comprehension questions;

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(b) Perform Activity 6 about planning a day's balanced meal for the elderly. Check the correctness of their answers; and

(c) Attempt Exercise 2. Then, check the correctness of their answers and provide feedback.

6. Guide the pupils to:
   (a) Read silently the text about physical exercise and its advantages to health for various groups of people such as children, youths, sedentary workers, pregnant women, and the elderly. Then, ask them comprehension questions;
   (b) Read silently the text on the advantages of doing physical exercise and the effects of not doing it. Then, ask them comprehension questions;
   (c) Perform physical exercise in groups as instructed in Activity 7. Then, monitor the correctness of the activity and answers; and
   (d) Work on Exercise 3; then, check the correctness of their answers and provide feedback.

Answers to questions

Exercise 1

1. A balanced diet is a meal which contains the right proportion of all types of food nutrients such as carbohydrates, proteins, fats, vitamins and minerals.
2. The main types of food groups are carbohydrates, proteins, fats and oil, vitamins and minerals.
3. It is important to eat fruits and fresh green vegetables because they contain vitamins and minerals that protect the body against diseases and strengthen the bones, muscles, and the brain.
4. The importance of water in the body includes the following:
   (a) To help various body systems to function properly, as in digestion and absorption of food nutrients in the body;

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(b) To cool the body when a person is sweating; and
(c) To help remove body wastes and toxins.

5. Examples of foods which contain proteins, carbohydrates, fats, and vitamins:
   (a) Proteins: mushroom, meat, and beans
   (b) Carbohydrates: ugali, rice and potatoes
   (c) Fats and oil: butter, sunflower oil, and groundnut; and
   (d) Vitamins: pineapple, oranges and amaranth

   Note: Verify the correctiness of other examples given by the pupil.

Exercise 2

1. Children under five years old should be given soft foods which contain a balanced diet with a lot of proteins.
2. (a) The nutrients you get from milk include proteins, vitamins and minerals.
   (b) Proteins build the body and replace the dead or destroyed cells with the new ones. Vitamins protect the body against diseases. Minerals build bones, teeth and repair of various body systems to function properly.
3. Sick persons require meals with enough proteins because they help to replace the destroyed and dead cells caused by the effects of diseases. They need to eat enough vegetables to strengthen body immunity and protect it from new infections.
4. Food groups
   (a) Proteins: Fish, soybeans, and meat
   (b) Carbohydrates: Rice, ugali, and cassava
   (c) Fats: Coconuts, groundnuts, and cashew nuts
   (d) Vitamins and minerals: Orange, mango, jackfruit, spinach, and carrot
5. A pregnant woman should eat enough proteins to build her body and for the development of the foetus.

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Exercise 3

Section A

1	2	3	4	5
d	d	b	c	d

Section B

6.

(a)	(b)	(c)	(d)	(e)	(f)
FALSE	FALSE	TRUE	TRUE	FALSE	TRUE

Section C

7. Five types of physical activities which can be done at school include the following: running, rope skipping, digging, pruning, cleaning the classes, arranging tables and chairs in the class, playing football or netball (and other games which the pupils mention in relation to physical exercise).
8. Types of physical exercise which are relevant for
   (a) Children under five years of age: simple exercise depending on their ages, such as running, jumping, creating various things, playing with ball and riding a bicycle for a short period.
   (b) The elderly: simple exercise depending on their capacities such as walking and jogging.
   (c) Youths: various types of exercise perfomed for a long time, such as running, ball playing, traditional dances, and doing vocational activities (carpentry, auto mechanics and welding).
   (d) Pregnant women: simple exercise, such as walking and strengthening muscles, as well as other body parts.
9. The types of diseases which sedentary workers may get if they do not do physical exercise include the following:

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(a) high blood pressure,
(b) diabetes, and
(c) obesity.

