South Sudan

Primary Science 6

Primary Science has been written and developed by Ministry of General Education and Instruction, Government of South Sudan in conjunction with Subjects experts. This course book provides a fun and practical approach to the subject of Science, and at the same time imparting life long skills to the pupils.

The book comprehensively covers the Primary 6 syllabus as developed by **Ministry of General Education and Instruction.**

Each year comprises of a Pupil's Book and teacher's Guide.

The Pupil's Books provide:

- Full coverage of the national syllabus.
- A strong grounding in the basics of Science.
- Clear presentation and explanation of learning points.
- A wide variety of practice exercises, often showing how Science can be applied to real-life situations.
- It provides opportunities for collaboration through group work activities.
- Stimulating illustrations.

All the courses in this primary series were developed by the Ministry of General Education and Instruction, Republic of South Sudan. The books have been designed to meet the primary school syllabus, and at the same time equiping the pupils with skills to fit in the modern day global society.

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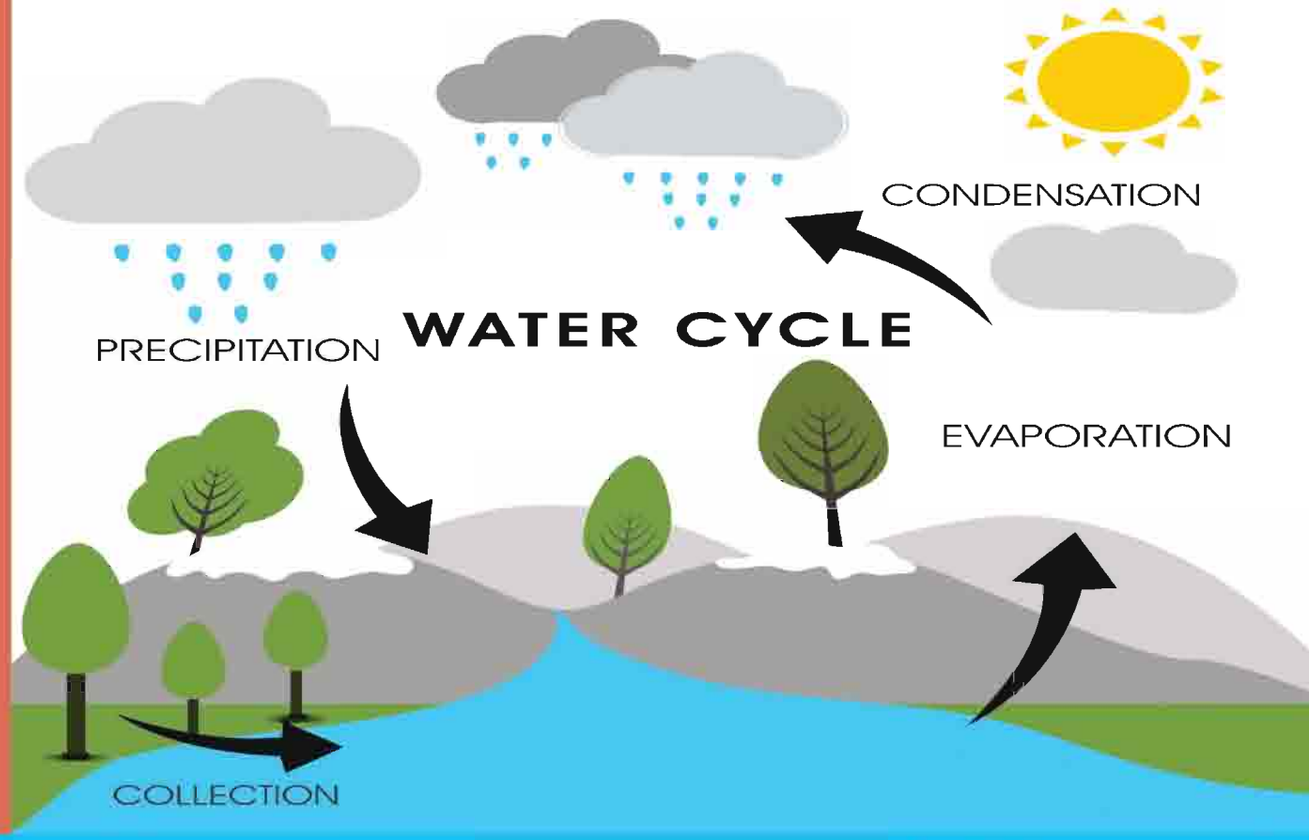
South Sudan

Primary Science 6

Pupil's Book



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Do's

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2. **Please make sure you have clean hands before you use your book.**
3. **Always use a book marker do not fold the pages.**
4. **If the book is damaged please repair it as quickly as possible.**
5. **Be careful who you lend your schoolbook to.**
6. **Please keep the book in a dry place.**
7. **When you lose your book please report it immediately to your teacher.**

Don'ts

1. **Do not write on the book cover or inside pages.**
2. **Do not cut pictures out of the book.**
3. **Do not tear pages out of the book.**
4. **Do not leave the book open and face down.**
5. **Do not use pens, pencils or something thick as a book mark.**
6. **Do not force your book into your schoolbag when it is full.**
7. **Do not use your book as an umbrella for the sun or rain.**
8. **Do not use your book as a seat.**

South Sudan

Primary 6

Science

Primary 6

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FOREWORD

I am delighted to present to you this textbook, which is developed by the Ministry of General Education and Instruction based on the new South Sudan National Curriculum. The National Curriculum is a learner-centered curriculum that aims to meet the needs and aspirations of the new nation. In particular, it aims to develop (a) Good citizens; (b) successful lifelong learners; (c) creative, active and productive individuals; and (d) Environmentally responsible members of our society. This textbook, like many others, has been designed to contribute to achievement of these noble aims. It has been revised thoroughly by our Subject Panels, is deemed to be fit for the purpose and has been recommended to me for approval. Therefore, I hereby grant my approval. This textbook shall be used to facilitate learning for learners in all schools of the Republic of South Sudan, except international schools, with effect from 4th February, 2019.

I am deeply grateful to the staff of the Ministry of General Education and Instruction, especially Mr Michael Lopuke Lotyam Longolio, the Undersecretary of the Ministry, the staff of the Curriculum Development Centre, under the supervision of Mr Omot Okony Olok, the Director General for Quality Assurance and Standards, the Subject Panelists, the Curriculum Foundation (UK), under the able leadership of Dr Brian Male, for providing professional guidance throughout the process of the development of National Curriculum and school textbooks for the Republic of South Sudan since 2013. I wish to thank UNICEF South Sudan for managing the project funded by the Global Partnership in Education so well and funding the development of the National Curriculum and the new textbooks. I am equally grateful for the support provided by Mr Tony Calderbank, the former Country Director of the British Council, South Sudan; Sir Richard Arden, Senior Education Advisor of DfID, South Sudan. I thank Longhorn and Mountain Top publishers in Kenya for working closely with the Ministry, the Subject Panels, UNICEF and the Curriculum Foundation UK to write the new textbooks. Finally, I thank the former Ministers of Education, Hon. Joseph Ukel Abango and Hon. Dr John Gai Nyuot Yoh, for supporting me, in my previous role as the Undersecretary of the Ministry, to lead the Technical Committee to develop and complete the consultations on the new National Curriculum Framework by 29 November 2013.

The Ministry of General Education and Instruction, Republic of South Sudan, is most grateful to all these key stakeholders for their overwhelming support to the design and development of this historic South Sudan National Curriculum. This historic reform in South Sudan's education system is intended to benefit the people of South Sudan, especially the children and youth and the future generations. It shall enhance the quality of education in the country to promote peace, justice, liberty and prosperity for all. I urge all Teachers to put this textbook to good use.

May God bless South Sudan. May He help our Teachers to inspire, educate and transform the lives of all the children and youth of South Sudan.

Deng Deng Hoc Yai, (Hon.)

Minister of General Education and Instruction, Republic of South Sudan

Table of Contents

Unit 1 Keeping ourselves healthy

1.1 Drugs and drug abuse

Work in groups

1. Observe the pictures below.

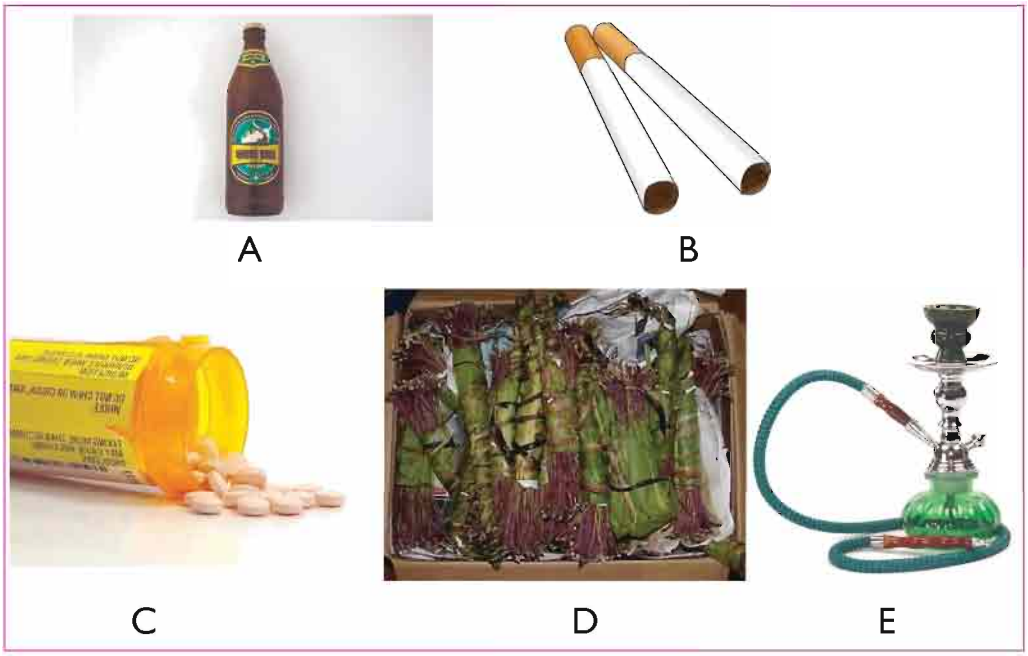


Fig 1.1

- Identify the things in the above pictures?
- Where do you see them?
- Are they good or bad for your health?
- Are they legal or outlawed?

2. Discuss the meaning of the terms drug, medicine and drug abuse.
3. Research from the textbooks and internet and come up with a list of medicines or drugs with their warnings.
4. Present your findings in form of a table. Discuss your findings in a class discussion.

Further activity

Design a poster with warning on different drugs and show some at the community members at home.

Learning point

A drug is any substance that when taken into the body changes it's normal functioning. Drugs can be classified into medicinal and non-medicinal.

Medicines are drugs taken by patients to cure diseases with the advise from medical doctors. They should not be taken without a medical prescription. This can be harmful to the body. Medicines cure a disease, improve person's health and prevent diseases. The various types of medicines are: antibiotics, vaccines, sedatives, pain killers among others. Medicinal drugs can be used:

- to cure diseases for example antibiotics cure bacterial infections.
- as vaccines - preventive
- as stimulants
- as depressants
- as sedatives

Examples of non-medicinal drugs include:

- Alcohol
- Tobacco
- Miraa
- Bhang
- Cocaine
- Mandrax

Remember!

Always check the expiry date of medicine before taking them.

Drug abuse

Drug abuse is taking illegal drugs. It is also the excessive taking of medicines other than what the doctor advises.

Class discussion

1. Using textbooks or the internet find the effects of drug abuse.
2. Record your findings in a table like the one below.

Drug	Effects of the drugs
1. Alcohol	
2. Bhang	
3. Tobacco	
4. Cocaine	
5. Miraa	
6. Glue	
7. Cigarettes	

3. Find out what causes drug abuse among the youth and how to avoid it.

Learning point

Causes of drug abuse among the youth include:

- Peer pressure
- To derive or get pleasure
- To forget problems
- To become stronger
- To become brave or courageous
- To imitate or be like others

All these should be avoided in order to stay healthy. Drug abuse has effects on health and social life. Generally, a person who abuses drugs suffers a number of effects:

(a) Health effects

1. Lack of concentration.
2. Impaired judgment.
3. Loss of consciousness.
4. Addiction to drugs.

(b) Social effects

1. Marital conflicts for example unnecessary quarrels.
2. Dropping out of school.
3. Fighting due to irritability.
4. Loss of income for a family.

Drugs are taken into the body through:

- injection
- the mouth
- sniffing
- smoking

Remember!

Continuous abuse of drugs can lead to drug addiction. Avoid drugs!!!

Control of drug abuse

Work in groups

1. Discuss in groups the control measures of drug abuse.
2. Present your work to other members of your class in a class discussion.
3. Your teacher will now invite a resource person to talk to you about control of drug abuse. Listen to him or her carefully and take notes.
4. Compare your notes in step 3 above with your discussion results. Were you accurate? Correct them accordingly.

Learning point

Some of the control measures of drug abuse include:

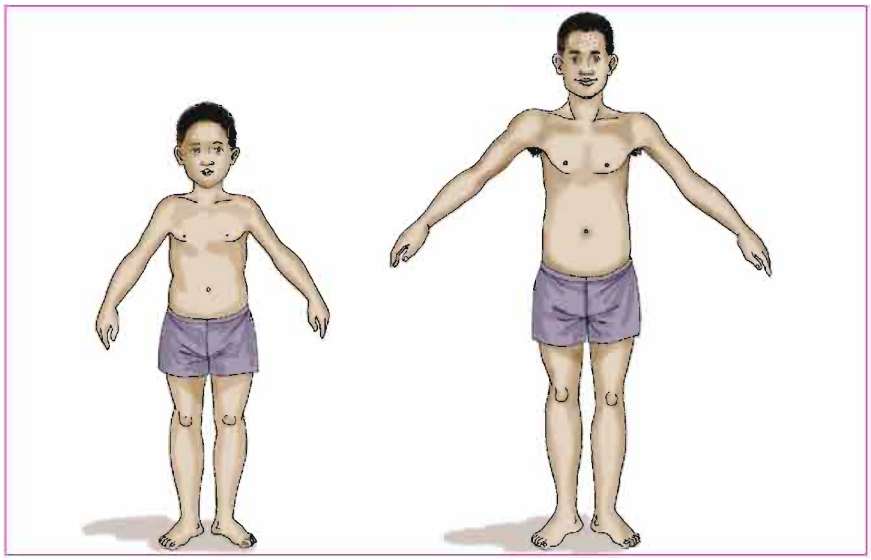
- Avoid negative peer influence.
- Sensitisation on the dangers of drug abuse.
- Taking the drug addicts to rehabilitation centres.
- Avoiding idleness among the youths

1. Garang a class 6 pupil who always performed well both in class and in the field activities met a new friend Juve who was a drug addict. What advise can Garang give to Juve?
2. Write **true** or **false** for the following statements.
   (a) A drug can be medicine for one person and poison for another. _____
   (b) An overdose of medicine may kill a patient. _____
   (c) All herbal medicines are harmful. _____
   (d) Drugs should be kept out of children's reach. _____
3. The best explanation for addiction is?
   A. Harmful
   B. Habit-forming
   C. Unpleasant
   D. Depressing
4. Which of the following is not a good reason for taking drugs?
   A. To prevent diseases.
   B. To relax and make the mind happy.
   C. To cure diseases.
   D. To reduce pain caused by injuries.
5. Alcohol abuse leads to_____.

1.2 Puberty and changes during puberty

Work in pairs

1. Study the pictures below.



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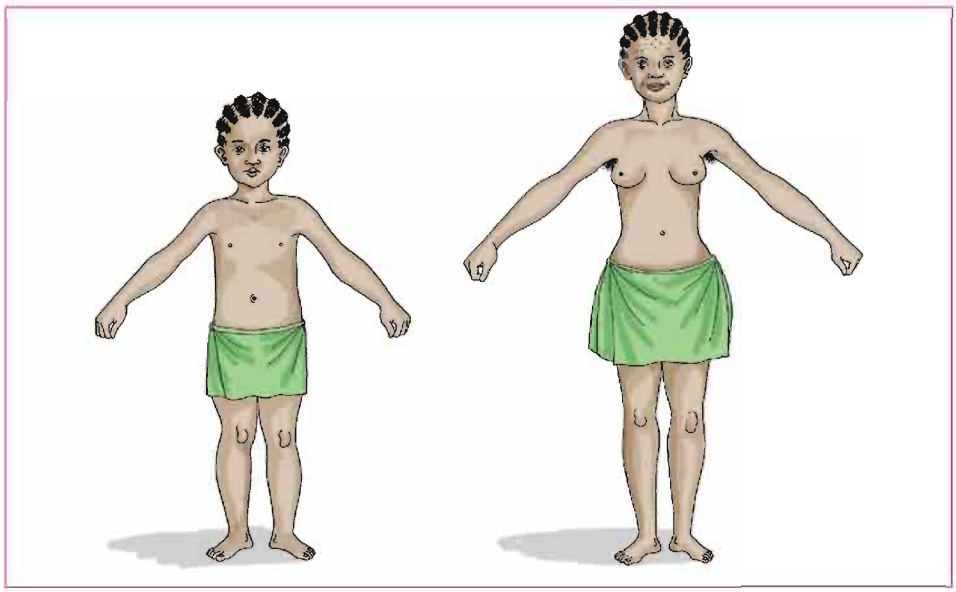


B

Fig 1.2

2. Identify the physical differences between the two boys and the two girls. Fill the table below.

Differences between the two boys	Differences between the two girls

3. Compare your answers with that of other groups.

Physical changes during adolescence

Learning point

When a baby is born he or she grows into a **young adult** and finally a **mature** person. The body size increases as the baby grows. Way of thinking also changes. Many changes occur in bodies of both the boys and girls as they grow.

The period of growth between childhood and adulthood is known as adolescence. This stage starts at puberty. Puberty is the first stage of adolescence. At puberty the reproductive organs start developing. During adolescence, the reproductive organs grow and become mature in order to carry out their reproductive functions. In girls, the adolescence age is between 9 and 19 years. In boys, it is between 14 and 21 years. This age is known as teenage.

Remember!

Teenagers are advised to avoid bad influence from peers and friends in order to remain healthy and safe.

Work in groups;

1. Talk to your group members about the changes during adolescence.
2. Note down the changes.
3. Compare your findings with other groups.

(a) Changes in boys during adolescence

During adolescence in boys, the following physical changes occur:

- The penis and testes increase in size.
- A fluid known as **semen** which contains sperms sometimes comes out of the penis at night when the adolescent is sleeping. This is commonly referred to as "wet dreams".
- Hair grows under the armpit, on the chest and in lower abdomen. Hair also grows around the reproductive organs. This is called pubic hair.
- Hair appears on face the chin. They are called beards.
- Some boys experience slight breast growth but these are often temporary and disappear after a while.
- There is increase in general body weight.
- The voice becomes deep. This is referred to as "breaking voice".
- The chest widens due to enlargement of bones. The muscles become big too, making the body appear stronger.
- In some boys, pimples may appear on the face.

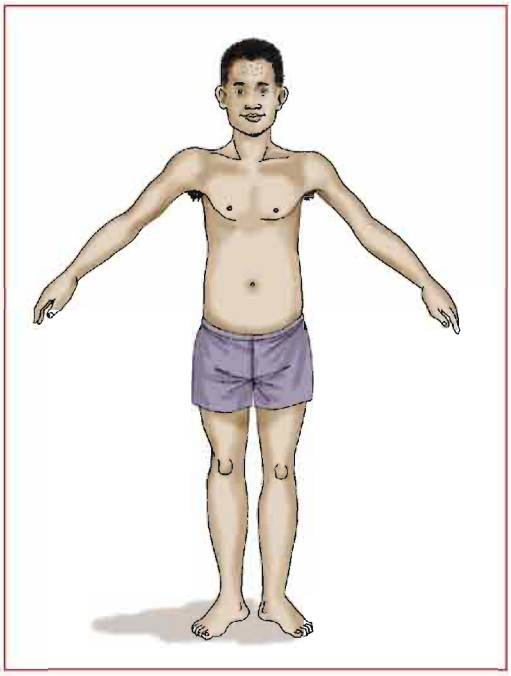


Fig 1.3: Adolescent boy

Figure 1.3 shows a boy at puberty. Can you identify some of these features.

(b) Changes in girls during adolescence

During adolescence in girls, the following physical changes occur:

- Breasts enlarge and become tender and pointed.
- The hips enlarge because of the enlargement (increase in size) of the hip bones. The girls also increase in weight.
- The face of most girls become smooth. Some girls however develop pimples.
- Hair grows under the armpit and on the pubic area.
- Much more hair starts to grow on the head and may become more silky.
- The uterus develops and the ovaries mature. Menstruation or monthly periods begin as mature eggs are released by the ovary and passed out. Menstruation lasts for 3 to 6 days. At first the periods can be irregular but later on they occur every month hence the name monthly periods.

Figure 1.4 shows a girl at puberty. The 16 years old girl is at puberty.

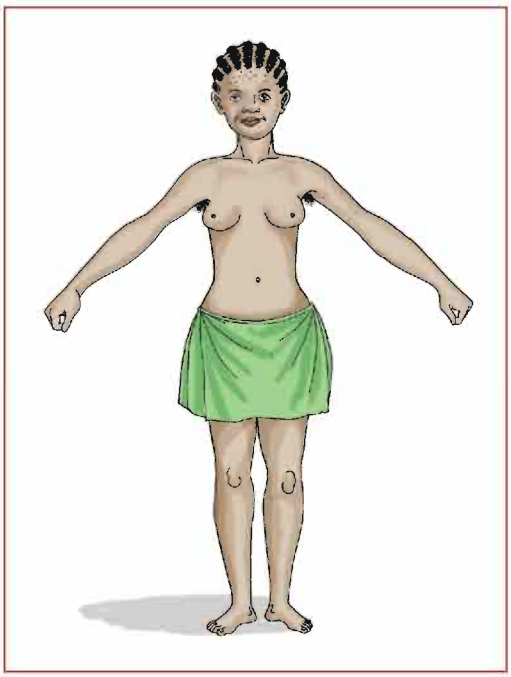


Fig 1.4: Adolescent girl

Remember!

Girls should not share personal items such as pants and sanitary towels. This helps to prevent spread of diseases.

More about Menstruation

Work as a class

1. Your teacher will invite a local nurse or doctor to talk about menstruation.

4. Listen to the nurse or doctor and ask him or her questions.

Every girl should wear protective sanitary towels and keep herself clean, get enough sleep and eat a balanced diet during menstruation.

In some girls, the menstrual period can come with abdominal pains. This should not worry you. Do light work or exercise and take hot drinks. One can also dip the feet in hot water or perform hot compresses on the belly.

(c) Emotional changes during adolescence

The physical changes which take place in teenagers and the fast growth in body or height bring about emotional changes which include:

- The adolescent develops special needs such as company. They may move in small groups made up of agemates. These groups are known as peers. Peers greatly influence each other in the way they think, act and generally behave.
- A feeling of self-importance and looking for recognition in their groups (peer group).
- Urge for freedom and willingness to rebel against established rules.
- The feeling and wanting to act like adults.
- Developing interest in the opposite sex.

Remember!

You should NOT engage in sexual intercourse before marriage. This will help to prevent unwanted pregnancies and sexually transmitted diseases such as HIV and AIDS.

When adolescents are faced with all these rapid changes they can become moody, shy, anxious, aggressive, angry, disappointed and easily offended. Try to avoid all these.

In order to avoid or control such emotional conditions one can keep busy by joining useful groups such as: creative clubs, sports clubs, religious organisations and community development groups.

Special personal hygiene for boys and girls at puberty

Work in pairs

1. Study the pictures below and discuss the differences in hygiene.

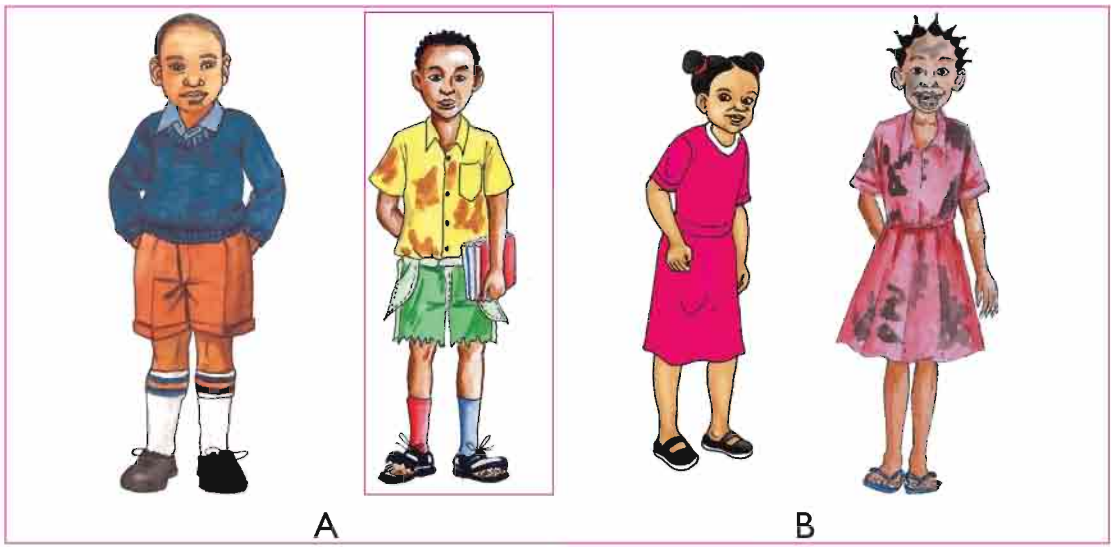


Fig 1.5

2. What can you conclude from the pictures?

Learning point

We should ensure hygiene for the following parts:

(a) Hair

Wash your hair every day using warm water and shampoo or soap. Comb it and keep it clean.

(b) Skin

During puberty hair grows in new places of the body. The body has to be kept clean always. Sweat glands become very active, especially around the armpits, feet and genitals. We should bath or shower every day using a mild soap and warm water. We should ensure we clean our clothes, socks and underwear always. Ensure your clothes are made of cotton since they can absorb moisture.

Use deodorants if you sweat a lot. You have to shave under your armpits and pubic area as well and beards for boys.

(a) Teeth

- Brush and floss your teeth properly everyday.
- Periodic dental check-ups should be done to prevent tooth decay and gum diseases.

(b) Menstrual hygiene

During menstruation, girls should use sanitary pads and bath regularly. The pads should be changed three times a day.

Work in groups

1. Discuss in groups some of the ways boys and girls at puberty can keep themselves clean.
2. Give examples of materials that boys and girls can use to enhance personal hygiene during puberty.

Learning point

Puberty causes all kinds of changes in the body. Boys and girls are active and energetic during puberty. Their bodies have very active sweat glands therefore producing a lot of sweat. They need to bathe daily to maintain proper hygiene.

Girls should use sanitary pads during menstruation for personal hygiene. Boys and girls should also have handkerchiefs to wipe sweat. This is because they seem to sweat most of the time producing odours they never had before.

1. List any four physical changes experienced by

   (i) A male adolescent. (ii) A female adolescent.

2. Why should we seek counselling when experiencing emotional changes during adolescence?

3. Why is it necessary to keep ourselves clean during puberty?

1.3 Food and nutrition

Basic food groups

Work in groups

With your teacher visit the market near your school.

1. Look at the different types of foods sold in the market.
2. Draw them and write their names down in your notebook.

Learning point

People eat many types of foods. For example, maize, rice, beans, meat, fish, cabbages, lentils, okra and fruits.

Each type of food has its own function in the body. Foods are grouped according to their function in the body e.g:

- providing energy for the body to carry on activities.
- helping the body in building and repairing worn out parts.
- helping the body protect itself against diseases.

We classify foods as follows:

- Body-building foods
- Energy-giving foods
- Protective foods

Let us now learn more about foods in each of these groups.

(a) Body building foods

Work in pairs

1. Look at these foods.


A


B


C


D


E


F

Fig 1.6

2. Identify and name the foods in the above pictures. What do they give us?

Learning point

Foods that help the body in building and repairing any damaged parts are called **body building foods**. They are also called **proteins**. They help the body to grow. Examples of body building foods are beans, greengrams, meat, fish, eggs, milk and others.

(b) Energy-giving foods

Work in pairs

1. Look at these foods.


A


B


C


D

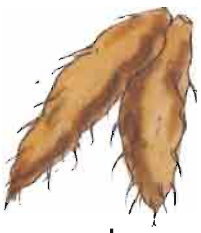

E


F


G


H


I


J

K


L

Fig 1.7

2. Identify and name the foods in the above pictures. What do they give us?

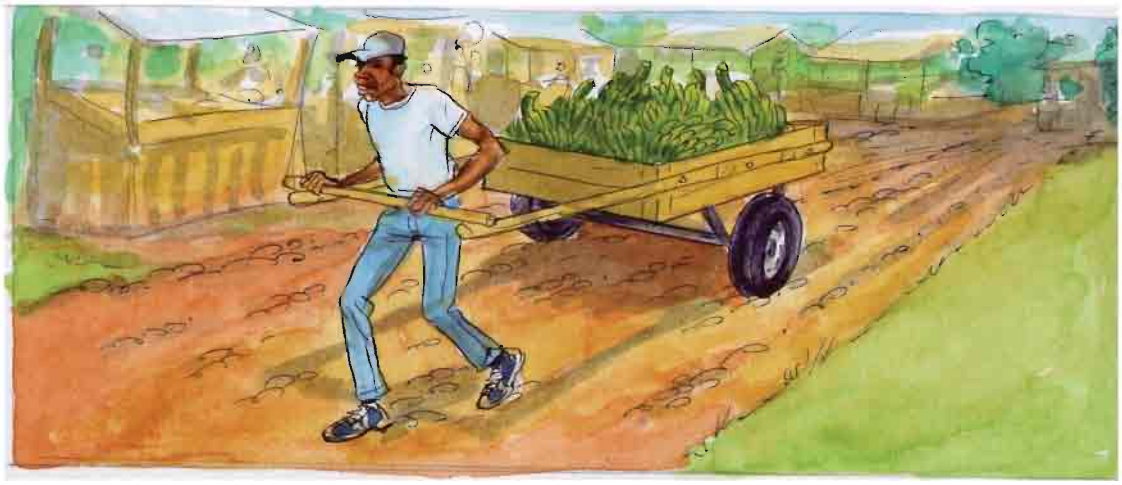
Learning point

The foods that provide energy for the body are called energy giving foods. They are also called carbohydrates. Examples of energy giving foods are rice, maize, potatoes, cassava, yams, sugarcane, cooked bananas, arrowroots and others. Fats and oils also provide energy too.

These foods give us the strength to play and work. We like to play most of the time. We need a lot of energy. People who do a lot of difficult work like digging, building houses and carrying heavy things as shown below, need to eat a lot of energy giving foods.

A

B



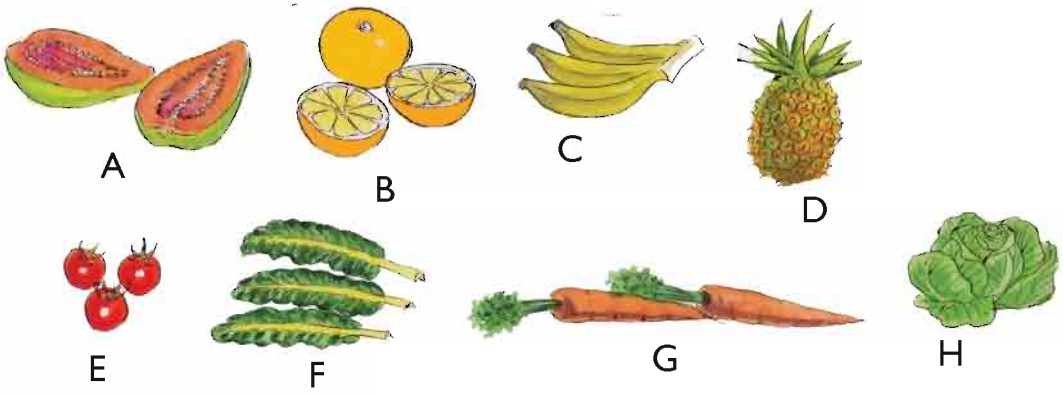
C

Fig. 1.8: People using energy in different ways

(c) Protective foods

Work in pairs.

1. Look at the pictures below.



My health my life

We should eat alot of fruits. They are rich in vitamin C.

2. Identify and name the foods. What do the foods do to our bodies?

Learning point

Foods that help the body in protecting itself against diseases are called protective foods. These foods provide vitamins and minerals. They help the body to stay healthy. Protective foods help the body to recover quickly from diseases and wounds to heal much faster. Examples of protective foods are fruits and vegetables.

Classifying locally available foods

Work in groups

1. List all the foods that people eat at home.
2. Write down all the foods that are found in the market near your home or school.

3. Classify each food and fill it in a table like the one shown below.

Body-building foods (proteins)	Energy-giving foods (carbohydrates, fats and oils)	Protective foods
1. Fish 2. 3 4. 5. 6.	rice	mango

Learning point

Foods can be classified into three groups:

- Body building foods
- Energy giving foods and
- Protective foods.

Locally available foods can also be classified into these groups.

My health my life.

We should exercise daily to remain physically fit.

1. Why do we eat food everyday?
2. Are carbohydrates good or bad for our health? Why?
3. Is it safe to eat soya beans and other soy foods? Which other foods can you eat instead of soya beans?

4. Which type of food will you advise your brother or sister to take if he or she has an eye sight problem? Why?

5. Keji attended a wedding ceremony and she saw the following foods as she was taking lunch. Rice, eggs, vegetables, kisra, fruits and beans.

   Suppose you were asked to classify the foods above into three major groups of food, how could you classify them?

6. Give an example of a body-building food that we get from animals.

7. Fruits and vegetables are examples of ____ foods. (body-building, protective, energy-giving)

8. Maize and rice are example of foods rich in.

   A. vitamins
   B. proteins.
   C. carbohydrates
   D. fats

9. Which of the following foods gives us energy to work?

   A. Rice
   B. chicken meat
   C. tomatoes
   D. carrots

10. Which of the following lists consists of body-building foods that help to repair worn out parts of the body?

    A. beef, maize, potatoes
    B. mutton, cassava, eggs
    C. fish, beans, white ants or termites
    D. chicken meat, oranges, pumpkin

Balanced diet

Work in groups

1. Study the meals below with a friend.

Breakfast	Lunch	Supper
 sweet potatoes	 beans	 kisra
 tea	 rice	 spinach
 eggs	 cabbages	 pineapple
 pawpaw	 orange	 meat
 bread		

Fig 1.9

2. Are the meals balanced? Why?

Learning point

For us to grow healthy and strong, we must eat food from each food group.

When a person eats a meal containing the right amounts of body-building foods, energy-giving foods and protective foods, we say the person has eaten a balanced meal.

When we eat balanced meals everyday we say we are having a balanced diet. A balanced diet therefore is having meals that contain the right quantities of each of the three groups of foods. This means having the right quantity of energy giving food, body building foods and protective foods. When we eat a balanced diet, we grow healthy and strong.

A balanced diet also involves drinking plenty of water and eating foods rich in roughage. Roughage is material in food that helps in keeping the stomach comfortable.

My health my life.

We should drink at least 8 glasses of water every day.

Work in pairs

Using the list of foods given below plan different balanced meals.

Maize, mutton, chicken, beans, pawpaw, table salt, pumpkin, mandazi, beef, fish, green grams, ugali, coconut, dates, groundnut, termites, spinach, bread, milk, sugarcane, peas, oranges, eggs, yams, melon seeds, honey, pumpkin seeds, lemon, cassava, tomato, ripe banana, kunde leaves, cooking oil, potatoes and cashewnuts.

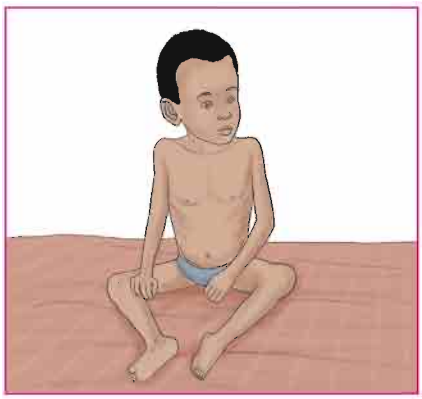
Remember!

A balanced diet is very important when taking care of people suffering from HIV and AIDS.

Importance of balanced diet

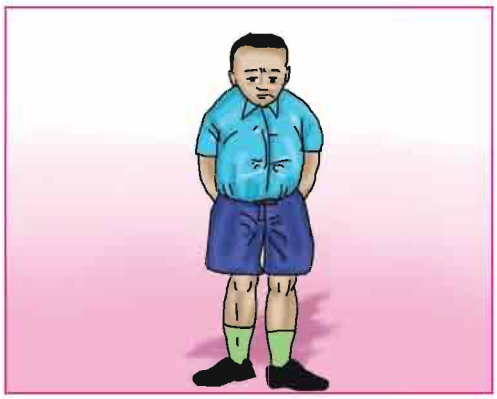
Work in pairs

1. Look at the pictures below.

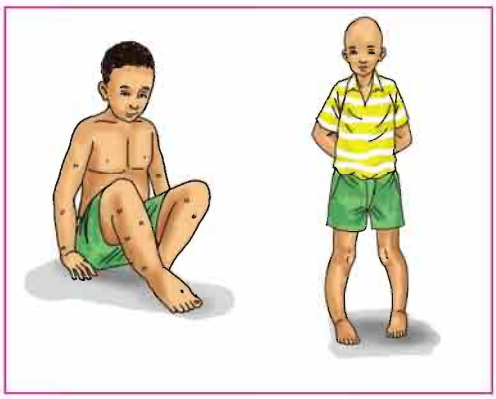


A

B



C



D

Fig 1.10

2. Identify the kinds of diseases the children are suffering from.
3. What do you think causes the diseases in the pictures above?
4. What advice would you give to the parents of these children?

Learning point

Taking a balanced diet keeps our body healthy. A balanced diet should contain carbohydrates, proteins, vitamins and minerals. Lack of any of the three foods causes deficiency diseases a condition known as **malnutrition**. Some of the deficiency diseases are shown in the table below.

Food group	Disease
Lack of carbohydrates	Marasmus
Lack of proteins	Kwashiorkor
Lack of vitamins	Scurvy, night blindness
Lack of minerals	Anaemia, rickets, goitre

Remember!

Fibre (roughage) and water are also important in the diet.

- Fibre prevents constipation hence helps in the removal of faeces.
- Water helps in digestion, formation of body fluids and prevents dehydration.

1. Study the pictures below and answer the following questions.

A

B

C

(i) Name the type of deficiencies shown in the pictures above.

(ii) Identify any sign in each of the pictures that shows any deficiency.

(iii) How would you advice a person suffering from the above conditions.

2. Deng had a difficulty in passing stool. How will you advise him?

3. When does one say he or she has taken a balanced diet? Why is it important to have a balanced diet?

4. Lagu was heading home from school. Along the road he came across a child with the condition shown in the picture below.

(a) Which type of deficiency do you think the child was suffering from?

(b) Which vitamin was the child lacking?

(c) How would you advise him?

Unit 2 Organisation and structure of living things

2.1 Parts of a plant and their functions

Work in groups

1. Study the plants in the pictures below.

A

B

C

D

E

F

G

H

2. Fill the table below based on the pictures above.

	Name of plant	Part of plant used	Uses of the part
A			
B			
C			
D			
E			
F			
G			
H			

3. Answer the questions below.

   (a) Which plant foods do you eat at home?

   (b) Which plants are grown for food in your area?

   (c) Which type of plants have medicinal value?

Work in groups

Materials

- A ruler
- A sheet of newspaper
- Paper and pencil
- A stick or a hoe

What to do

1. Go into the school compound, using a stick or a hoe, dig up a small plant from the soil. Dig down deep to remove the roots.
2. Place the plant down on a sheet of newspaper. Look at it carefully.
   - Which part of the plant was above the soil?
   - Which part of the plant were below the soil?
3. Find and look at the following parts of the plant.

   (a) The stem

   (b) The branches

   (c) The leaves

   (d) The flowers

   (e) The flower buds

   (f) The leaf buds

   (g) The roots
4. Make a drawing of the plant. Label the parts that you identified in (3) above. Find out and write the name of the plant you have drawn?

5. Measure the length of the root and stem with a ruler. Record the lengths in the table as follows.

Part of the plant	How long it is

6. Discuss in pairs the function of the parts of the plant you have drawn.

Learning point

- The main parts of the plant are the roots, stem, leaves and flowers.
- The root is the part of a plant below the ground. They are important to the plant in the following ways.
  - Helps in taking water from the soil to the rest of the parts of plant
  - Holds the plant firmly in place in the soil. How does this help the plant? What will happen if there is strong wind?
  - Some roots store food. Can you name the roots that store food?