10. The advantages of physical exercise include the following: strengthening the body systems to perform their functions well, improving body immunity, removing stress and depression, and activating the brain. See the pupil's textbook on the advantages of doing physical exercise.
11. The effects which a pregnant woman can get if she does not do physical exercise include the following:
    (a) She can get excess weight which can cause problems to her during delivery.
    (b) She can feel uncomfortable and weak.
    (c) She can get problems during delivery because of her weak muscles.
12. The importance of physical exercise to the elderly include the following:
    (a) It helps the elderly to avoid gaining excessive weight which may result into high blood pressure and diabetes;
    (b) It helps the elderly to feel comfortable all the time and do their daily activities;
    (c) It ensures effective functioning of different body systems such as the circulatory system, hence protecting them from high blood pressure;
    (d) It strengthens body immunity against infections; and
    (e) It makes them strong and reduce stress.
13. It is important to do physical exercise in the morning or evening because there is a conducive weather condition.

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Chapter Nine

Nervous system

Introduction

The human body is made up of different systems. These systems depend on one another. When one system does not work efficiently, it affects other systems. In Standard Six, the pupil learnt about the reproductive system and the circulatory system. In this chapter, the pupil will learn about the nervous system, parts of the nervous system, and the functions of each part of the system. They will also learn about sensory organs, the various functions of the sensory organs, their disorders, and how to treat them. The competencies gained will help the pupil to take care of their nervous system and avoid behaviour that may affect its functioning.

Pupil's activities

(a) Explaining the concept of the nervous system
(b) Identifying parts of the central nervous system and the functions of each part
(c) Explaining the peripheral nervous system and its functions
(d) Elaborating functions of sensory organs
(e) Explaining disorders that may affect the sensory organs and how to treat them

Teaching and learning resources

Brain and spinal cord models, pictures or models of the ear, eye, tongue, nose and skin, office pins, ruler, chair, torch, a piece of cloth, manila

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paper or light white paper, wheat or cassava flour or clay, glue, stick and different watercolour paint

Teaching steps

1. Guide the pupils to:
   (a) Brainstorm on the concept of the nervous system;
   (b) Read aloud, one after another, the text on the concept and parts of the nervous system and its functions. Then, ask them comprehension questions; and
   (c) Perform Activity 1 to create a model of the central nervous system using the materials you have instructed them to collect, and store the created models in a safe place for future use.
2. Guide the pupils to:
   (a) Read aloud the text on the peripheral nervous system, nerve structure, types of nerves and their functions, then ask them comprehension questions;
   (b) Attempt Activity 2 in pairs about the ways nerves work. Then, check the accuracy of their responses.
   Precaution: When the lower part of the knee is tapped, the leg will be shocked and jerk forward. This is an involuntary action.
   (c) Attempt Exercise 1. Check the correctness of their answers and provide feedback.
3. Guide the pupils to:
   (a) Look at each other, in pairs, examine the sensory organs they see and explain the functions of the organs. Then, check the accuracy of their responses;
   (b) Read the text about the eye, parts of the eye, and its functions. Then, ask them comprehension questions;
   (c) Study the picture or a model of the human eye and describe the functions of its parts. Then, check the accuracy of their responses;

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(d) Attempt Activity 3, in pairs, to observe the dilation and contraction of the pupil because of increased and decreased light intensity entering the eye and answer the questions; and

(e) Read aloud, one after another, the text on eye disorders and the way of correcting them. Then, ask them comprehension questions.

4. Guide the pupils to:
   (a) Use a picture or a model of an ear to study in pairs the outer part of the ear and name the visible parts. Check the correctness of their answers; and
   (b) Read the text about the parts of the ear and the functions of each part. Then, ask them comprehension questions.

5. Guide the pupils to:
   (a) Use a picture or a model of the tongue to identify the parts containing taste buds. Then, ask them comprehension questions;
   (b) Taste foods with different flavours such as sugar, salt, lemon, lemon seeds or orange seeds and tomatoes to identify the parts that taste sweet, sour, bitter, umami, and salty; and
   (c) Read the text about the tongue and its functions as well as the parts with the taste buds to detect sweetness, sour, bitterness, saltiness and umami. Then, ask them comprehension questions.

6. Guide the pupils to:
   (a) Sniff things that give out various smells such as perfumes and flowers. Then, ask them comprehension questions; and
   (b) Read the text about the nose and its functions. Then, ask them comprehension questions.