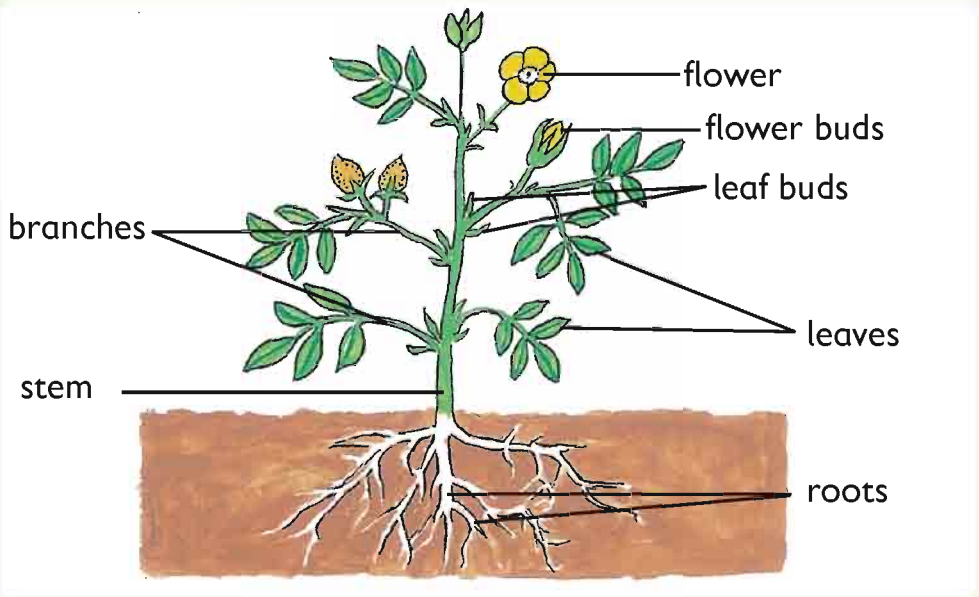


Fig 2.1: Parts of a plant

- The stem carries water from the roots. It takes it to the leaves and flowers. It also takes food from one part of the plant to another. The stem also holds the leaves up so that they are facing the sun.

- The leaves in plants trap sunlight and uses it to make their own food through the process of photosynthesis. The stem keeps up the flowers, making it easy for insects to visit them helping the plant to reproduce by transferring pollen grains.
- In most plants, the flower is bright and coloured. Flowers enable the plant to reproduce.
- The leaf is a part of the plant that is attached to the stems or branches and is green in colour. It is the site for making food for the plant.

1. A plant with roots is placed in coloured water. After 2 hours, slices are cut from the roots and stem.

   (a) What do you expect to see?

   (b) What does this tell you about the work of the roots and the stem?

2. Write down the uses of a plant in the table below.

Part of plant	Use

2.2 Adaptations of different parts of a plant to their functions

(a) Leaves

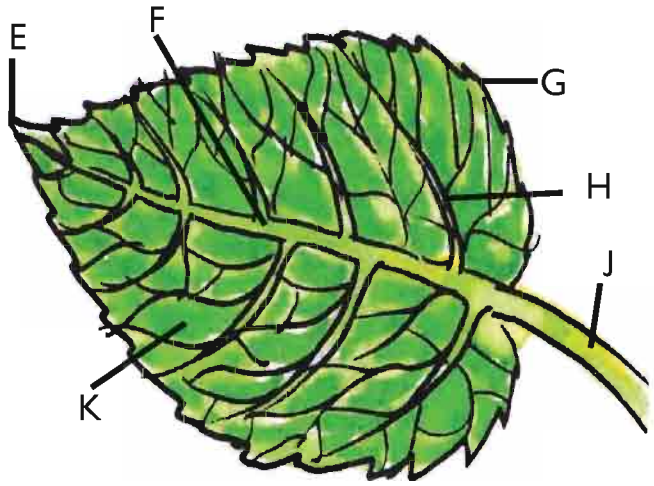
Work in groups

1. Collect leaves from plants and trees in the school compound.
2. Observe the leaves carefully.
3. Are you able to identify the following parts of the leaves?

(a) Apex (c) Lamina (e) Veins

(b) Midrib (d) Leaf margin (f) Stalk

4. Use the words in 3 above to label parts of the leaf drawn below

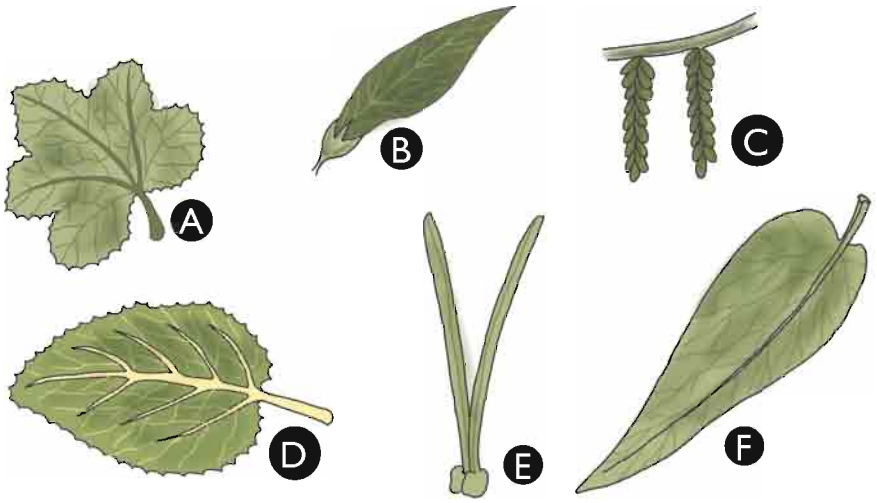


E _____ H _____

F _____ K _____

G _____ J _____

5. Study the leaves below.



Group the leaves according to their structures. Did you group them as either

- simple or compound?
- broad or narrow?
- network or parallel veins?

Compare the structure of leaves with their adaptation to their habitat.

6. Look at the plants below. Can you tell the kind of habitat they live in? Write them down by filling the table below.

A

B

C

D

Plant	Habitat
A	
B	
C	
D	

Learning point

- Different types of plants have different types of leaves. Leaves in plants differ in shape, colour, size and texture.
- Most leaves are green some are purple while others have patches of pink or yellow.

- The size of the leaves varies for example some plants such as bananas have large leaves. Other plants such as acacia or cypress also have small leaves.
- The shapes of leaves of different plants are different. A maize plant has long narrow leaves while beans have short leaves with pointed tips.
- Leaves of some plants are shaped like a heart, while others are shaped like an arrow.
- The margin of the leaves can be rough or smooth.
- Different leaves have different textures, for example, the leaves of sugarcane and maize plants are hairy. The leaves of mango tree and kales are smooth. The leaves of sodom apple plant have thorns.
- A cabbage plant has thick leaves while a mango plant has thin leaves.

Different plants grow well in different **habitats**. A habitat is the natural home or environment of animal, plant or other organism. Different plants adapt differently to the area they grow, for example:

- Cactus grow in dry habitats. They have thorny leaves and narrow succulent stems that have a waxy cuticle to reduce the rate of transpiration. This helps them to conserve water.

Fig 2.2: Cactus plant

- Maize, beans and bananas grow in areas with sufficient rainfall. Therefore their leaves are moderately wide and long.

Banana plant

Maize plant

Bean plant

Fig 2.3: Land plants

- Some plants grow on water, for example, water lilies and water hyacinth. Others such as see weeds grow under water in ponds, rivers, lakes and sea. The ones that float have broad leaves. This increases their rate of transpiration hence lose of water.

Water lilies

Water hyacinth

Sea weeds

Fig 2.4: Water plants

(b) Stem

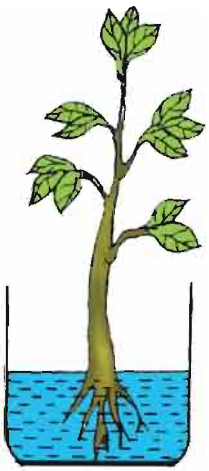
Work in groups

Materials

- A hand lens
- A tin or jar
- Uprooted young plant with soft stem
- Knife or blade
- Ink

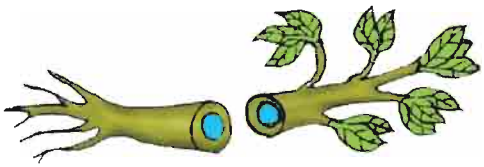
What to do

1. Put a few drops of ink in a glass of water.This should give you coloured water.
2. Place the roots of the plant in the coloured water as shown in figure **A** below.



A

3. Leave for a few hours. Remove the plant and wipe away all the water.
4. Cut off the slices from the stem and the roots as shown in diagram **B** below.



B

5. Look at the cut slices carefully. Can you find any coloured water inside the slices of the roots or stem?
6. Account for the observations made.

Work as a class

1. Go out into the school field and observe different stems of plants.
2. Look at the different plant stems from pictures provided by your teacher. Compare their stems.

- Are the stems the same?
- What kind of habitats are they found?
- What are their adaptations?

Learning point

- The stem is the part of the plant above the roots. The main function of the stem is to transport water and mineral salts from the roots to the leaves. Stems support the branches which exposes the leaves to sunlight for photosynthesis. It also holds the flowers and fruits in position.
- Some plants have thick stems while others have thin stems depending on the habitats. Plants with thin flexible stems are found in **water** habitats while those with thick woody stems are found in **dry** habitats.

(c) Roots

Work in groups

1. Uproot various plants in the school compound or farm and use the chart provided by your teacher to identify the type of root they have.
2. Classify the plants according to the type of roots.
3. Draw the roots of the plant as observed.
   - Do all the roots look alike?
   - Do the roots of the plant look like those of maize and some like those of beans?
4. Write the differences between the two types of roots. What names

Learning point

are the two categories given?

1. There are two major types of roots in plants: **tap** and **fibrous** roots.

2. Tap roots have the main root and sub- roots as shown below. Examples of plants with tap roots include beans, mango and acacia.

Fig 2.5: Tap root

3. Fibrous roots have hair like roots growing from the base of the stem. Examples of plants with fibrous roots include; onion and coconut.

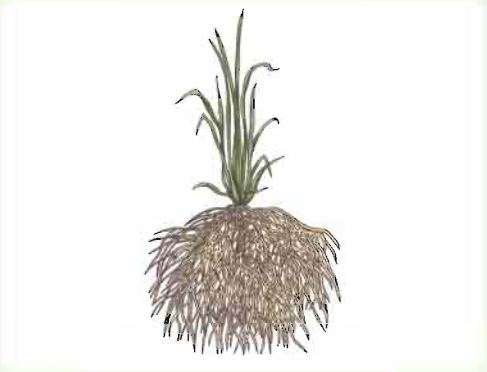


Fig 2.6: Fibrous root

4. The table below gives the differences between tap root and fibrous roots.

Table 2.1: Differences between tap roots and fibrous roots

Tap root	Fibrous root
Has one main root.	There is no main root.
Has lateral roots and root hairs.	Has hair like roots that grow from the base of the stem.
Is found in dicotyledonous plants such as beans.	It is found in monocotyledonous plants such as maize.

In general, plants in dry habitat have deep roots while plants in wet habitats have shallow roots.

1. Model a plant like the one shown below using clay or plasticine.

On the model, indicate different parts of a plant.

2. Which of the following is not a function of the leaf?

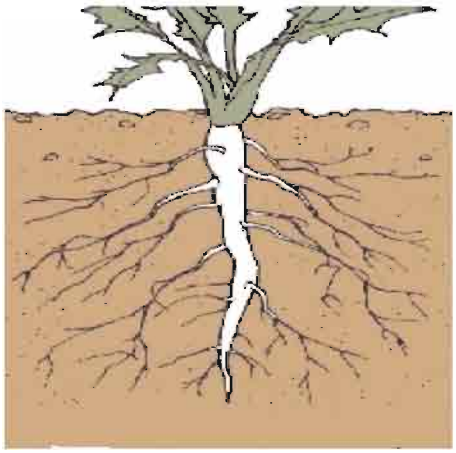
   A. photosynthesis

   B. transport

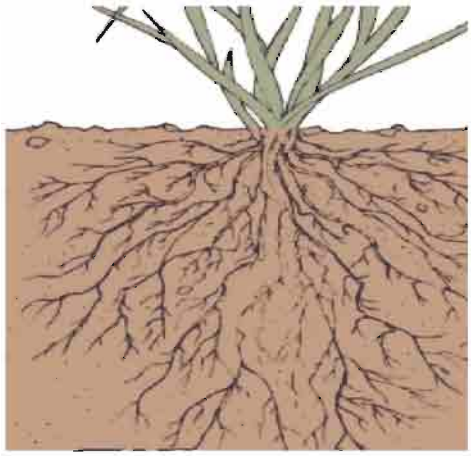
   C. breathing

   D. food storage

3. Study the pictures below.



A



B

(a) Identify the types of roots marked **A** and **B**.

(b) Give examples of plants that have the type of roots shown in **A** and **B**?

(c) What are the functions of roots in a plant?

2.3 Comparison between structures in animals and plants

Work in groups

1. Draw an animal and label its body parts.
2. Discuss in groups various parts of the animal drawn.
3. Give the functions of the parts labelled.
4. Compare parts and functions of plant with those of animals.

Learning point

The diagram below summarises the featrures of plants and animals.

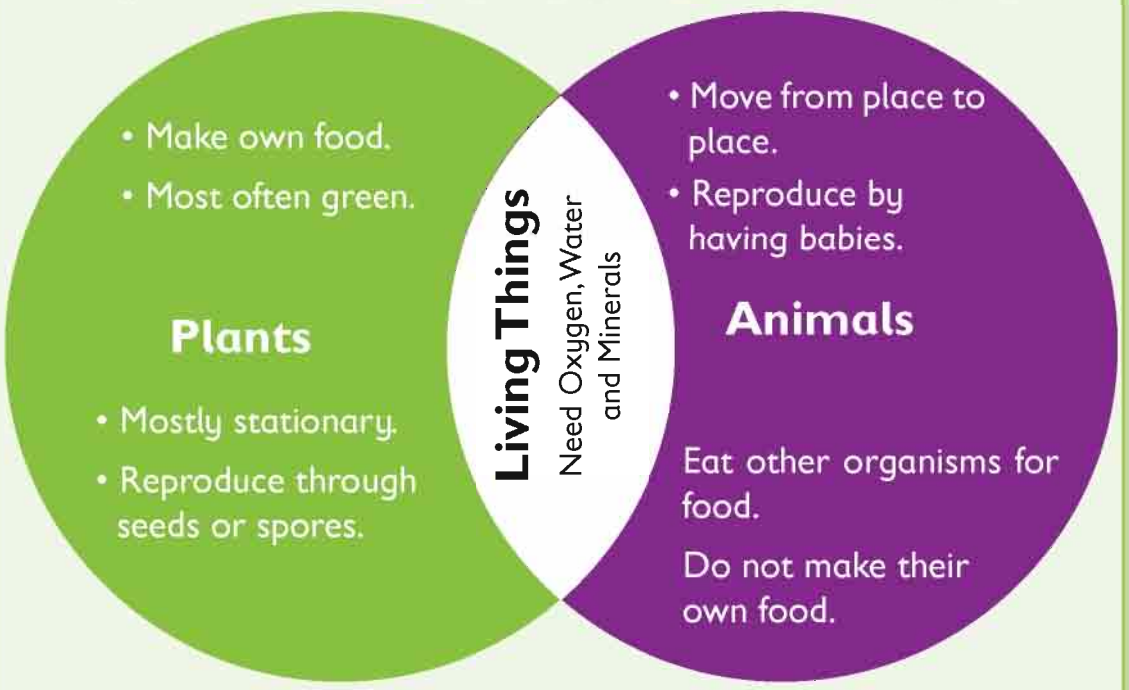


Fig 2.7: Summary of characteristics of plants and animals

The white part shows what is common to both plants and animals.

Table2.2:Differencesandsimilaritiesinreproductivepartsofanimalsandplants

Plant	Animal
Ovary	Ovary
Ovule	Ovum
Pollen grain	Sperm
Stigma	Vagina
Anther	Testis

1. What structural similarities are seen between plants and animals?
2. What structural differences are seen between plants and animals?

2.4 Level of organisation of living things

Work in groups

What to do

1. Using textbooks and the internet, research on cells, tissues, organs and organ systems.
2. Watch a video that you may be shown by your teacher on cells, tissues, organs and organ system.
3. Observe pictures and photographs of onion cells given to you by your teacher.
4. Answer the following questions.
    - What are cells, tissues, organ and organ system?
    - How are living things organised?
    - Why do simple organisms have less specialised structures than larger plants and animals?

Learning point

Cells

Plants and animals are made up of small units called cells. Some living things have bodies made up of a single cell. They are called single-celled or unicellular organisms, for example, amoeba. Other organisms have bodies made up of many cells. They are called multicellular organisms. Therefore the cell is a structural unit because it makes up the structure of organisms.

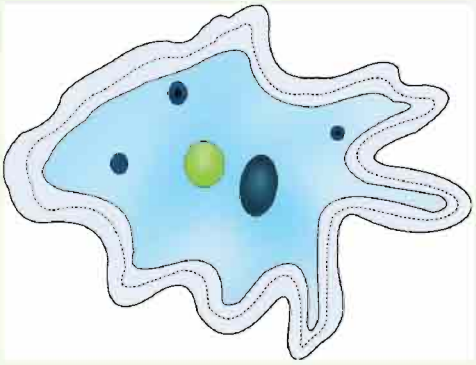


Fig 2.8(a): Amoeba

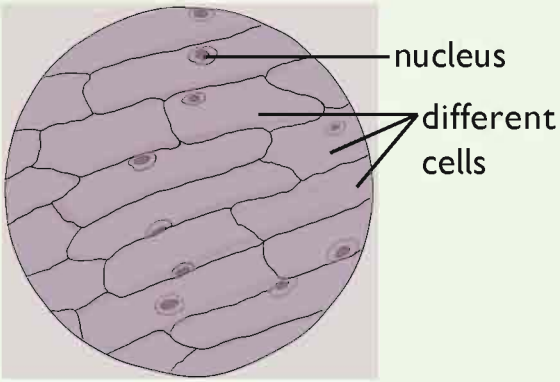


Fig 2.8 (b) Onion cells (multicellular)

Many chemical processes take place in the cells. These processes keep the organism alive and functioning. A cell can survive on its own under suitable conditions. That is why cells are considered to be units of life.

Cells basically have the same structure but they show differences in other aspects. They do not have the same shape, size or organisation. Some cells function individually as unicellular organisms, for example, Amoeba. Multicellular organisms are made up of many types of cells with different shapes and sizes. The cells also perform different functions. The change in structure of cells to enable them perform a specific function is called cell specialisation. By specialising, cells become more efficient at performing particular tasks, for example, in animals we have muscle cells are more efficient in contracting, white blood cells protect the body against diseases among others. In plants we have root hair cells for absorbing water and mineral salts and palisade cells which help the plant to manufacture food among others.

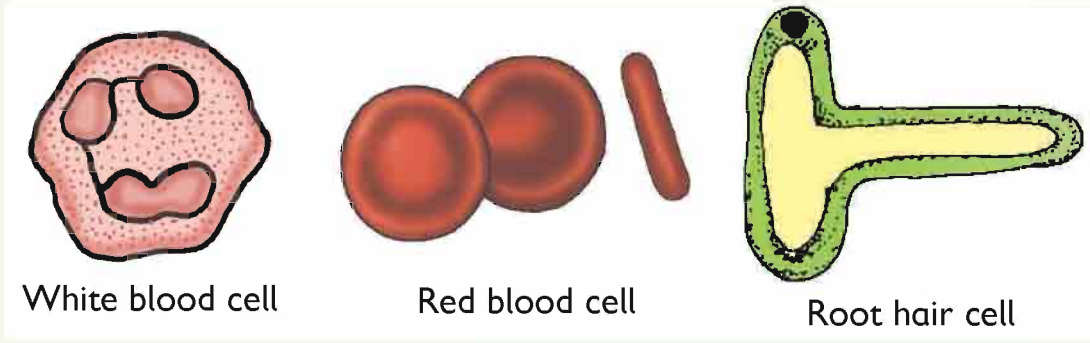


Fig 2.9: Different types of cells

Tissues

A tissue is a group of similar cells that work together to perform a specific function. Both animals and plants have structures made up of tissues. For example, blood tissues transport food materials, water, oxygen and carbon dioxide around the body and defend the body against germs. Muscle tissue enables us to move. Plants on the other hand have photosynthetic cells used for making food for the plant.

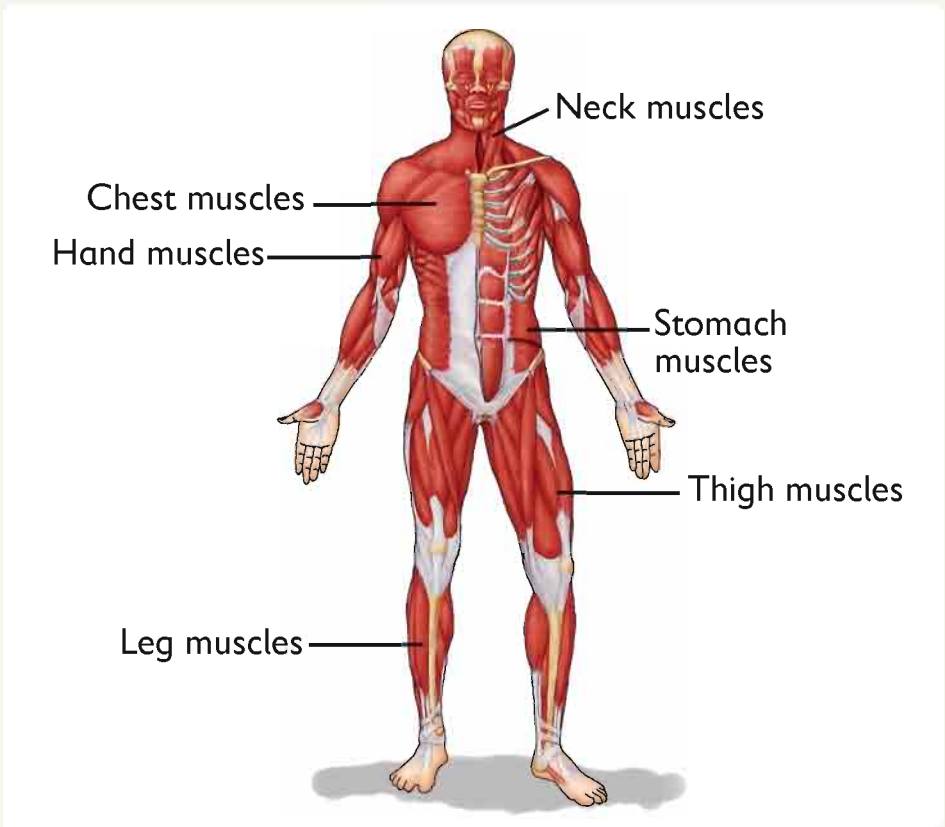


Fig 2.10: Human body showing muscle tissues

Organs

Organs are two or more types of tissues working together to perform a specific function, for example, some organs found in animals include heart, lungs, stomach, kidney, skin, liver among others. In plants, we have leaves, stems and roots.

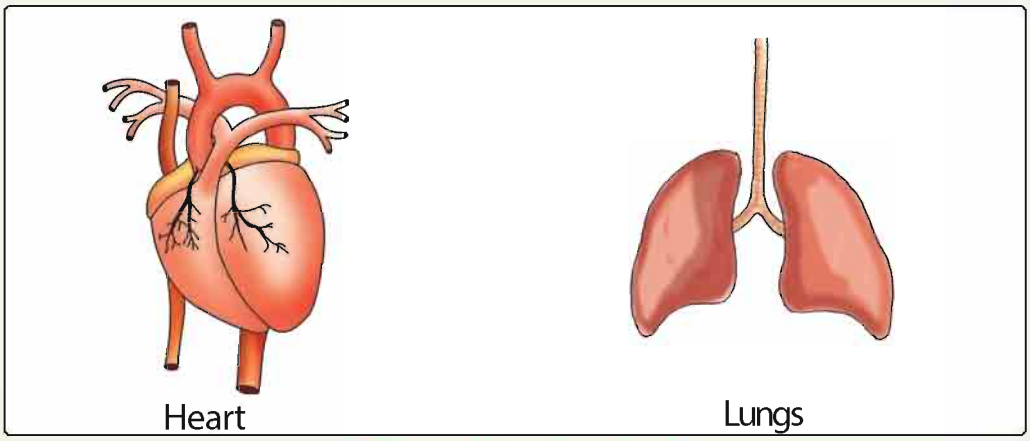


Fig 2.11: Examples of animal organs

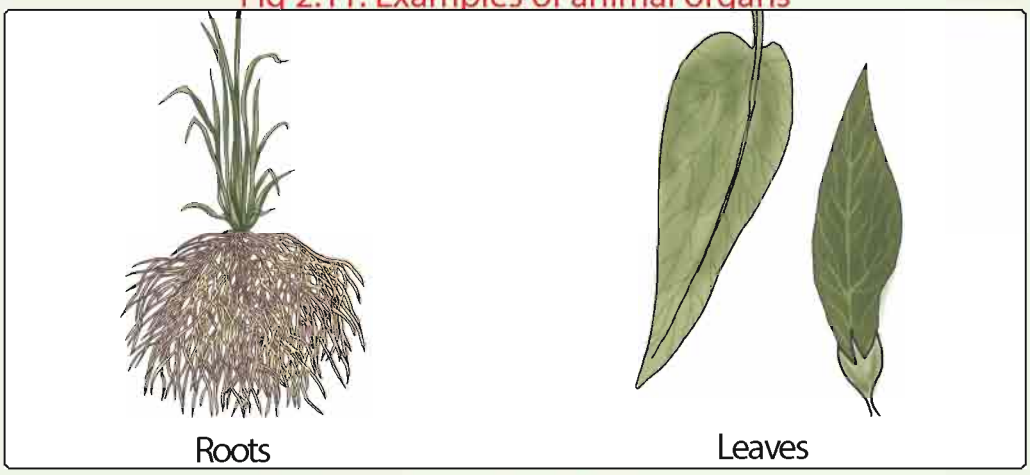


Fig 2.12: Examples of plant organ

Organ systems

Organ systems consist of a group of organs that work together to perform a specific function. In human beings the digestive system is an example of an organ system. It is involved in the digestion and absorption of food. It is composed of many organs including the mouth, oesophagus, salivary glands, liver, pancreas, stomach and intestines. Other organ system in aniamls include circulatory, respiratory and excretory. In plants, for example we have the transport and reproductive systems.

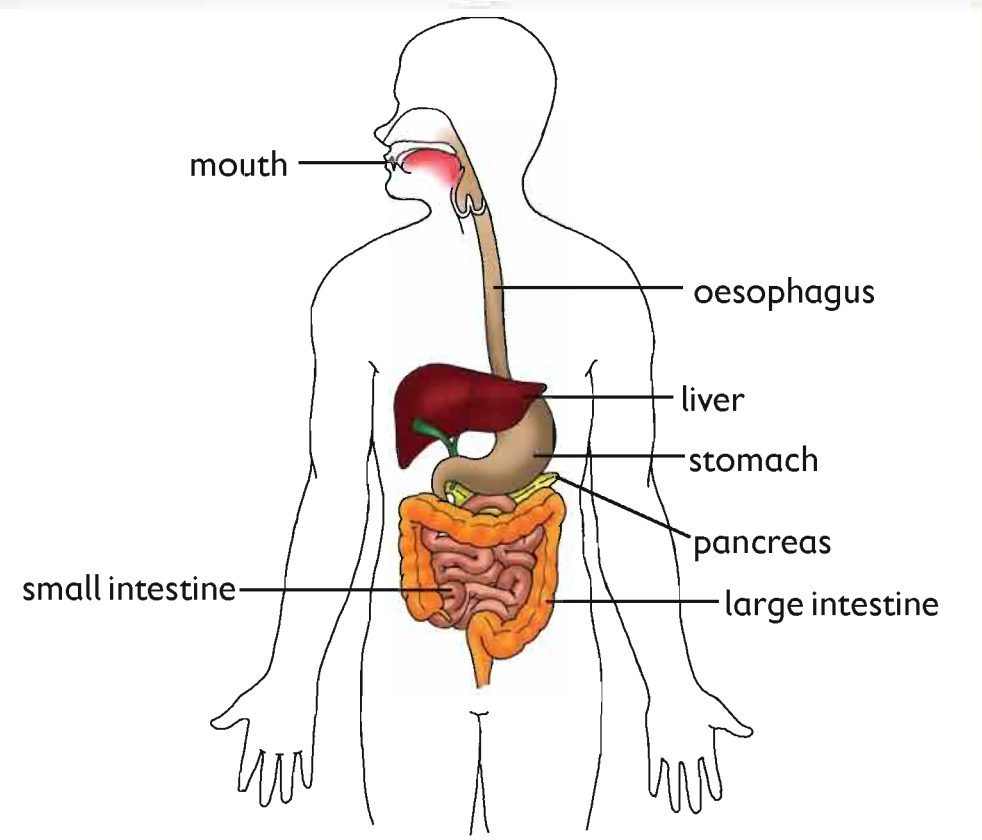


Fig 2.13: Digestive system is an example of organ system in animals.

Need for transport system in multicellular organisms

Materials

- Potato
- Razor blade
- Ruler

What to do

1. Cut five cubes of potato each of side 1 cm long.

2. Cut another five cubes each of sides 3 cm long.
3. Calculate the surface area (S.A) to volume (V) ratio of the cubes. Use the formula $\frac{S.A}{V}$.

Study questions

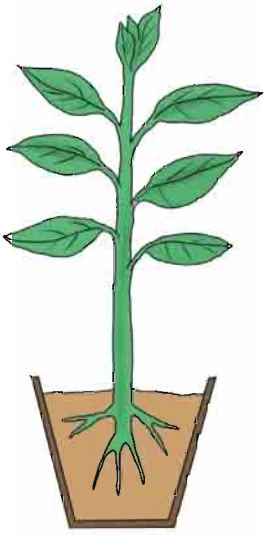
1. Which cube has a smaller surface area to volume ratio?
2. What is the significance of the surface area to volume ratio?

Learning point

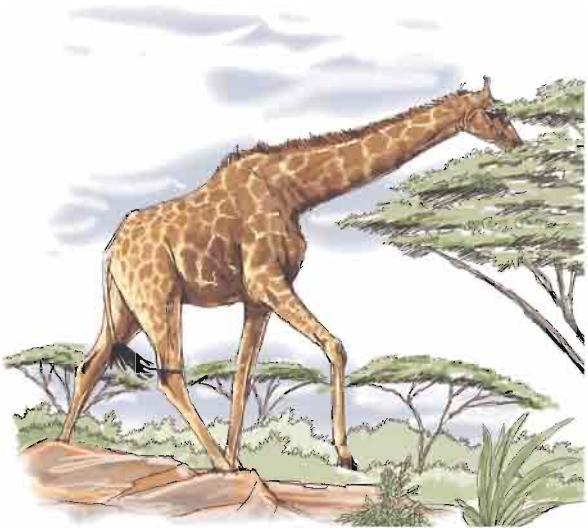
The surface area to volume ratio of the small potato cube was three times that of the larger potato cube.

This means that the rate of diffusion in the smaller cube would be three times as high as that in the bigger cube. The same applies to organisms. Therefore, small organisms can absorb oxygen and other materials from the environment much more rapidly than large ones. Diffusion is faster in smaller organisms compared to large organisms.

Most single-celled organisms are very small. They have a large surface area compared to their volume. In these organisms, substances rapidly get in and out of the cell by **simple diffusion** to meet the cell requirements. The multicellular organisms on the other hand are usually big and hence have a small surface area compared to their volume. In addition, many of their cells are far from the outside environment, which is a source of oxygen and food or into which they release waste substances, which can be harmful if left to accumulate in the cells. These organisms therefore need a special transport system to efficiently move substances into and out of the cells. Examples of multicellular organism that require a transport system are given below.



Tree



Giraffe

Fig 2.14: Organisms that require a transport system

A transport system in living organisms is made up of specialised tissues and organ systems. The type of transport system contained in an organism depends on its complexity and whether it is a plant or an animal.

1. Giving one example in each case, what is the name given to organisms whose bodies are made up of;
   (a) One cell only.
   (b) Many cells.
2. Arrange the following levels of organisation in order giving an example in each case.

   Organ, cell, organ system, tissues
3. Why is transport of materials necessary in both plants and animals? Explain.
4. In terms of surface area to volume ratio, explain why rats respire faster compared to elephants?

Unit 3 Weather, air and diffusion

3.1 The water cycle

Work in pairs

Reflect upon the following occurrences and answer the questions that follow.

1. Every morning, you see water droplets on materials left outdoors. But in the course of the day, the droplets disappear. Discuss what this implies and come up with points and ideas.
2. When it rains, surface run-off goes to the seas, oceans and lakes. Does this water contribute to the amount of rainfall in surrounding areas?
3. Where does rainfall come from? Discuss.

Learning point

At night, water vapour condenses. It then drops back onto the vegetation and materials as moisture.

Evaporation taking place in water bodies like oceans, seas and lakes contributes to the amount of rainfall in surrounding areas. Rainfall is as a result of condensed water vapour in the atmosphere.

Water continuously circulates from water bodies to the atmosphere and back to the land and water bodies. This cycle is known as the water cycle.

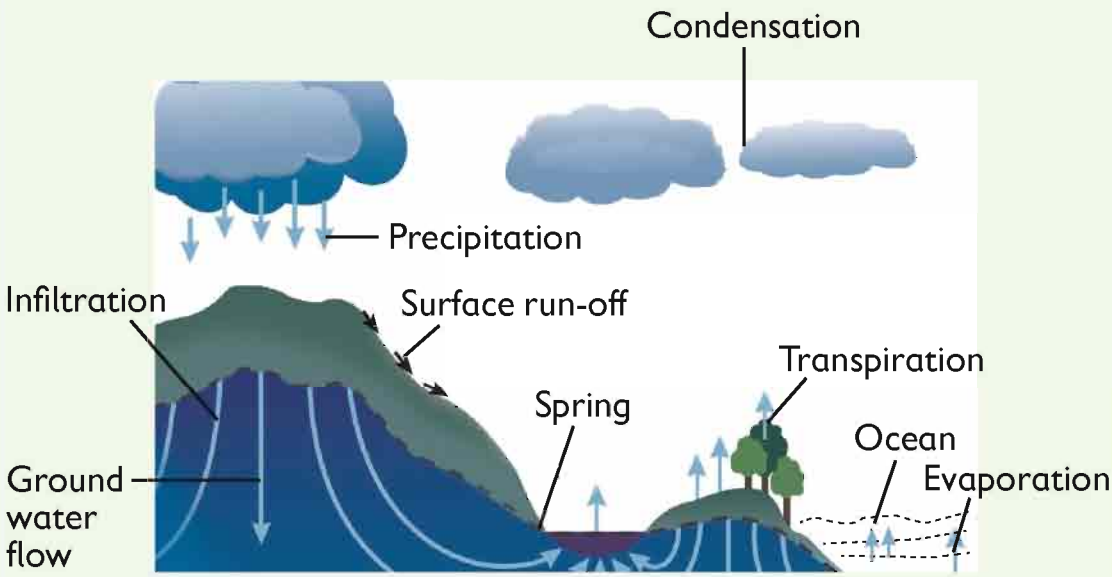


Fig 3.1: The water cycle

Water evaporates from seas, oceans, lakes, rivers and leaves of plants. Loss of water from plant leaves is known as transpiration. The vapour condenses to form clouds and later falls as rain, hail, or snow that is precipitation. The rain or melting snow completes the cycles by flowing downstream into rivers, lakes and seas.

Water goes through different phases namely liquid, solid and gas during the cycle.

Mass flow and diffusion

(a) Mass flow

Work in groups

Refer to Activity 2.4 in Unit 2 pages 33 – 34.

Dip a plant in coloured water and cut the stem after two days to observe if the ink appears in the stem.

- What did you observe? What conclusion do you make?

(b) Diffusion

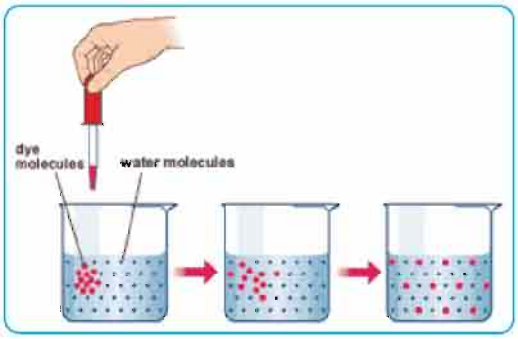
Work as a class

Materials

- Glass container
- Water
- Bottle
- Ink
- Dropper

What to do

1. Fill a beaker half-way with water.
2. Using a dropper add a drop of ink into the water.
   - What do you notice?



3. Add another drop of ink. Does the same thing happen again? What can you conclude?
4. Open a bottle of strong perfume.
   - What do you notice after a few minutes?

Learning point

Mass flow is the movement of dissolved nutrients into a plant through the roots as the plant absorbs water for transpiration in the leaves.

Diffusion is the movement of particles from a region of high concentration to a region of low concentration. In plants it is the movement of nutrients

to the root surface in response to the concentration gradient. The difference in the concentration of particles in the two regions is called **concentration gradient** or **diffusion gradient.**

Diffusion occurs in liquids and gases. Diffusion does not take place in solids. When particles move from a region of high concentration to a region of low concentration, they are said to diffuse a long a concentration gradient. As long as the concentration gradient is maintained, the movement of particles continues until they are evenly distributed in the available space.

Effects of weather on human activities

Work in groups

1. In groups of five discuss the effects of weather on human activities.
2. Write a report and present it in class.

Learning point

Weather and climate play a huge role in defining human activities. For instance, farming types are directly influenced by the weather. The changes in weather affect farming activities. Farming means keeping animals and growing crops. Examples of farm animals are cows, goats, sheep, chicken and pigs. Name other animals farmers keep in your area.

Farmers also grow different types of crops. Examples of crops which farmers grow are bananas, beans, maize, cassava, sugarcane, tea and coffee. Name other crops which farmers grow in your area.

What happens to crops and animals when weather conditions change?

(a) During a rainy season

The time of the year when most of the region's annual rainfall occurs is called rainy season.

(i) Plants

- During a rainy season, plants get enough water and grow well.

Fig 3.2: Plants grow well when it rains

(ii) Planting

When rain fall, seeds germinate.

They become young plants. We call these young plants seedlings and the act of putting or pacing seeds in the soil is called planting.

Fig 3.3: Planting seeds

If some seeds do not germinate, a farmer plants other seeds in their place. This is called Gap filling..

(iii) Weeding

As the plants grow, weeds also grow in the garden. Weeds are unwanted plants growing in the garden. When people remove the weeds. The process is called weeding.

Fig 3.4: Weeding

(iv) Animals

Animals get enough water to drink and plenty of grass to eat.

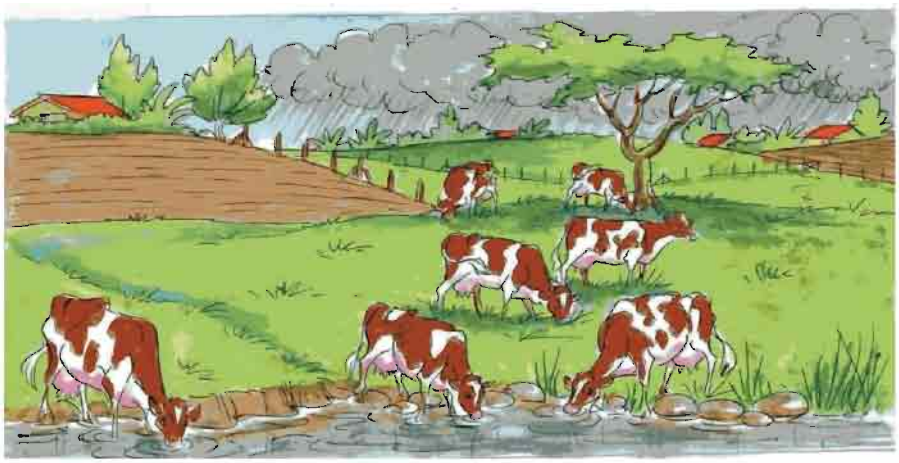


Fig 3.5: Plenty of food and water for animals

(b) During dry season

When it does not rain and it is hot for many months, we call this a dry season. During the dry season, leaves of plants fall off and the grass may dry up. What do farmers do to animals and plants during a rainy and a dry season?

(i) Ploughing or digging

During the dry season farmers prepare land for planting crops. Some people dig with hoes. Others use tractors.

(a) Ploughing land using a tractor

(b) Ploughing land using a hoe

Fig 3.6: Ploughing land

(ii) Mulching

To prevent crops from drying during dry season, farmers may spread dry grass or leaves around the plants' base. The spreading of the dry grass or other leaves around plants is called **mulching**.

Fig 3.7: Mulching

(iii) Watering

The young plants are watered during a dry season. It is usually done in the morning and evening.

Fig 3.8: Watering seedlings

(iv) Harvesting

After the crops are ready they are harvested. The farmer sells some of the harvest. The farmer may also store some to feed the family in the future.

Fig 3.9: Harvesting crops

(v) Shading

During dry season, plants do not get enough water. Young plants dry up quickly if they do not have enough water. Young plants are protected

in a nursery bed by making a shed over the nursery bed to protect the young plants from the hot sun. The farmer also waters the plants.

Fig 3.10: Shading to keep off hot sun

Animals

During the dry season, animals do not get enough water for drinking The land also get dry leading to scarce grass for animals to graze.

Extreme weather conditions

Weather changes bring about droughts and flooding. These two are extreme weather conditions that affect human activities.

(a) **Drought** refers to a period when there is no rainfall. This results in shortage of water supplies to both plants and animals. Water supplies dry up and run out. Serious droughts can cause death of people and animals. Plants also dry up.

Fig 3.11: People affected by drought

(f) Flooding

Too much rainfall in an area causes **flooding**. This causes rivers and lakes to overflow to nearby fields. Floods displaces people and animals. It also destroys plants and other crops.

Fig 3.12: Flooding

1. What is the importance of water cycle in our daily life?
2. During dry season, what foods can a farmer give to the cows and goats?
3. In which season do rivers and dams have little or no water?
4. What do you do for your plants during dry season?

3.2 Components of air and their properties

Research Activity

Individual work

1. Using textbooks and the internet, carry out research on components of air, their properties and uses.
2. Write a short report. Compare your findings with the rest of the class.

Learning point

Air is a mixture of colourless, odourless invisible gases that surround the Earth. It is all around us. We breathe air to live. We need air to burn fuel and keep warm. We cannot see it, but we can feel it when it moves as wind. Oxygen is a component of air used in burning of substances and breathing.