7. Guide the pupils to:
   (a) Use a picture or a model of the skin to identify the visible parts on the skin. Then, ask them comprehension questions;
   (b) Name the functions of the skin that they know. Then, check the correctness of the answers and provide feedback;

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(c) Read texts on the human skin and its functions. Then, ask them comprehension questions;
(d) Read the text on skin disorders and how to take care of the skin. Then, ask them comprehension questions;
(e) Read texts on the disorders of the nervous system and how to keep the system safe. Then, ask them comprehension questions; and
(f) Attempt Exercise 2. Then, check the correctness of their answers and provide feedback.

Answers to questions

Exercise 1

1. The three groups of nerves are sensory nerves, motor nerves and intermediate nerves. Sensory nerves take information from different parts of the body and transmit them to the brain and the spinal cord.

   Motor nerves take information from the central nervous system and transmit them to various parts of the body where the responses occur.

   The function of the intermediate nerves is to receive information from the sensory nerves and send it to the motor nerves.
2. Voluntary actions are those done at the discretion or will of the person. Examples are walking, throwing and taking things by hand. In contrast, involuntary actions occur without a person's will. Good examples are heartbeats, breathing, sneezing, coughing, and the decrease or increase in the size of the eye's pupil.
3. The central nervous system is made up of two parts, namely the brain and the spinal cord. It receives information from all parts of the body and provides accurate and timely feedback after interpretation. The brain is the largest and most important part

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of the nervous system. It is soft and delicate in nature. It is stored inside the skull to protect it from mechanical injury. The spinal cord is the part of the central nervous system that is connected to the brain. The spinal cord passes through the connected bones that form a vertebral column from the neck to the waist.

4. Involuntary actions are important for our survival because, without them, our lives would be in danger. For example, a person can die if he or she cannot breathe just for a few minutes. If breathing was a voluntary action, a person who is asleep would have died because of being unconscious during sleep. In addition, when an object passes through the air passage without being conscious, a persons involuntarily coughs to force it out. Otherwise, the air passage would be blocked and the person would lose life. Therefore, no one would have survived without these involuntary actions.

Exercise 2

Section A

1	2	3	4	5	6	7
c	d	a	d	c	a	b

Section B

8.

i	ii	iii	iv	v	vi	vii
b	d	a	e	g	h	j

9	10	11	12	13	14	15
FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE

Section C

16. **Speaking:** The tongue enables us to give out different sounds. It is fast enough to move quickly to create different sounds and words.

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Eating: The tongue receives food put into the mouth during eating, moves it to the teeth, and mixes it with saliva to soften it.

Ingestion: Once the food is chewed, the tongue turns solid food into a mash (bolus) that can be swallowed and initiates the act of swallowing.

Tasting: The tongue is involved in tasting various flavours including sweetness, sourness, bitterness, and saltiness. We can not recognize whether the food has a good or bad taste without the tongue.

17. When a person moves from the bright light to the dim light, the pupil's size increases to allow more light to enter the eye and see the object better.
18. The decrease and increase in the size of the pupil allow the required amount of light to enter the lens to facilitate the formation of the image of an object and improve vision.
19. Mzee Kalulu's eyes had a long sightedness defect. Before he had been given the spectacles, an image of the object was being formed behind the retina. The convex lenses attached to the given spectacles collect light rays and enable it to land on the retina, thus creating a clear image of the object.

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Chapter Ten

Human respiratory system

Introduction

Breathing is an action of taking air in and out of the lungs. The air that enters the lungs contains a high amount of oxygen gas while air from the lungs contains a high amount of carbon dioxide gas. In Standard Six, the pupil learnt about the concept of air, characteristics of gases that compose air and uses of air in daily life. In this chapter, the pupil will learn about the concept of the respiratory system, parts of the human respiratory system, and how breathing occurs. The pupil will also learn about disorders in the respiratory system. The competencies gained will enable the pupil to maintain body health and avoid behaviour that may affect their respiratory system.

Pupil's activities

(a) Explaining the concept of the respiratory system
(b) Explaining how breathing takes place
(c) Performing an experiment to show how breathing occurs
(d) Elaborating disorders of the respiratory system and how to prevent them

Teaching and learning resources

Two balloons, three tubes, plastic bottle (five litres or more) with a cap, a wide rubber sheet or plastic bag, pair of scissors, rope or rubber belt

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Teaching steps

1. Guide the pupils in groups to:
   (a) Read aloud the text on the concept of the respiratory system, parts of the respiratory system, and the importance of breathing. Ask them comprehension questions; and
   (b) Attempt Exercise 1; then, check the correctness of their answers and provide feedback.
2. Guide the pupils to:
   (a) Read aloud the text, one after another, on how breathing occurs. Then, ask them comprehension questions;
   (b) Perform an experiment on how breathing occurs and check the correctness of their results and conclusion;

   Note: This experiment will yield the following:

   (i) When the wide rubber sheet is pulled downwards, the balloons will allow air to enter, and they will expand.
   (ii) When the wide rubber sheet is pushed upwards, the balloons will allow air to go out, and they will shrink.