Composition of air (percentage composition of air by volume)

Work in pairs

1. Study the table below

Table 3.1: Percentage composition of air

Substance	Percentage %
Nitrogen	78
Oxygen	21
Carbon dioxide	0.03
Inert gases	0.97

Come up with a pie-chart based on this data.

2. Did your pie chart look like this?

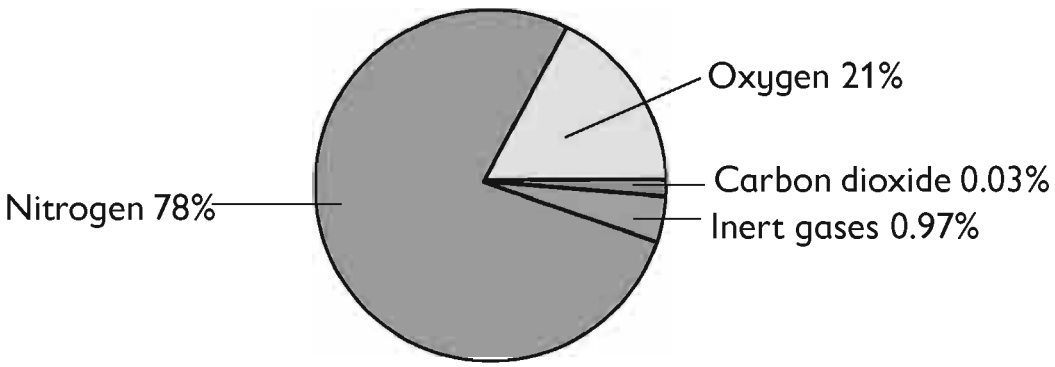


Fig. 3.13: Percentage composition of air

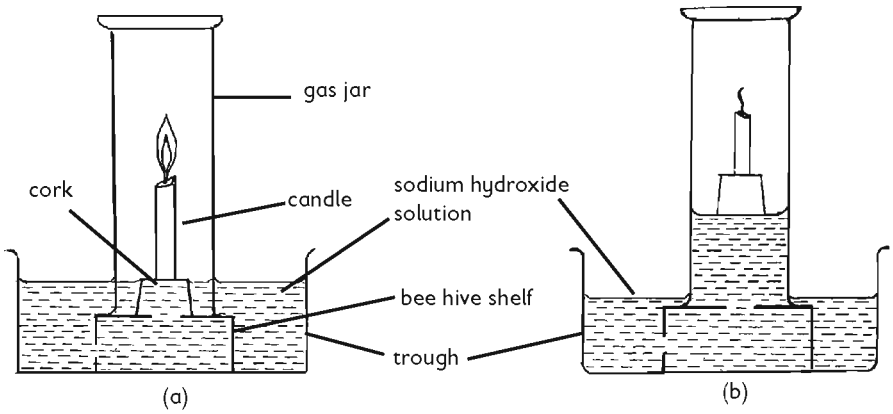
Class work

Materials

Beehive shelf, candle, gas jar, cork, sodium hydroxide solution

Procedure

1. Place the beehive shelf in the middle of the trough.
2. Place the candle mounted on a cork.
3. Add dilute sodium hydroxide solution to just cover the cork as shown in the figure below.
4. Light the candle.
5. Lower the gas jar over the burning candle.
6. Wait for some time.
7. Lift the gas jar and put a burning splint in the remaining part of air.



- Write and explain the observations made.

Learning point

When the gas jar is lowered to cover the burning candle, the candle is exposed to only a limited supply of air. The candle goes off when the part of air that supports burning is used up. This experiment shows that

a burning candle does not use up all air, but only a portion of it. We therefore conclude that air is made up of **two parts**. One part that supports burning and the other that does not. The part that supports burning is the **active part** of air. The active part of air that is required for burning is **oxygen**.

Research Activity

Work in pairs

Materials

- Lime water
- Clear containers
- Straws

What to do

1. Place lime water in a clear container.
2. Using a straw breath out into the lime water solution in the clear container.
   - What did you observe?
   - What conclusion do you make from that observation?

Learning point

The air we breathe out contains carbon dioxide gas. In the experiment above, lime water turned milky. This confirms the presence of carbon dioxide in air.

Uses of components of air

(a) Oxygen

Oxygen is used in:

- Burning of substances
- Germination of seeds
- Breathing

(b) Nitrogen

Nitrogen is used by leguminous plants to make nitrates which they use to make proteins. The plants contain root nodules which has special bacteria that converts atmospheric nitrogen to nitrates. Examples of leguminous plant include beans, groundnuts, peas and others.

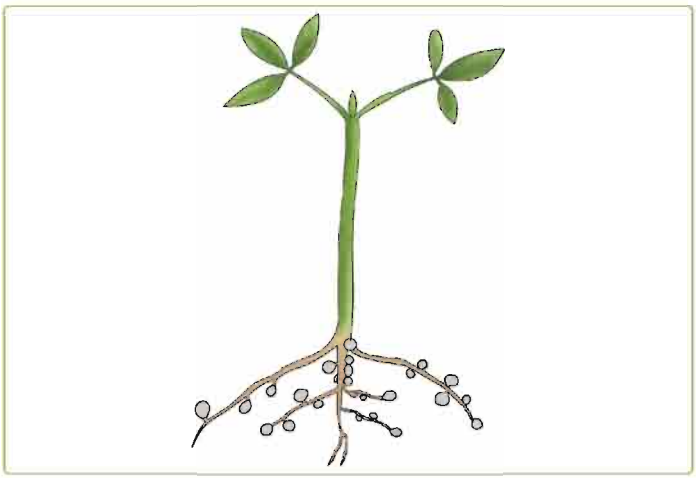


Fig 3.14: Leguminous plant showing root nodules

(c) Carbon dioxide:

Carbon dioxide is used in

- Making plant food (photosynthesis).
- To put out fire. Fire extinguishers contain carbon dioxide.

Fig 3.15: Fire extinguisher

- Preservation of soft drinks.

(d) Inert gases

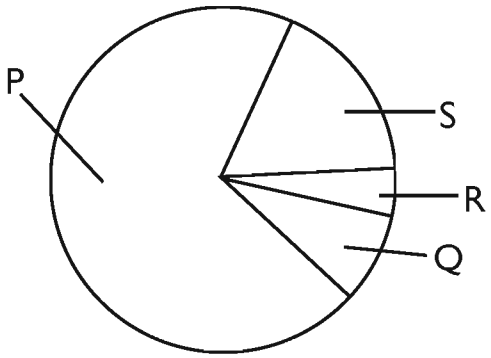
These gases are referred to as inert because they are not active and do not burn completely. They are also known as rare or noble gases. Examples are argon and neon.

They are used in electric bulbs and florescent tubes.

Fig 3.16: Florescent bulb

Fig 3.17: Bulb lighting

1. Which component of air is approximately 1/5?
2. Identify the components of air marked with letters in the pie chart below.



3. Complete the table below.

Component of air	Uses
Nitrogen	
Oxygen	

Component of air	Uses
Inert gases	
Carbon dioxide	

3.3 States of matter

Work in pairs

1. Look inside and outside your class.
2. Name some of the things you can see, smell or touch.
3. In which state are they? Solids, liquid or gas? How did you know?

Learning point

You may have seen things like trees, water, animals, stones, soil, books, pen, smoke and many other things.

All these things are made up of certain materials. These materials are referred to as matter.

Matter is anything that occupies space and has mass.

Your pen, for example, has mass. It also occupies space. All the things you named above occupy space and have mass. They are examples of matter.

Matter can be put into three different groups:

- solids
- liquids
- gases

The state in which matter exists depends on two things:

- Temperature
- Pressure

Characteristics of different states of matter

(a) Solids

Individual Activity

Materials: A small stone and a clear container.

1. Place the small stone on your desk. Trace the stone's shape on a piece of paper. What shape did you come up with?
2. Now put the stone in the clear container. Does the shape change or it remains the same?

Learning point

The shape of the stone does not change. It remains the same even after putting it in the clear container. Solids have a fixed shape. Because the shape does not change, the space it occupies does not change too.

Solids have a definite shape and a fixed volume. Example of solids are stone, bottle, pen, tree, cooking fat, salt, sugar among others.

Some examples of solids are given below. Can you name them?

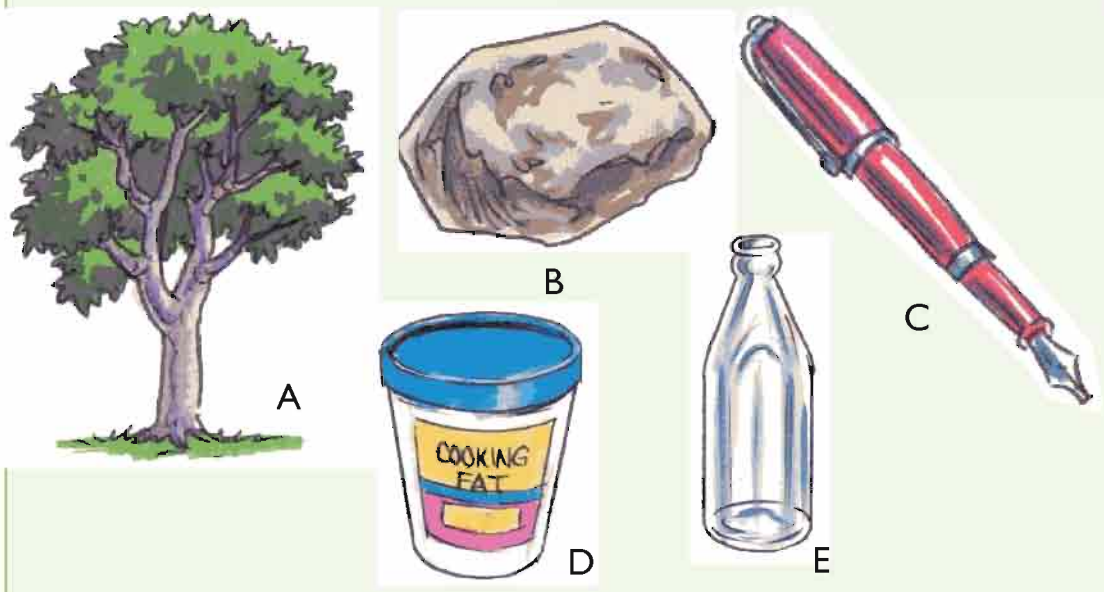


Figure 3.18: Examples of solids

Materials: Piece of bread, piece of wood, stone, water and a basin.

Use the above materials to carry out an activity to demonstrate floating and sinking.

(a) Which objects sink, floats and takes time to sink?

(b) Does the shape of stone and wood change?

(c) What about the piece of bread? Why is this so? Explain.

(d) Design another experiment of your choice similar to the one above.

Learning point

You may have noticed that when you place a piece of bread, stone and wood in water, the piece of wood floats on water, the stone sinks while the piece of bread absorbs water then sinks after some time.

The shape of stone and piece of wood remains the same while the piece of bread absorbs water and retains the same shape.

Solids have a definite shape and fixed volume.

(b) Liquids

Work in pairs

What you need: water and containers of different shapes. Objects such as bottle tops, coin, paper, key, stone, leaf, pieces of wood.

1. Pour equal amounts of water into each container. Observe the shape of the water in each container.
2. Now pour some water on a flat table. Notice the way it spreads.
3. Put each object in water one at a time.

4. Which object float and which object sink when in water?
5. Tilt a flat piece of wood slightly. Pour some water on it.

When water is poured on a tilted flat surface, it flows down the slope. This shows that liquids flow. Therefore, liquids have the following characteristics:

- They have a fixed volume.
- They take the shape of the container.
- It is easy for something to go through a liquid.
- They can flow.

Learning point

- You may have noticed that the water level in the narrower container is higher than the level in the wider container. Although the water in the different containers may appear to be at different levels, their volumes are still the same.
- Below are some examples of liquids.

Water

Juice

Cooking oil

Figure 3.19: Examples of liquids

(c) Gases

Work in pairs

1. Pump some air into a bicycle tube or a ball.

Fig 3.20 A ball filled with air

2. What happens to the tube or the ball? What does this tell you about air?

Learning point

The air around us is a mixture of many gases. Some of these gases are oxygen, carbon dioxide, nitrogen and water vapour. We cannot be able to see air although we can feel it moving from one place to another. This moving air is called wind.

Unlike solids and liquids, gases spread to fill the container they are put in.

Gases have no fixed shape since they spread all over.

They also have no fixed volume. They can therefore be squeezed, or compressed, into a small space. For example, when we put pressure into a football or bicycle tyre, we are compressing air into them hence forcing a lot of air to take a small space.

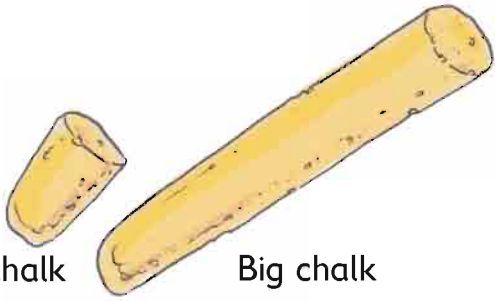
It is easy for objects to pass through gases. For example, one can be able to throw a stone through the air without any difficulty.

Matter and mass

(a) Solids

Work in pairs

1. Look at the pieces of chalk below.



Small chalk Big chalk

Fig 3.21: Pieces of chalks of different sizes

2. Now, look at these packets of sugar.

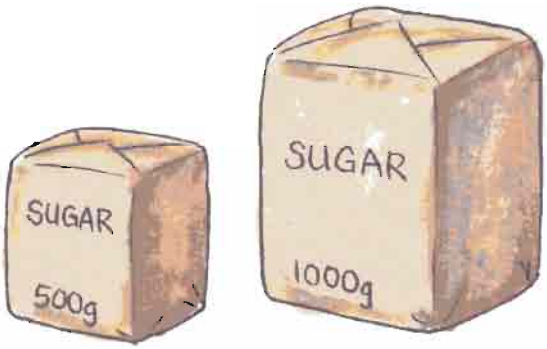
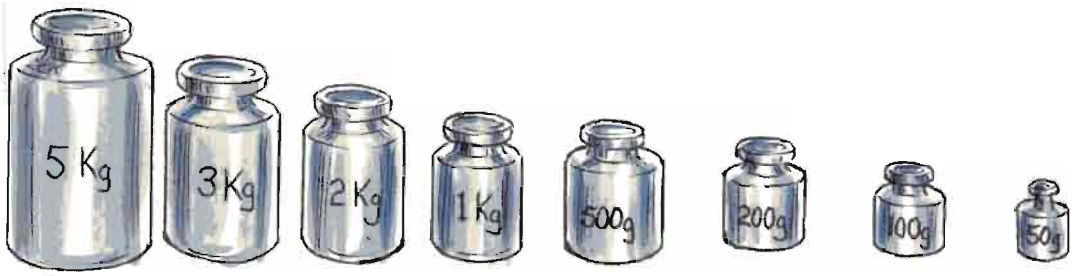


Fig 3.22: Packets of sugar with different masses

3. Finally, study these standard masses.



Which of the masses shown have a bigger mass? Why?

Learning point

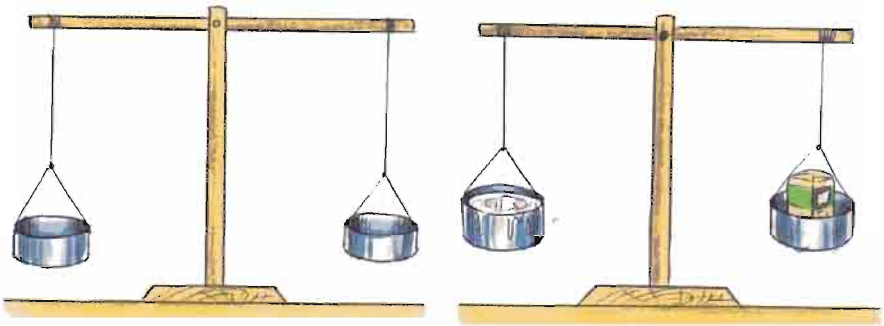
The amount of material that makes up a substance is called its mass. For instance, the bigger chalk, has a bigger mass than the smaller one, the same applies to sugar.

All solids have mass.

(b) Liquids

Work in groups

1. Balance two similar containers as shown in the picture A below.
2. Now place a 250 gram packet of flour in one of the containers on the balance as shown in B. What happens?



A B

3. Pour water gently into the other container until it balances with the packet of flour. How much water did you use?

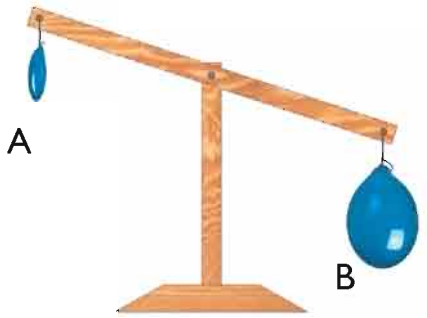
Learning point

In the first case, the containers balance. When the flour is put in one, the balance tilts. On pouring water in the other container, it reaches a point when the water and the flour balance. All this point: The water in the container has mass which is equal to the mass of the flour. The water in the container therefore has a mass of 250 grams.

(c) Gases

Work in pairs

1. Blow equal amounts of air into two balloons.
2. Balance the balloons.



3. Prick ballon B using a pin. What happens? Why?

Learning point

We learnt earlier on that air is made up of many different gases. Just like solids and liquids, gases also have mass. This is why the balance is tilted when balloon B is pricked. It looses the air and its mass reduces. This cause the tilting.

Table 3.2 Summary of characteristics of matter

States of matter	Mass	Volume (size)	Shape
Solid	*definite*	*definite*	*definite*
Liquid	*definite*	*definite*	*indefinite*
Gas	*definite*	*indefinite*	*indefinite*

Effect of heat on matter

We have already learnt that matter exists in form of solids, liquids and gases. Heating and cooling can affect matter in different ways.

Materials: Some fat or candle wax and a candle.

1. Put some cooking fat or candle wax in an open container.
2. Warm it over a small flame.
   - What happens to the fat or candle wax?

Learning point

3. Take the melted fat and place it in cold water. What do you notice?

This changing of fat, or any solid, into a liquid due to heating is known as melting.

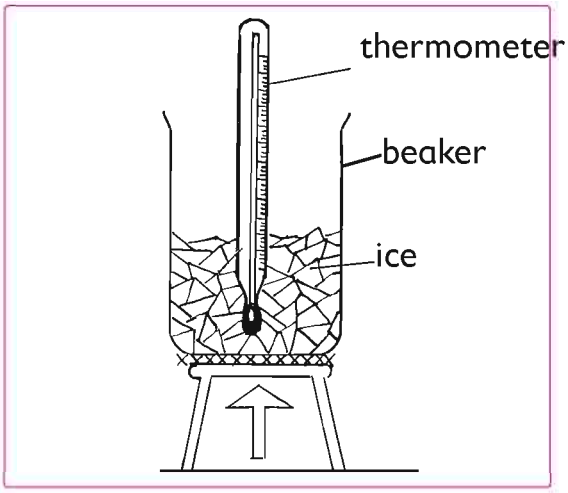
When a solid is heated, it melts and becomes a liquid. When the liquid is cooled, it changes back into a solid.

Group work

To show that ice melts when heated and freezes when cooled

Materials: a piece of ice, a source of heat and a pan or beaker.

1. Place some ice in a tin and heat.
   What happens to the ice?



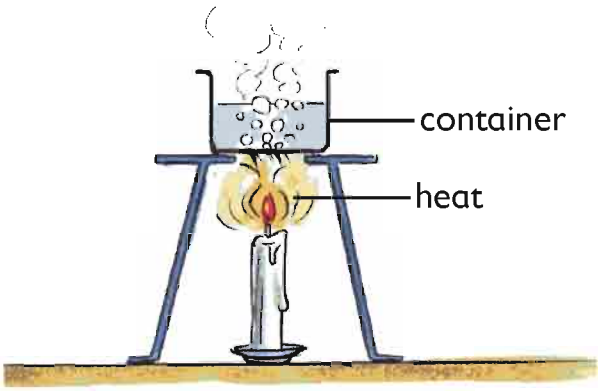
2. Now put the liquid water into a refrigerator and leave it in the freezer overnight. Observe what happens the following day.

Learning point

When ice is heated, it melts and changes to liquid state. When it is cooled it changes back to ice. The water you put in the freezer may have changed to ice. The process by which water changes to ice is known as freezing.

Work in groups

1. Put some water in a shallow tin.
2. Heat it over a candle flame.
   What can you see?
3. Now cover the tin with a metal lid.
4. Remove the lid after some time and observe its underside. What do you see?



Learning point

On heating, water changes to vapour (gas). The process through which water changes state from liquid to gas is known as evaporation. Very hot vapour emitted from boiling water is called steam. If steam gets to a cooler surface, it changes back to liquid state. The process through which a gas changes back to a liquid when cooled is known as condensation.

Therefore matter can change from one state to another, either through heating or cooling. Heating changes a solid into a liquid. Heating also changes a liquid into a gas. Cooling changes a gas into a liquid and

further cooling changes liquid back solid. Below is a summary diagram on the changes of states of matter.

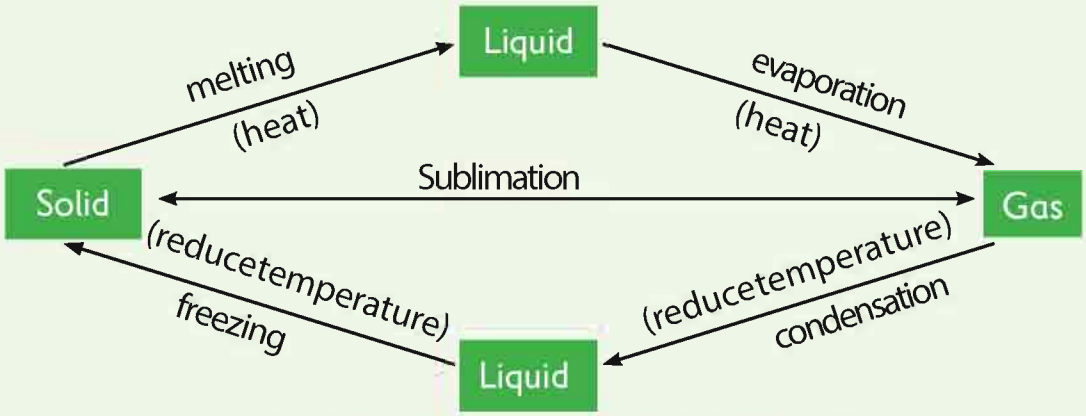


Fig 3.23: Changes of states of matter

Note: Some substances for example dry ice and solid carbon dioxide change from a solid to a gas without ever passing through a liquid phase. Such a change is called sublimation.

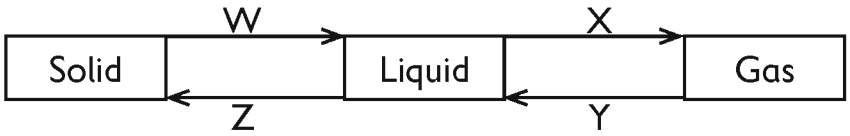
Therefore, in general:

- Increasing temperature causes melting and evaporation.
- Decreasing temperature causes condensation and freezing.

1. Matter exists in three states. Name the three states.

   _____, _____ and _____.

2. Identify the processes marked with letters in the flow chart below.



   W ....., X .....

   Y ..... , Z .....

3. Which one of the following has no fixed volume and shape?

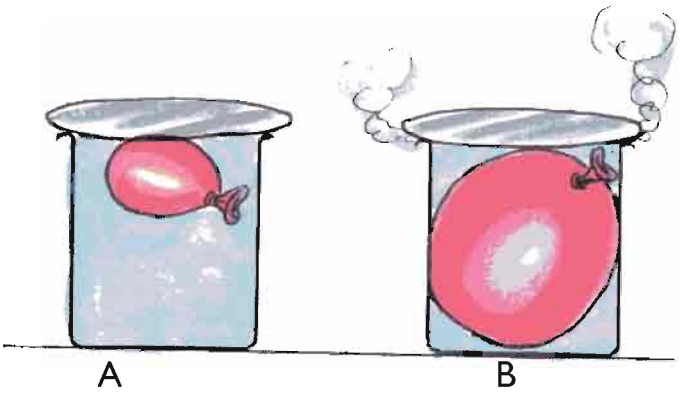
   A. Water
   B. Sand
   C. Air
   D. Wood

4. When ice and cooking fat are placed near fire, they _____.

5. Which of these best describes evaporation? The process by which
   A. a liquid changes into a solid.
   B. a solid changes into a liquid.
   C. a liquid changes into a gas.
   D. a solid changes into a gas.

6. Matter is anything that occupies_____ and has _____.

7. The two containers below shows a balloon dipped in cold water, then in warm water.



Explain the results observed.

3.4 Atoms, elements, molecules compounds and mixtures

Research Activity

Individual work

1. Using the Internet and textbooks, look for the meaning and examples of the following terms and give the differences.

   (a) Atom
   (b) Element
   (c) Mixture
   (d) Compound

2. Write a report on your findings and present it to the rest of the class.

Learning point

(a) Atoms and elements

Elements are substances that cannot be split (broken down) into simpler substances by any chemical means, for example iron, copper and hydrogen tin. Therefore an **element is a pure substance, which cannot be split into anything simpler by any chemical process.**

Note: There are about 118 known elements. About 90 of these occur naturally on Earth and its atmosphere while the rest have been made in the laboratories. Most elements can be classified as: metals or non-metals.

Elements are made up of very tiny particles. These particles can be divided further by chemical means. When they cannot be divided any further without changing their properties, they are called **atoms**.

An atom is therefore the smallest particle into which an element can be divided without losing the properties of the element. An atom is also the smallest particle of an element that takes part in a chemical reaction.

Note: An atom of one element is different from atoms of another element. That means that an iron atom is different from copper atom. A copper atom is different from a zinc atom and hydrogen among others.

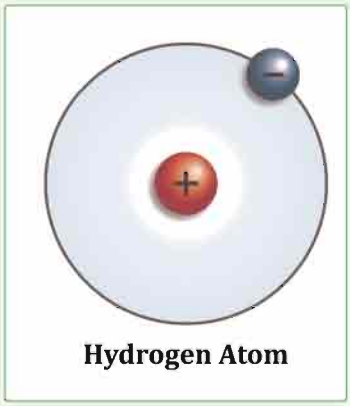


Fig 3.24 Structure of hydrogen – the simplest known atom

There are many atoms as there are elements. There are about 118 different types of elements and therefore there are also 118 different types of atoms.

Note: Atoms do not exist on their own instead they occur in groups. Most atoms are unstable and take part in chemical reactions.

(b) Molecules compounds and mixtures

Work in groups

Materials

- Water
- Boiling pot
- Salt
- Source of heat
- Clean container
- Stirring rod

What to do

1. Dissolve some salt in a little water in a clear container.

   Shake or stir the mixture using the glass rod. What happens?

2. Heat the mixture to dryness in the boiling pot. What happens?
3. In your group discuss the observations above.

Learning point

The salt dissolves in the water when stirred and when heated to dryness the salt is regained. This shows that the salt mixed with water to form salt solution. A mixture is formed as a result of bringing particles of different substances into close contact with each other, without chemically combining them. Usually, the substances making up the mixture can

be mixed in any proportion and each component retains its original physical and chemical properties. A mixture shows the properties of its components, for example, a mixture of sand and salt has the properties of both sand and salt. Similarly, a sugar **solution**, which is a mixture, has the properties of both sugar and water. Air is an example of a mixture as well.

Therefore, a mixture refers to two or more substances that are not chemically combined.

On the other hand, a substance formed by chemically combining two or more elements together is called **compound**. For example:

When magnesium (one element), is burnt in air, it combines with oxygen (another element) to form magnesium oxide. Magnesium oxide is a compound of magnesium and oxygen elements.

Other examples of compounds are salt, sugar, chalk and petrol. The substances making up a compound are difficult to separate and are in fixed proportions. A compound has different chemical and physical properties from those of the elements of which it is composed. All compounds consist of two or more elements chemically combined together.

A compound is therefore a substance made up of two or more elements combined together by chemical means.

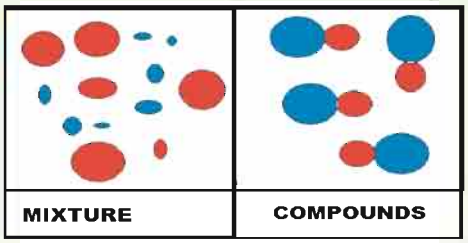


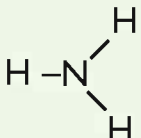
Fig 3.25: Illustration of compound and mixture.

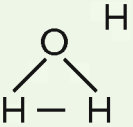
On the other hand, the smallest particle of an element or a compound, which can normally exist in a free and separate state is called a molecule. For example, Fig 3.27 below shows a molecule of hydrogen.

Fig 3.26: A Hydrogen molecule

The hydrogen molecule is made up of two atoms of hydrogen. There are some elements whose molecules consist of two atoms while others have two or more atoms of different elements. For example:

(a) O = C = O (CO_2) Carbon dioxide molecule

(b)  (NH_3) Ammonia molecule

(c)  (H_2O) Water molecule

The structure of water molecule

Research Activity

Individual work

1. Find out from the Internet and reference books the structure of water molecule. Draw the structure shown in your exercise book.
2. Compare your work with that of other class members.

Learning point

A water molecule consists of two hydrogen atoms bonded to an oxygen atom. The bond between hydrogen atoms and oxygen atom is called **Hydrogen Bonds** (which are weak in comparison with other chemical bonds). Water will forms hydrogen bonds within itself.

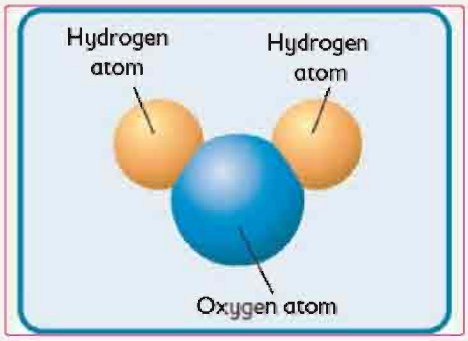
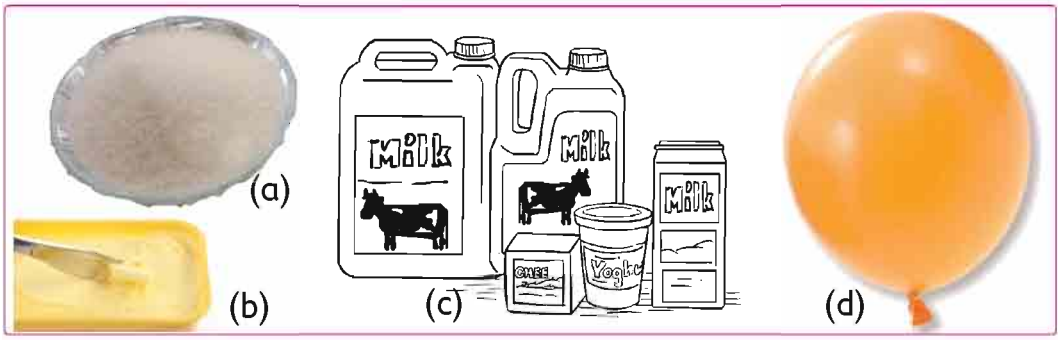


Fig 3.27 Structure of water molecule

Hydrogen atoms and oxygen atom in water stick together. This is known as cohesion. This property of water is important in transport of water in the plant stems, as plants relies on water that is pulled to the leaves from the roots. This helps during mass flow and diffusion of substances in plants. This property of water is also important in the movement of blood in our blood vessels.

1. Differentiate between an atom and an element.
2. What is the difference between a mixture and compound?
3. State whether the following are compounds, elements or mixtures.



4. In water _____bonds helps the atoms to stick together in the molecules.

3.5 Metals and non-metals

Work in groups

Materials

- Collect samples of a number of materials with the help of the teacher such as: Iron, tin, copper, solder wire, zinc, chalk, brass, plastic, aluminium, wood, charcoal, glass.
- Components of electric circuit (switch, wire, dry cells, bulb)
- Water
- Hammer
- Wrapping materials
- Gloves
- Cutting tool such as scissors or pliers

What to do

1. Observe the various substances; is the material shiny or dull in appearance?
2. Using a simple electric circuit (shown below) with a gap, connect every material to complete the circuit and check if the bulb lights.

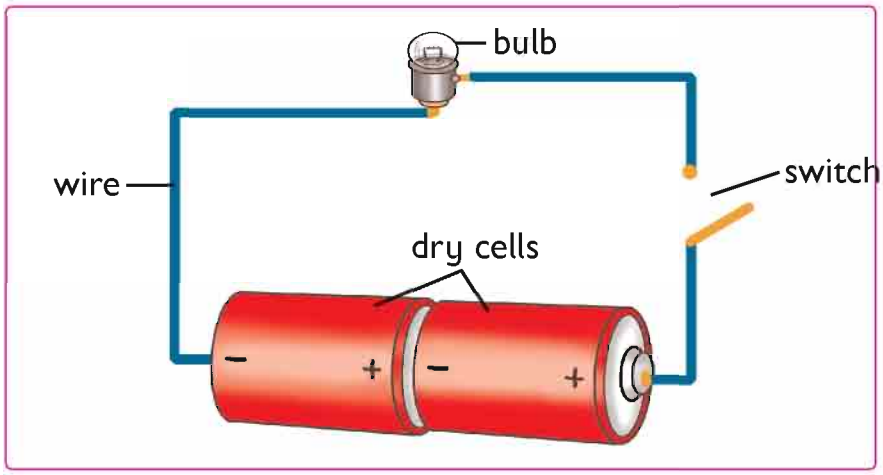


Fig 3.28Simple electric circuit

Use the observation above to classify the materials (**Hint:** if the bulb lights the materials conducts electricity and if the bulb does not light then the material does not conduct electricity.) Come up with a table like this.

Conductor of electricity	Non-conductor of electricity

- Record the materials that conduct and those that do not conduct electricity.

3. Wrap the material being tested in heavy plastic or a cloth to prevent pieces from flying off.
   - Place the material on a hard flat surface.
   - Using a hammer, hit the material flat.

   (If the material being hit flattens then the material is **malleable.** If the material breaks or does not change then it is **non- malleable.)**

   Try stretching each material to see if it can be drawn into a wire. If it can be drawn then it is **ductile**.
4. Observe each material and record the colour of each.
5. Cut a piece of each material and dip in water.
   - How do they react?
6. Come up with a table on properties of metals and non-metals. Compare your list that of other members of your class.

Learning point

Some properties of metals and non-metals are given below.

(a) Metals

1. They are hard and shiny.
2. They have high melting and boiling points.

3. They are opaque and ductile.
4. They are good conductors of heat and electricity.
5. Most metals are malleable and are in general, denser than other elemental substances.
6. Metals react with water.
7. Examples of metals are copper, magnesium, aluminium, sodium and zinc.

(b) Non-metals

1. They are dull and break easily.
2. They have low melting and boiling points as compared to metals.
3. They cannot be hammered into sheets (are not malleable) or drawn into wires (are not ductile).
4. They are highly volatile, have low elasticity, and are bad conductors of heat and electricity.
5. Examples of non-metals are carbon, nitrogen, oxygen, plastics, wood among others.

Table 3.3 Summary of Properties of metals and non-metals

Property	Metals	Non–metals
Appearance	Shiny	Dull
Hardness	Very hard or hard	Brittle
Malleability	Malleable	Non-malleable
Ductility	Ductile	Non-ductile
Heat conduction	Good conductor	Bad conductor
Conduction of electricity	Good conductor	Bad conductor
State	Solid	Solids, liquids, gases
Density	Higher	Lower

1. Group the following as either metals or non-metals.

   Wood, gas, plastic, iron, copper, water.

2. Compare the properties of metals and non- metals.
3. If you were given a project of forming an electrical equipment, which materials would you use and why?
4. Why do you think you burn your fingers when you touch a hot metallic container?

Unit 4 The earth and space

4.1 The Earth as part of the universe

Individual activity

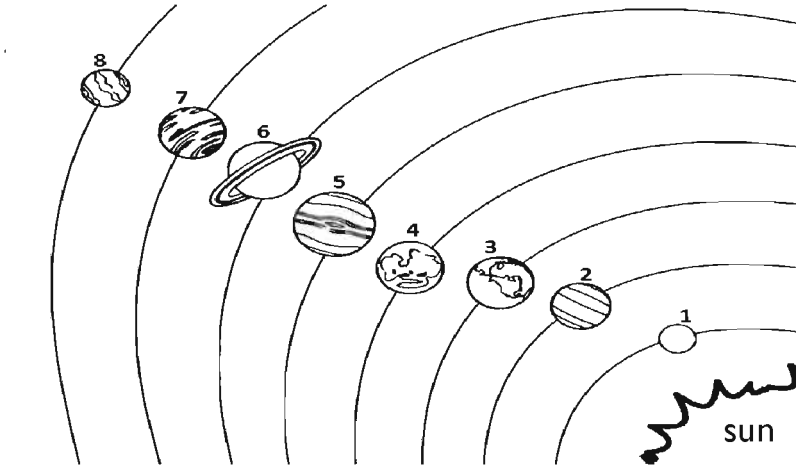
1. Go out of class and observe the sky at different times of the day.
   - Record the observations made.
2. Back at home, observe the sky at night, what do you see?
   - Record your observations.
3. Using the Internet and textbook research on the solar system.
4. Present your work to the rest of the class.

Learning point

The solar system is made up of the Sun, eight planets, moon and heavenly bodies like asteroids and comets.

Work in groups

1. Discuss and identify the planets numbered 1 to 8 in the figure below. Use the school library and the internet to do further research.



2. Discuss their characteristics and fill the table below.

Position from the sun	Planet	Characteristics
1	Mercury	
2		
3		
4		
5		
6		
7		
8		

Learning point

The following are some of the characteristics of the eight planets.

Planet	Characteristics
Mercury	• The first planet from the Sun that is nearest to the sun. • It is the smallest of all the planets. • Always seen in the west after sunset.

Venus	• The second planet from the Sun. • It is the brightest and hottest planet. • Its seen early in the morning in the east.
Earth	• The third planet from the Sun. • It has water and air, therefore supports plant and animal life. • It is the planet we live in.
Mars	• The fourth planet from the sun. • It is known as the orange-red planet. • It is nearest to the Earth.
Jupiter	• The fifth planet from the Sun. • It is the largest planet in the solar system.
Saturn	• The sixth planet from the Sun. • It has rings round it.
Uranus	• The seventh planet. • It appears greenish.
Neptune	• The eighth planet. • It appears bluish. • It is the farthest planet from the sun.

These planets are arranged in space as shown below.

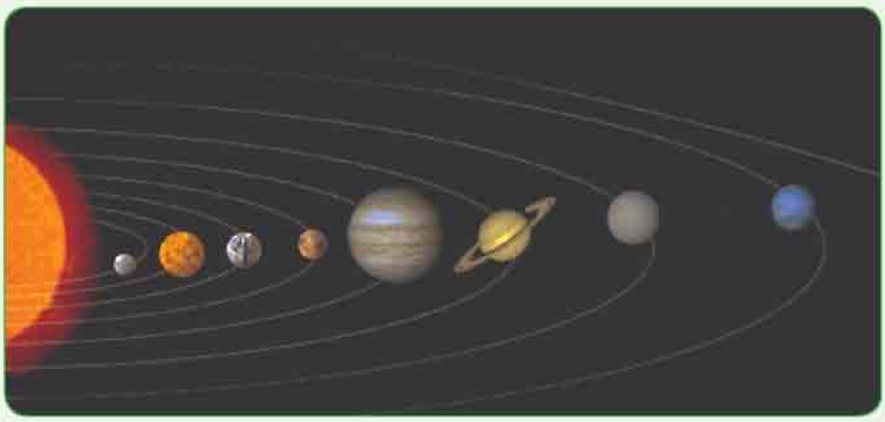


Fig 4.1: The solar system

The Earth

The earth is the third planet from the sun. It is the only planet so far that supports both plants and animal life. It is round like a ball but slightly spherical. It is made up of soil, water and air. Water in lakes, oceans and seas. cover the largest part of the Earth's surface.

The Earth is surrounded by the atmosphere.

Fig 4.2: The Earth

The interior of the earth is made up of:

- **Crust** - the outermost thin layer of rocks and soil.
- **Mantle -** the second thick layer of rocks
- **Core -** the innermost layer consisting of molten rocks and minerals.

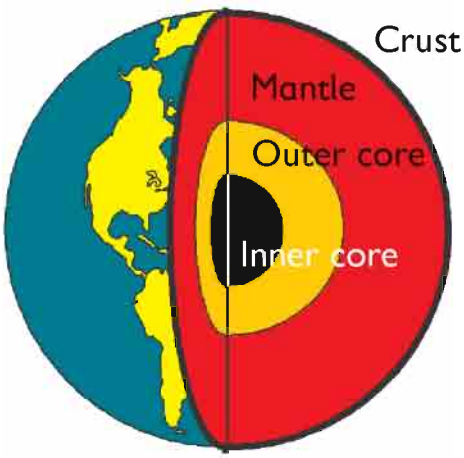


Fig 4.3: Interior of the earth

Two types of movements occur on the Earth:

- Rotation of the Earth.
- Revolution of the Earth.

1. The shape of the earth is _____.
2. The innermost part of the earth consists of _____.
3. The Earth goes round in an imaginary line called _____.

4.2 Rotation of the earth

Work in groups

Materials

- Torch
- A stick or wire
- A round object like a ball
-
- Felt pens
- The globe

What to do

1. Insert the stick through the middle of round object to pass through to the other side.
2. Using felt pens of different colours draw diagrams or stick objects on the round object.
3. Holding the wire on one end with one hand, spin the round object slowly with the other hand, while a group member is lighting torch on one side to demonstrate rotation of the earth.
4. Repeat the procedure three times with the globe shown below. Discuss the observations made.