Conclusion of the experiment

The similarities between the materials used in the model of the respiratory system and parts of the respiratory system of a human being

Parts in the model	Parts in the respiratory system
Balloons	Lungs
Tubes	Trachea, left and right bronchi
Bottle	Chest
A wide rubber sheet or plastic bag	Diaphragm

(c) Read silently the text on the factors that cause changes in the rate of breathing and the difference between the inhaled air and the exhaled air. Then, ask them comprehension questions; and

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(d) Read the text on gaseous exchange in the lungs and ask them comprehension questions.

3. Guide the pupils in groups to:
   (a) Read aloud the text on the disorders of the respiratory system. Then, ask them comprehension questions; and
   (b) Attempt Exercise 2. Check the correctness of their answers and provide feedback.

Answers to questions

Exercise 1

1. **A**-Nose
   B-Pharynx
   C-Trachea
   D-Lung
2. **Nose**-to receive air from the atmosphere and pass it to the pharynx
   Trachea- to pass air from the pharynx to the lungs
   Bronchus- to pass air from the trachea to the lungs
   Lungs-gaseous exchange between the inhaled and exhaled air occurs
   Alveoli-exchange of oxygen and carbon dioxide gases in and out of the blood stream occurs
   Pharynx- to pass air from the nose to the trachea
3. Alveoli are small air sacs in the lungs where gaseous exchange occurs. They increase the surface area of the lungs hence efficient gaseous exchange.
4. It is advised to breathe using the nose instead of the mouth because, when the air passes through the nose, it is warmed and particles are filtered off. The hair and the mucus inside the nose trap microorganisms and dust, thereby cleaning the air that enters the lungs. In the mouth, the air is not cleaned because there is no hair. Thus, it is easy for dust to reach the lungs.

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Exercise 2

Section A

1	2	3	4	5
d	d	b	a	c

Section B

6.

a	b	c	d	e	f
FALSE	TRUE	TRUE	TRUE	FALSE	TRUE

Section C

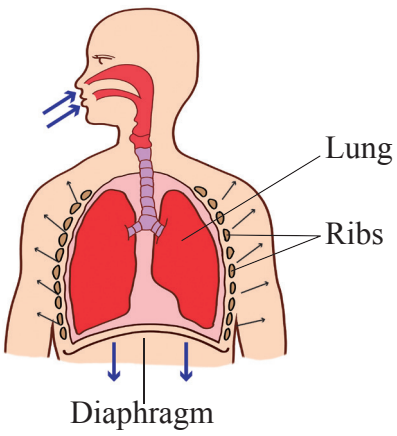
7. (a) The air that enters the body contains a high amount of oxygen gas and a low amount of carbon dioxide gas, while air from the lungs contains a high amount of carbon dioxide gas and a low amount of oxygen gas.

(b) The air that enters the body is dry, while the air that leaves it contains moisture.

(c) The air that enters the body is cold, while the air that leaves it is warm.

N.B: Consider other correct answers given by the pupil.

8.