Learning point

Rotation of the earth refers to the spinning movement of the earth on its own **axis**.

How does earth's rotation cause day and night?

The earth spins round an imaginary line passing through its centre. This imaginary line is axis. The spinning of the earth on its axis is known as rotation. **The earth rotates on its axis from west to east.**

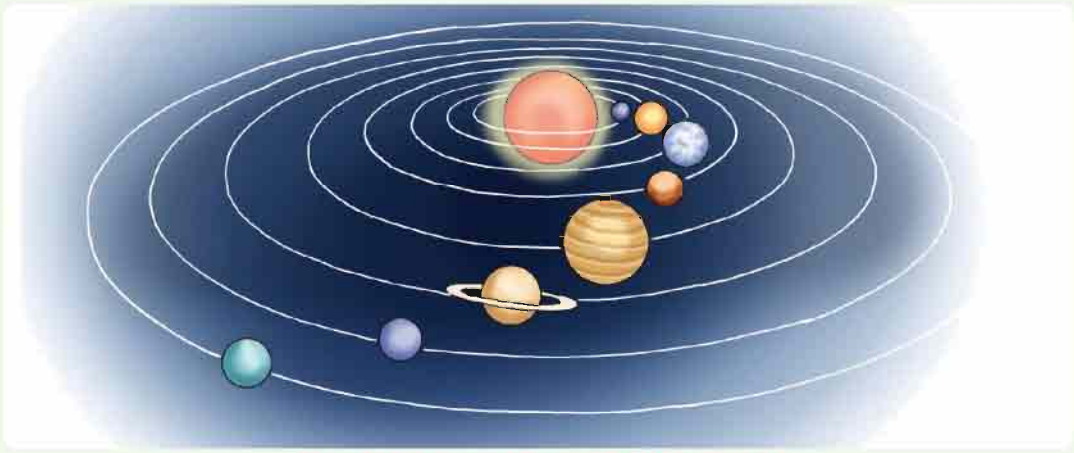


Fig 4.4 The rotation of the earth

The rotation of the earth causes day and night. The earth does not have its own light. It gets light from the Sun. As the Earth rotates, sunshine contacts also changes based on that location. This means that half of it faces *towards* the sun while the other half faces *away*. The half facing *away* from the sun is experiences night time. On the other hand, the half facing the sun experiences day time. The earth completes one rotation in about 24 hours. Therefore, one full day including one day and one night has about 24 hours.

Since the earth rotates, any part facing the sun will also rotate. It will rotate until it is no longer facing the sun, causing the sun to 'set' and for night-time to begin.

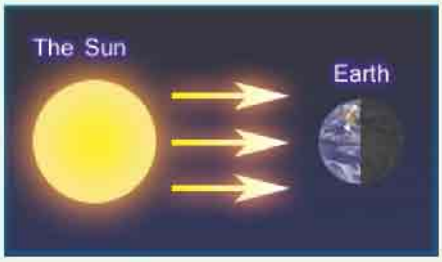


Fig 4.5: How day and night comes about

Rotation of the Earth also causes:

- Variation in time in the world.
- Rising and falling of ocean tides.
- Deflection of wind and ocean tides.
- Differences in speed of air and atmospheric pressure.

Remember!

When is night time in South Sudan, it is daytime in the U.S.A and other countries in the Southern hemisphere.

1. Draw the solar system and show the position of the Earth.
2. The ___ of the Earth on its own _____ causes ____ and _____.
3. The sun sets in the _____ and rises in the _____ directions.
4. Write true or false for each of the following questions.
   (a) The sun is a star _____.
   (b) Neptune is bigger than the Earth _____.
   (c) The sun orbits around the earth _____.

(d) Planet mars is not red in colour _____.

(e) Rising and falling of ocean tides is caused by rotation of the earth _____.

(f) Planet Uranus is famous of its beautiful rings around it.

4.3 Revolution of the earth

Work in groups

Materials: Clay, Sticks

What to do

1. Use clay to model the Earth and the Sun.
2. Put the Sun in the middle and draw a line round the sun using a stick to represent the Earths orbit.
3. Move the earth round the sun on the orbit.
   - What did you observe?
4. Discuss your observations with your group members.

Learning point

Revolution is the movement of the earth round the sun in its **orbit**. The Earth spins on its axis and at the same time, moves round the Sun in a fixed path. This fixed path is the orbit. The movement of the Earth round the sun is known as **revolution**. The earth completes one revolution round of the Sun in about 365 ¼ days.

Fig 4.6 Revolution of the earth

Revolution of earth causes **seasons**. This is caused by how far away the earth is from the sun and direction of the Earth. In one year, the earth goes through one cycle of the following seasons.

- Summer
- Winter
- Autumn
- Spring

Remember!

We do not experience all these seasons in South Sudan. We only experience summer and winter. Spring and autumn are experienced in other countries in the Southern and Southern hemispheres.

Difference in seasons at the polar and equatorial regions

The angle (tilt) of the earth's axis causes the difference in temperature between the equator and earth's polar regions. The **equator** receives direct light from the sun at all times of the year; the tilted axis prevents the (south and north) **poles** from receiving such prolonged exposure to

sunlight. The tilt causes variation of other effects, such as the extreme length of day and night at polar locations.

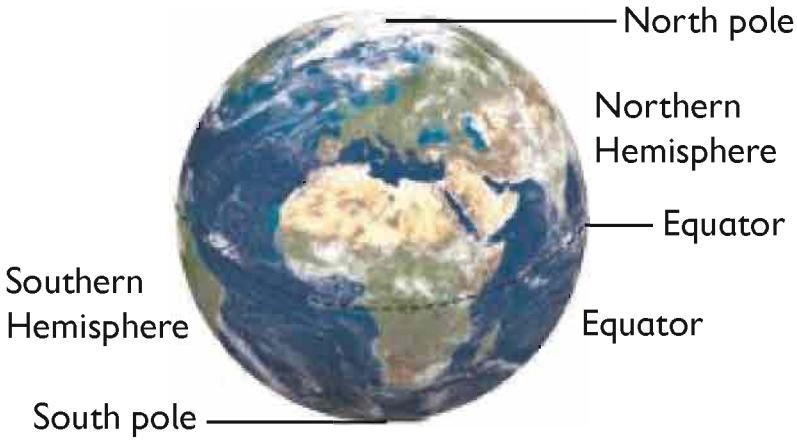


Fig 4.7: The earth

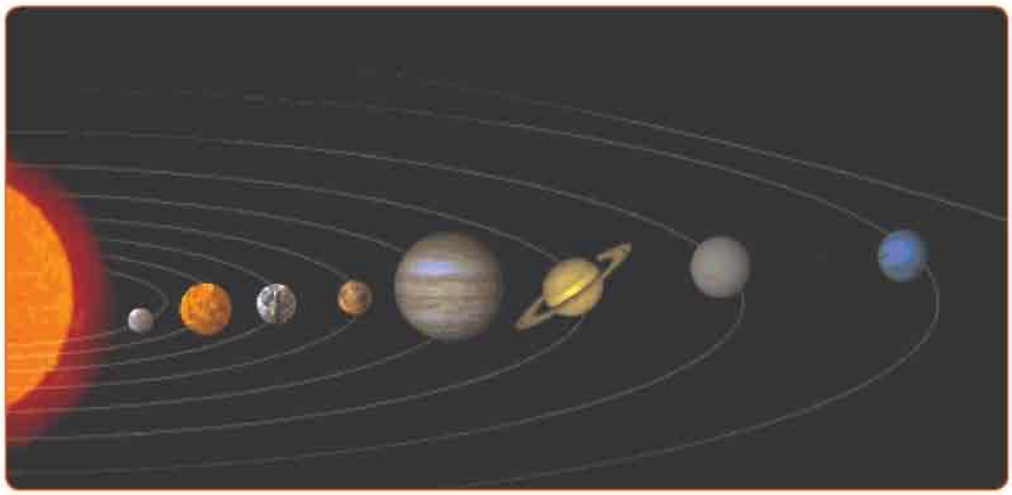
The earth is tilted 23.5° away from the Sun, and remains in this position throughout the year. The polar areas spend half of the year pointed away from the sun. The tilt on the earth means that when sunlight reaches the poles, its strength reduces hence the cooling effect.

On the other hand, **Equatorial areas** where South Sudan falls receive direct sunlight no matter what the Earth's position is relative to the sun. Consequently, the length of the day at the equator is almost exactly 12 hours all year long. Since there is little diffusion of sunlight at the equator, most equatorial regions effectively experience summer throughout the year.

Remember!

As the earth revolves around the sun, it also rotates on its own axis causing day and night.

1. Below are the planets in the solar system. Name the planets in order from the sun.



2. Differentiate between rotation and revolution of the earth.
3. Rotation of the earth causes _____while revolution of the earth causes_____.
4. Which two seasons do we experience in South Sudan?

Unit 5 Light, Heat and Sound

5.1 Light

Work in pairs

Materials

- A candle.
- A piece of a flexible plastic tube about 30 cm long. This can be obtained from a hose pipe.
- A matchstick.

What to do:

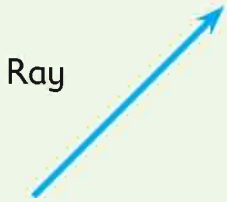
1. Light the candle and place it on a table.
2. Observe the candle using straight (unbent) tube as shown below.

   - Are you able to see light from the candle?
3. Now use a bend tube and once again try to observe the candle.

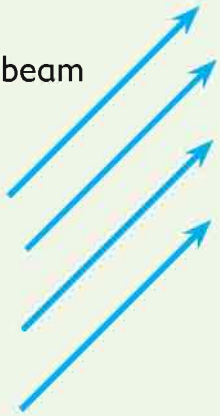
- Do you see light coming from the candle? What does this show you?

Learning point

Light is a form of energy. It is made up of rays. Many rays make a beam.



(a)



(b)

Fig 5.1 (a) Ray

Fig 5.1 (b) Beam of light

Light travels in a straight line and in all directions.

In the previous classes, you learnt about sources of light and uses of light.

Sources of light include the sun, fire, electricity and torch among others.

How light travels

Work in pairs

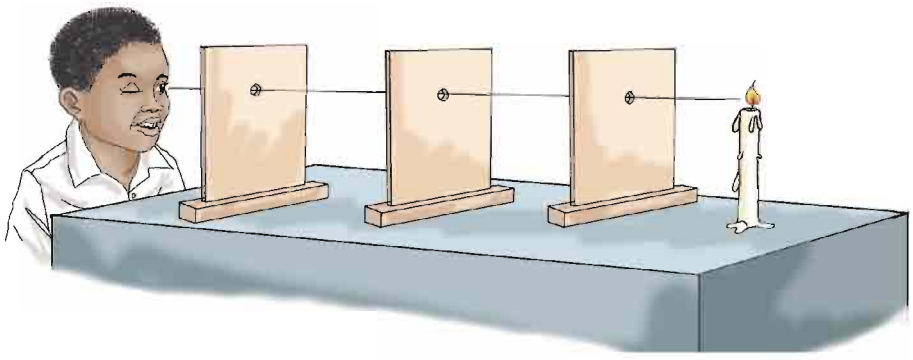
What you need

- Card board
- Candle or torch
- Match box
- Nail

Procedure

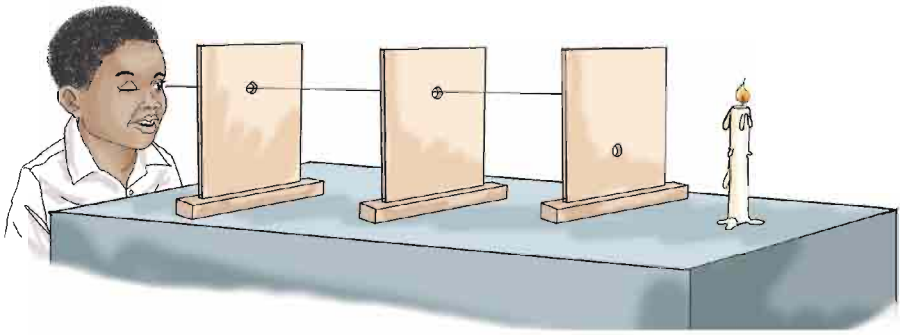
1. Make holes on a card board and arrange as shown in page 95.
2. In which set up did you see light passing through all holes?
3. In which set up did you not see light passing through?

4. What does that tell you about light?
5. We can demonstrate that light travels in a straight line by placing same-size cards with holes at their centres in a line and a source of straight light at one end as shown below. Try this out with a friend.



(a)

6. Displace one of the cards such that the holes are not in straight line as shown below. Observe the candle flame.



(b)

7. How can you design another experiment that shows light travels in a straight line?

Learning point

The light passes through the holes in a straight line and reaches the other end.

One looking through the holes of the cards will see light coming through.

1. Light travels in all directions

   When a lit lamp or bulb is placed in a room, light is received in all parts of the room. This shows that light travels in all directions.

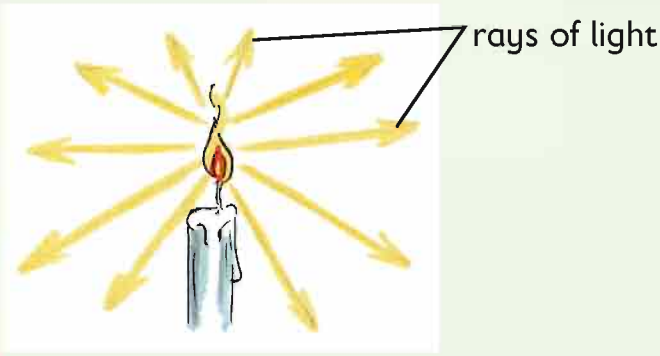


Fig. 5.2: Light rays traveling in all directions

2. Light travels in a straight line.

   Rays of light travel in a straight path from the source as shown by the lighted torch below.

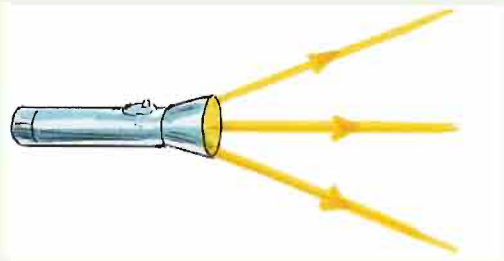


Fig. 5.3: Light travels in a straight line

However, when one of the holes is displaced, we cannot see the light. This shows that rays of light follow a straight path.

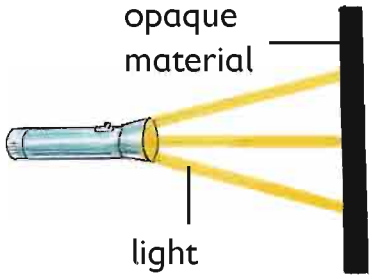
Some sources of light are specifically made to direct the light in a particular direction. For example the headlights of a vehicle and a torch.

Effects of different materials on light

(a) Opaque materials

Group work

1. Identify as many materials around you as possible. These may include a transparent glass, piece of wood, book wall among others.
2. Shine torch light on each material as shown below.



- What can you see?

Learning point

If light falls on materials such as stone, books, timber, cardboard and a sheet of metal, it does not pass through. All the light is "blocked" and a shadow is formed. Materials which do not allow light to pass through are said to be opaque. We cannot see through opaque materials.

(b) Transparent materials

If light falls on transparent materials such as clear glass, clean water or air, the light passes through them as shown below. A shadow is not formed as a result. Transparent materials allow light to pass through them.

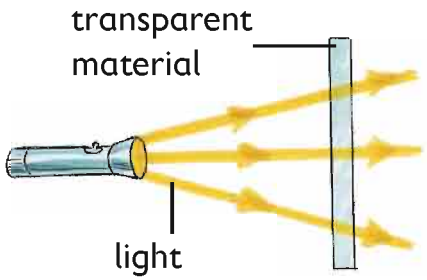


Fig. 5.4: Transparent material allows light to pass through

Most glass windows, drinking glasses and car windscreens are made of transparent materials. We are able to see through them very clearly.

(c) Translucent materials

Work in pairs

Materials

- Two white sheets of paper and clean oil or fat.

What to do

1. Look through the sheets of paper.
2. Smear the oil on one of the sheets of paper and look through.

   What happens?
3. Compare the two pieces of paper by placing each in turn over some writing. Through which two papers can you see the writing?

Learning point

You will notice that you are able to see the writing more clearly on the paper smeared with oil. Also, you are able to see through the paper smeared with fat slightly.

Translucent materials allow only some amount of light to pass through. A thin piece of white paper is a good example of a translucent material. Some light can pass through it but things placed behind it cannot be seen clearly.

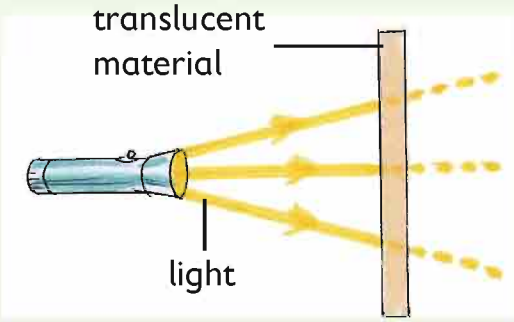


Fig. 5.5: Only part of light passes through a translucent material

Transparent roofing sheet and frosted glass are other examples of translucent materials. One cannot see through them clearly. Frosted glass is used in making toilet and bathroom window panes. When inside one cannot be clearly seen.

Fat or oil smeared on a paper makes it more translucent.

Work in pairs

1. Look around the classroom.
2. List the object that you can see.
3. Classify as many objects as you can find into the following groups.

Transparent materials	Translucent materials	Opaque materials

Reflection of light

Work individually

What you will need:

- A shiny surface such as a mirror, a wall with a shade on it.

What to do

1. Go outside at a time when the sun is not covered by clouds.
2. Hold the mirror towards the sun and reflect the sunlight on to the wall.
   - What do you notice?

You will notice that a patch of light forms on the wall.

Fig. 5.6 Reflecting light on to a wall

3. Now change the angle of the mirror. Does the light patch change its position?

Learning point

When light falls on the mirror the direction in which it will be reflected depends on the angle at which the light hits the mirror.

When light falls on a shiny surface, it bounces off. Bouncing of light from a shiny surface is called reflection. Shiny surfaces such as mirrors, polished floors, shiny metals and clear water surface reflect light very well. Bright surfaces reflect light better than dull surfaces.

When light falls on a shiny surface such as a mirror it is reflected as shown below.

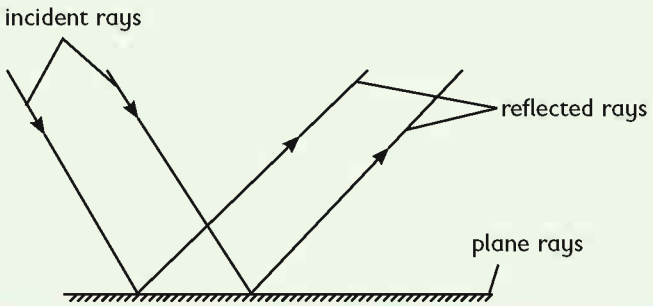


Fig. 5.7: Reflection of light on a smooth surface

Rays of light that fall on the reflecting surface are called incident rays. The rays which are reflected from a surface are called reflected rays.

When light is reflected from a smooth shiny surface such as a mirror the reflection is called regular reflection. Sometimes, a reflecting surface could be rough forming irregular or diffuse reflection.

Work in pairs

1. Play this game called "chase my patch" with a friend. Each of you will need a small mirror. Go outside a building and face the wall. Reflect the sun rays on the wall to get a "patch" of light. Your friend should use his or her mirror to make another patch to fall on top of your patch as shown below.

Fig. 5.8:

Fig. 5.9:

2. Now move your patch of light along the wall slowly. Ask your friend to move his or her patch to follow yours.
3. Place a mirror in such a way that it is facing the other side of the corner as shown in Fig. 5.9. Go and stand or sit down near the corner of the building. Can you see your friend round the corner from the mirror?
4. Design a similar game of chasing shadow using a different object. Which shapes are formed on the wall or on the ground? Write them down.
5. What do you think causes the patch to appear on the wall?

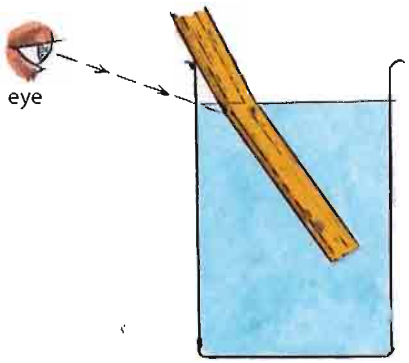
Further Activity

1. Place different objects such as a ball, stick, handkerchief or a container on a sunny day. Which type of shapes do the shadows of objects form. Record them in your notebook.
2. Practice playing a game of chasing your friends shadow. Change roles and repeat the activity again.

Refraction of light

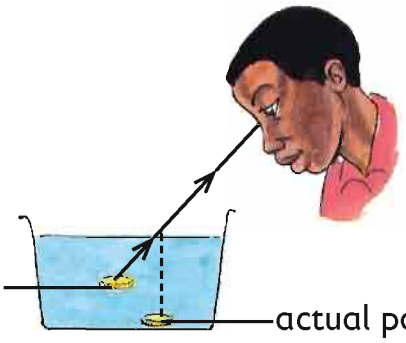
Work in groups

1. Dip a piece of stick into a glass of water then look at it at an angle as shown in the diagram below.



What can you see when you look at the stick through the water?

2. Place a coin at the bottom of a basin with water then observe it as shown below.



- What do you see?

Learning point

When halfway dipped in water the stick looks bent. This is because of refraction of light. The light from the part of pencil under water is bent or refracted as it leaves the water and travels to our eye.

A coin placed at the bottom of a container with water appears to be at shallower (raised) depth than its actual position in the container. This is because of refraction.

Refraction is the bending of light as it passes from one medium into another. For example, when light travels from air and enters into water, it is refracted.

While light is traveling in one material such as air, it does so in a straight line and only bends when it enters another different material. The bending occurs at the boundary between the two materials. Once inside the other material, it will again continue travelling in a straight line.

Forming a rainbow

A rainbow is formed when light is split up into its different colours.

Work individually

1. Spray water from your mouth as shown below on a sunny day.

2. What do you see?
3. Practice saying ROYGBIV. What do the letters stand for?

Learning point

A rainbow can be observed when one sprays water in the air from the mouth or from a hose pipe on a day when there is bright sunshine.

Similarly, we can create rainbow by:

- Observing a waterfall. Remember that in order to see these rainbows, the observer should face the spray with the back to the sun.
- When we look across and through a transparent ballpen casing which has corners (not the round type).
- On a floating oil film. If some oil is put on hard floor such as pavement or road and water poured on it, the oil spreads evenly and forms a thin layer of film. One can observe rainbow colours when sunlight falls on the layer of oil.
- We can also demonstrate formation of a rainbow using water in a container and a mirror.
- We see a rainbow when rain and sunshine are both present at the same time. For the rainbow to be seen, one has to face away from the sun with the rain falling in front. The tiny rain drops disperse (split up) light separating into its constituent colours of rainbow.

Fig. 5.10: Observing a rainbow during rainfall

The colours of the rainbow appear as shown in Fig 5.11.

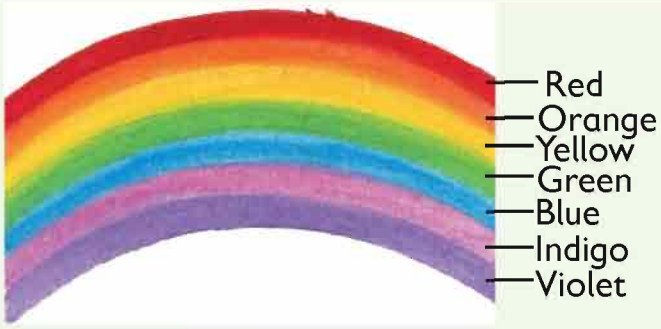


Fig. 5.11: Colours of the rainbow

ROYGBIV stands for the colours in the rainbow. It helps one identify the order of colours from the top to the bottom.

The red colour is on the outside and violet on the inner side. Sometimes we see two rainbows. The second one is faint and its colours reversed such that violet is on the outer side and red on the inner side. This second rainbow is a reflection of the original rainbow.

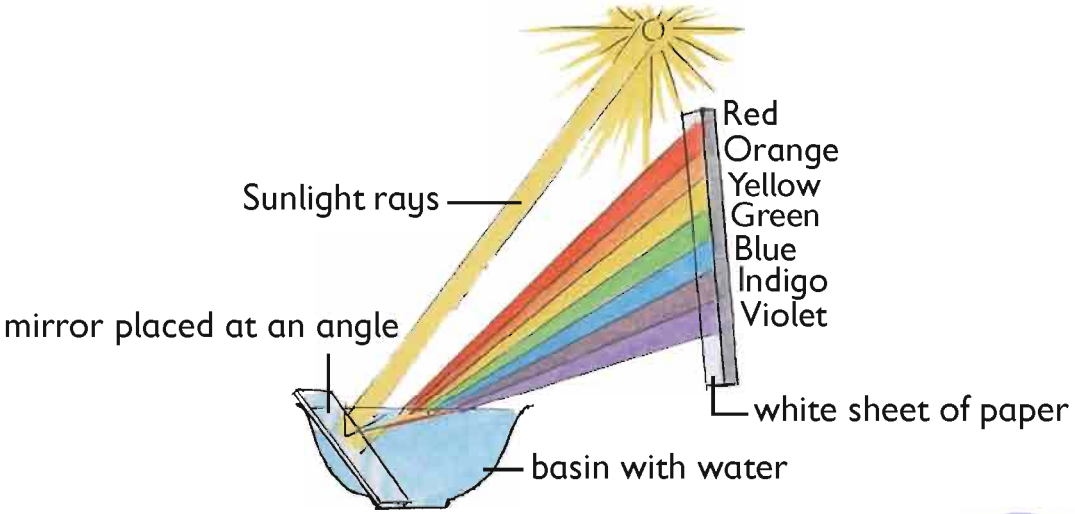
Work in groups

Materials

Basin with water and a mirror.

What to do

1. Fill the basin with water and then place the mirror inside the water at an angle facing the sun as shown in the diagram below.



2. Make your observations. When the basin is placed in the sunshine, a rainbow is produced and can be directed onto a screen such as a white wall or a large piece of paper by carefully adjusting the angle of the mirror facing the sun.

1. Which of the following best describes the way light from a source travels?

   A. It travels in only one direction.

   B. It travels in all directions.

   C. It travels back and forth.

   D. It travels round and round the source.

2. Mary was trying to view light from a candle through a bent tube during an experiment. She was not able to see the light. What does this experiment prove?

3. A material which cannot allow light to pass through it is called _____.

   A. transparent

   B. translucent

   C. opaque

   D. black

4. What would be the main problem if the air around us was opaque?

5. Which of the following would make the best mirror?

   A. Transparent material.

   B. An opaque shiny smooth surface.

   C. An opaque rough surface.

   D. A transparent rough surface.

6. _____ is the bending of light as it moves from one material into a different one.

7. _____ and _____ must be there at the same time for the rainbow to form.

8. Which of the following gives the correct order of the colours of the rainbow?

   A. Red, yellow, orange, green, indigo, blue and violet.

   B. Violet, red, orange, yellow, green, blue and indigo.

   C. Violet, indigo, blue, green, yellow, orange and red.

   D. Red, orange, green, yellow, blue, indigo and violet.

9. We are unable to see round corners because,

   A. light travels in a straight path.

   B. light can be reflected by mirrors.

   C. light bends as it travels from one material to another.

   D. light from a source travels in all directions.

5.2 Heat

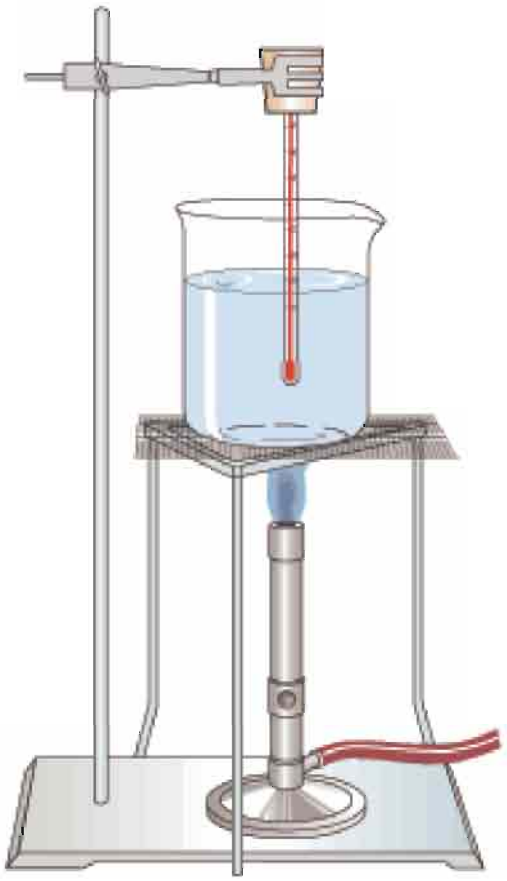
Work in groups,

Materials

- Thermometer
- Water
- Container
- Source of heat

What to do

1. Place some water in a container.
2. Heat the container gently.
3. Check the temperature reading with the thermometer after every 1 to 2 minutes and record.



- What did you find out?

Learning point

Heat is a form of energy that causes temperature to rise. **Temperature** is the degree of coldness or hotness of a body.

Heat leads to temperature rise that is measured using thermometer in **degrees celsius (^{0}c).**

Heat transfer

Heat moves from a hot place to a colder place the phenomenon is referred to as heat transfer.

Work in pairs

Requirements: a long rod and a source of heat.

1. Hold the long metal rod over a fire as shown.

- Do you feel any heat on your hand immediately?

2. Now hold it for a longer time.
   - Does the heat reach your hand?

Learning point

When you hold the end of a metallic object such as a metal rod over a fire, at first you do not feel any heat. Soon afterwards you get burnt and you have to let go off the rod.

How did the heat reach your hand from the fire? It must have travelled along the metal rod. The heat travelled from the hot end of the rod to the cooler end.

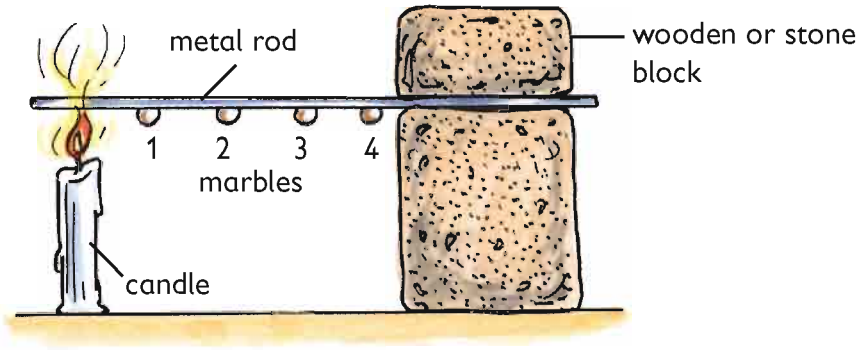
Heat travels through solids by conduction.

Work in pairs

Materials:

- Candle
- Metal rod
- Mables, stone or wooden block

1. Stick four glass marbles on a metal rod using melted candle wax as shown in the diagram below.



2. Support the rod between two heavy wooden or stone blocks.
3. Place a burning candle at one end and observe what happens to the marbles after sometime.

Learning point

You may have observed that after sometime, the wax on the marble nearest to the candle melts and the marble drops. Marble 2 drops followed by the third and lastly marble 4 at the farthest end. This shows heat conduction.

Good and poor conductors of heat

Work in groups

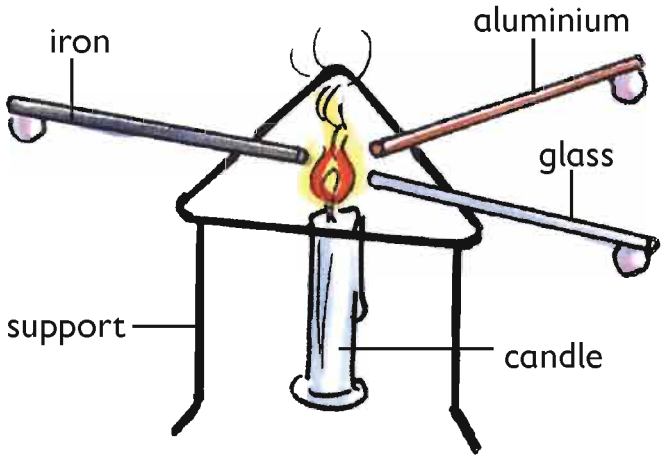
Materials

A candle, support and rods or strips made of different solids such as iron, aluminium and glass. Your teacher will help you to collect these materials.

The rods should be of the same thickness and length.

What to do

1. Stick a marble at the end of each rod using melted candle wax.
2. Set the three rods as shown in the picture below.
3. Balance them on the support. Observe what happens to the marbles after sometime.



- Which marble dropped off first?
- Which one dropped off last?

Learning point

Materials which allow heat to pass through them are called conductors. All metals are good conductors of heat. However, their degree of conductivity differs as shown above. On the other hand, materials which do not allow heat to pass through them are poor conductors. Most non-metals are poor conductors of heat. Poor conductors are also known as insulators.

Table 5.1: Good and poor conductors of heat

Good conductors of heat	Poor conductors of heat
Iron nail	Wood
Aluminium	Glass
Silver	Plastic
Steel spoon	Rubber
Office pin	Cloth
Wire	Biro casing
Copper	Thread

Uses of good and poor conductors of heat

Research Activity

Individual work

Find out how we use good and poor conductors in our lives. Write a report then share with other members of your class.

Learning point

Our cooking pans are made of materials, such as aluminium, which are good conductors of heat. Aluminium allows heat to pass from the fire to the food being cooked inside of it. The handles of such cooking pans or pots are made of poor-conducting materials such as hardened plastic or wood. These do not allow heat to pass from the cooking pan to our hands when handling the pan.

Sometimes we use a piece of cloth to pick a hot object. This is done to prevent our hands from being burnt.

Figure 5.12: A cooking pan with wooden handle

When poor conductors are used to keep off heat, we refer to them as heat insulators. Clothes meant to keep us warm during cold seasons such as jackets, socks and cardigans, are made of poor conducting materials. Blankets are also made of poor conducting materials to insulate us from the cold.

Work in groups

Materials

- Containers made of different materials e.g. wooden, metallic, glass, plastic
- Hot water

- Thermometer
- Watch/ clock

What to do

1. Place containers made of different materials on the table.
2. Pour hot water at the same time and measure the temperature using thermometer and record.
3. Measure the temperature after every 1 minute and record in a table like the one shown below.

Container	Temperature at the beginning	1 minute	2 minute	3 minute	4 minute	5 minute
Metallic						
Wooden						
Glass						
Plastic						

4. Answer these questions

(a) What conclusion do you make from your recordings above?

(b) In which container was heat loss the greatest?

(c) Which containers heat lost was the least?

5. Explain your results.

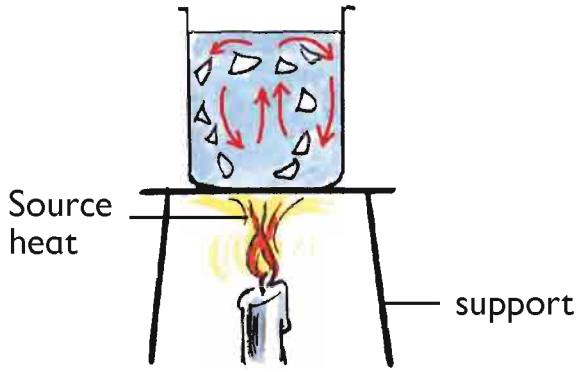
Note: Matter (solids, liquids and gases) expands when heated and contracts when cooled.

1. Complete the table below.

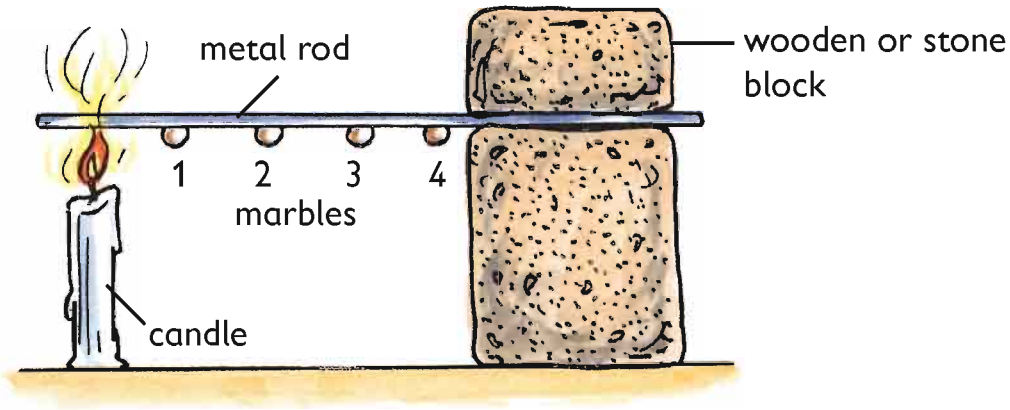
Good conductors of heat	**Poor conductors of heat**
1.	1.
2.	2.

3.	3.
4.	4.
5.	5.
6.	6.

2. Among the materials: iron, hardened plastic, glass, air and stone,
   (a) Which is the best conductor of heat?
   (b) In which material is heat best transferred by convection?
   (c) Which one is the best for making the handle of a cooking pan?
3. Why are cooking pans usually fitted with hardened plastic handles?
4. Which of the three methods of heat transfer does not need any material for the heat to travel through?
5. Which form of heat transfer is shown below? _____.



6. Below is a diagram that was used to investigate the transfer of heat.



Which marble was the last to drop?

5.3 Sound

Work in groups

Materials

- Drum
- Small seeds such as rice grains or sand
- A stick

What to do

1. Place rice grains on a drum.
2. Hit the drum with a stick gently.
3. Now hit the drum hard.
   - What did you notice?

Learning point

Sound is a form of energy produced when objects vibrate. The rice grains jump up and down when you hit the drum. This is due to vibration of drum skin giving out sound. Bigger vibrations produce loud sound while smaller vibrations produce soft sound. Loudness or softness of sound is known as **volume** while highness or lowness of sound is known as **pitch.**

How sound travels through different materials

(a) Solids

Work in groups

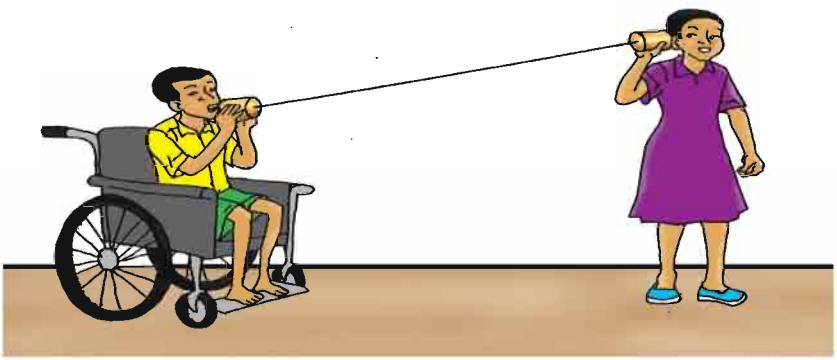
Materials

- String

- Empty tin containers
- Nails
- Hammer

What to do

1. Place your ear on the other end of the desk as your friend hits the other end.
    - Did you hear anything?
2. Make holes in the two tins using a nail and hammer.
3. Pass the string through the hole in both tins and make a knot.
4. Place the tin in your ear as your friend places the other end in the mouth and produces sound as shown below.
5. Let your friend speak to you.



- Did you hear sound produced by your friend?
- What do you conclude from the two activities?

(b) Liquids

Activity 5.19

Work in groups

Materials

- Basin

- Water

What to do

1. Place water in a basin.
2. Place your ear in water on one end as your friend taps the other end of the water as shown below.
    - Did you hear sound produced by your friend?
    - What do you conclude from the activity?

(c) Air

Further Activity

Stand at a distance of about 50 metres from your friend and let your friend produce sound as shown below.

- Did you hear sound produced by your friend?
- What do you conclude from the activity?

Compare the sounds produced in solids, liquids and air. In which case was the sound loudest?

What does this tell you about how sound travels in different media?

Learning point

Sound travels fifteen to twenty times faster in solids than in air.

Sound travels in liquid about five times faster than in air.

Sound needs a medium in order to travel. Therefore, sound does not travel in a vacuum. A reflected sound is called an echo.

Did you know?

Bats use echo to move in darkness.

Sailors use echo to measure the depth of the sea.

Sound insulation

Group discussion

Have a class discussion on the importance of insulating sound. Write a report and present to the rest of the class.

Learning point

Sound is insulated in a room or building to prevent spreading it to others who do not need it. People in hospitals, learning institutions and court buildings among others prefer silence to noise. Therefore, any place near such buildings that produces noise should be insulated to prevents or minimize disturbance.

It is important to avoid confusion between **sound absorption** and **sound insulation**.

- Sound absorption is the prevention of reflection of sound or a reduction in the sound energy reflected by the surfaces (walls, floor and roof) of a room.
- Sound insulation is the prevention of transmission of sound, a reduction of sound energy transmitted into a nearby air space.

1. Sound is a form of _____. All sounds are produced when objects _____. Loudness or softness of sound is referred to as _____.
2. If you place a wrist watch on a bare wooden table and press your ear to the other end, you will hear the ticking of the watch. This shows that _____? Bats are able to find their way in darkness due to _____.
3. Which animals are likely to be disturbed by noise? _____.
4. Which places require silence? Why?