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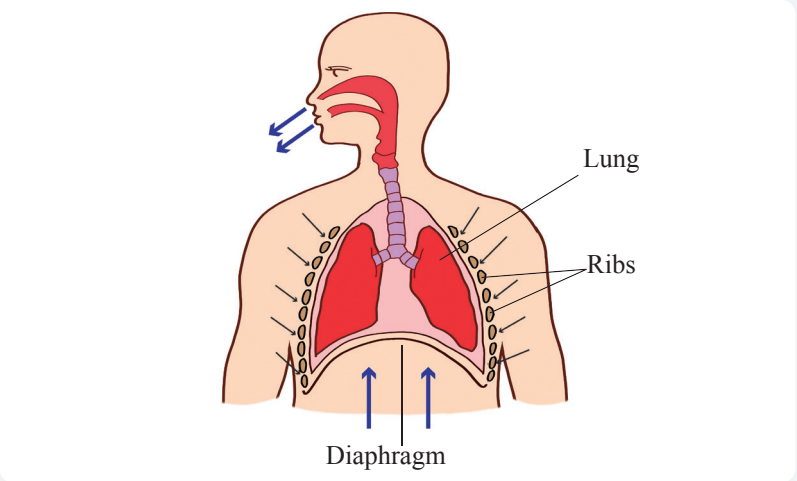
When a person breathes in, the diaphragm moves downward, the muscles between the ribs contract, forcing the ribs to go up. This action increases the space in the chest to allow the lungs to expand. When the lungs expand, the air from outside is drawn in to fill the empty space in the lungs.



When a person exhales, the diaphragm moves upward, the ribs move down and inward. This reduces space in the chest and lungs. As a result, air is pushed out.

9.

Defect	**Causes**
Lung cancer	Air with hazardous chemicals and radiation
Asthma	Inheritance, dust, pollen, perfume odours and smoke

10. Breathing enables gaseous exchange to take place. During this process, oxygen gas enters the body and carbon dioxide gas leaves it. Breathing also helps in the production of sound. When air passes through the larynx, it produces vibration which enables human beings to talk or sing.

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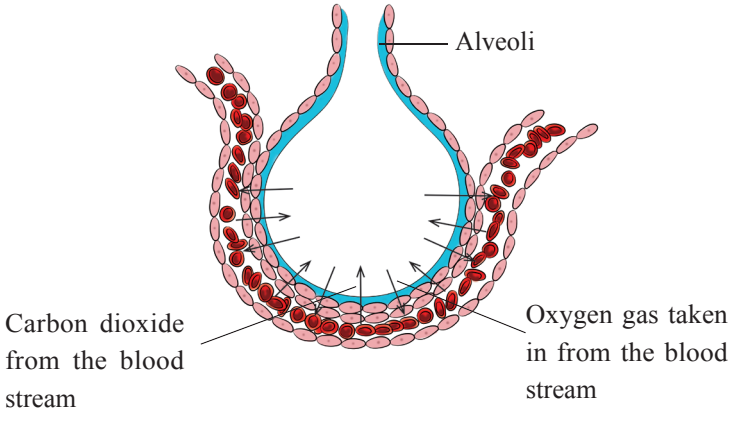
11. Gaseous exchange occurs in the alveoli, which are found in the lungs. These are small air sacs in the lungs. Alveoli have thin membranes, numerous blood capillaries, and moisture. These features enable oxygen gas to enter and carbon dioxide gas to leave the blood stream. The air that enters the blood stream contains a high amount of oxygen gas. Therefore, it is transported to different parts of the body. The carbon dioxide gas in the blood stream is transported to the lungs to be removed from the body.



12. Factors that can change the rate of breathing are as follows:
    (a) ***Physical exercise and manual activities:*** When you perform physical exercise or do manual activities, more energy is required in the body. The rate of breathing increases to allow more oxygen gas to burn food. A high amount of carbon dioxide gas is produced as a result of physical or manual activities. This gas must be taken out of the body.
    (b) ***Fear or anger:*** The rate of breathing increases when someone is afraid or angry because more energy is required to enable fighting or running away.
    (c) ***Anaemia:*** When a person is anaemic, the rate of breathing increases to increase the amount of oxygen which is required by the body.

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(d) ***Age:*** The rate of breathing is proportional to the age of the person. A child breathes faster than an adult. The rate of breathing in an adult is between 12 and 18 times per minute, while that of a child is between 22 and 60 times per minute.

(e) ***Altitude:*** The rate of breathing increases as one moves from low to high altitudes above sea level. This is because, at higher altitudes, air contains a little amount of oxygen gas. Thus, the rate of breathing increases so as to get enough oxygen gas for body use. At lower altitudes, air contains a higher amount of oxygen gas. Thus, the rate of breathing is normal.

(f) ***Temperature:*** The rate of breathing depends on the temperature of the environment. As the temperature increases, the rate of breathing increases. This enables the body to get more oxygen which is used to release energy for regulating body temperature to normal.

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