General Science

Grade VI

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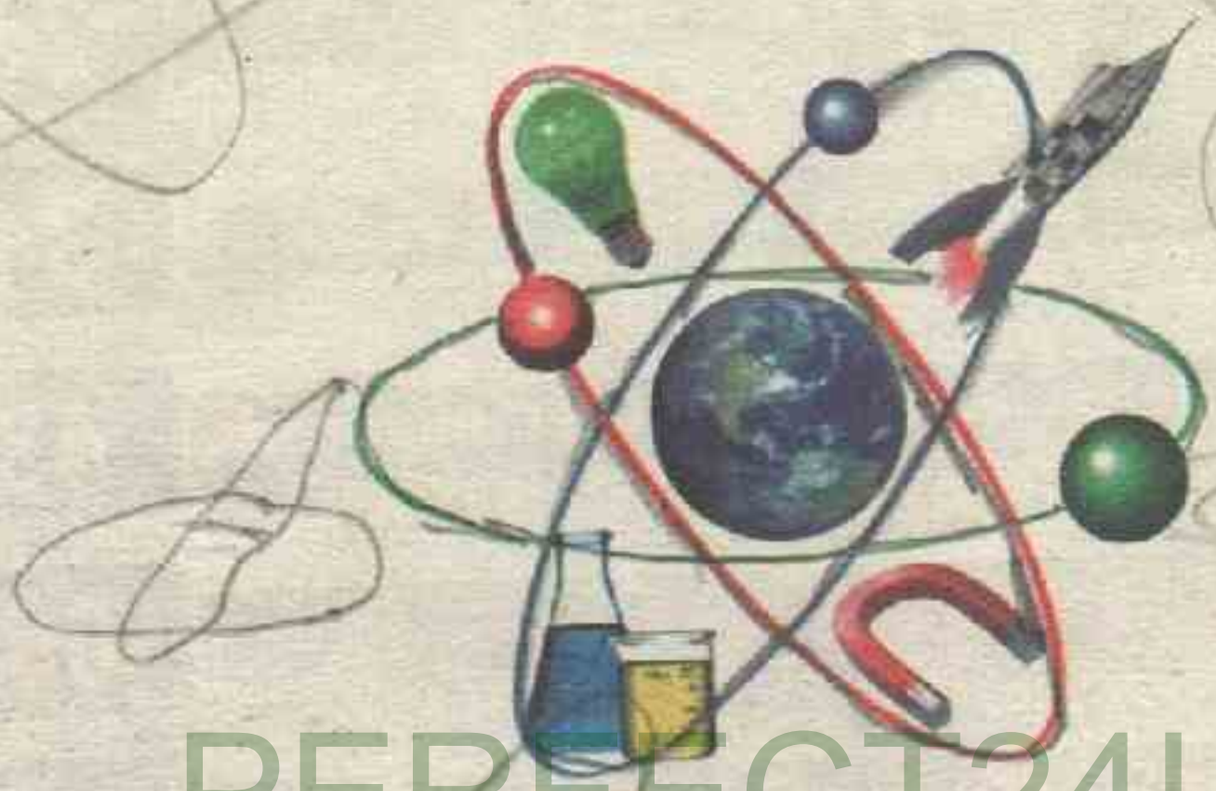
General Science

Grade VI



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CONTENTS

Unit 1

Cellular Organization of Plants and Animals

After studying this unit the students will be able to:

- Define a cell.
- Describe the different parts of a light microscope and its working.
- Identify different kinds of cells using a microscope.
- Draw, label and describe the basic structure of an animal cell and a plant cell.
- Compare and contrast an animal cell with a plant cell.
- State the function of each part of the cell to indicate how the cell supports life.
- Differentiate between unicellular and multi-cellular organisms.
- Distinguish between tissues and organs.
- Recognize root and shoot systems in plants.
- State the functions of the major systems of the human body.
- Describe the cellular hierarchy from cell to organ systems in animals and plants.

Introduction

In previous grades, you have learnt about characteristics and needs of living things. You have also learnt about the classification of living things (plants and animals). In this unit, you will learn about cellular organization of living things. Living things may consist of one or many cells. The organisms composed of a single cell are called unicellular while the organisms composed of more than one cell are called multicellular.

Microscope

"Micro" means small and "scope" means to see. Microscope is an instrument which helps us to see those things that we cannot see with our naked eyes, for example, micro-organisms. Microscope may be simple or compound. A microscope in which light is used to see the things, is called a light microscope. The parts of a light microscope and their functions are shown in the figure 1.1.

Figure 1.1 Parts and functions of Microscope

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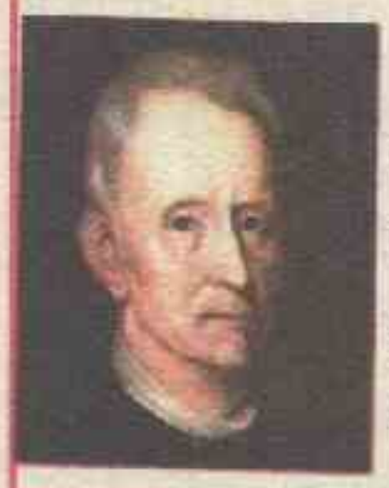
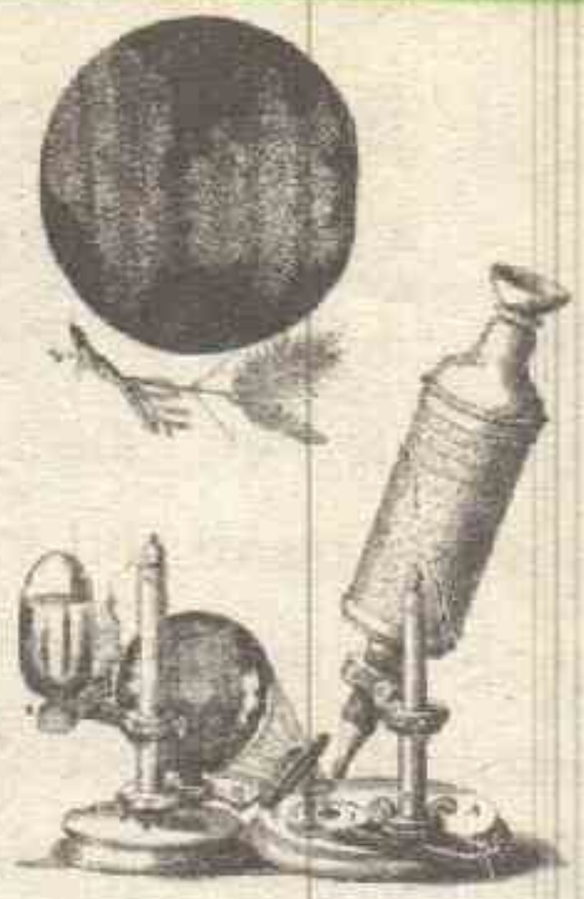


Robert Hooke, more than 300 years ago, used a microscope to see thin slices of cork. He found that the cork was made up of tiny boxes which he called "cell".



Working of a microscope

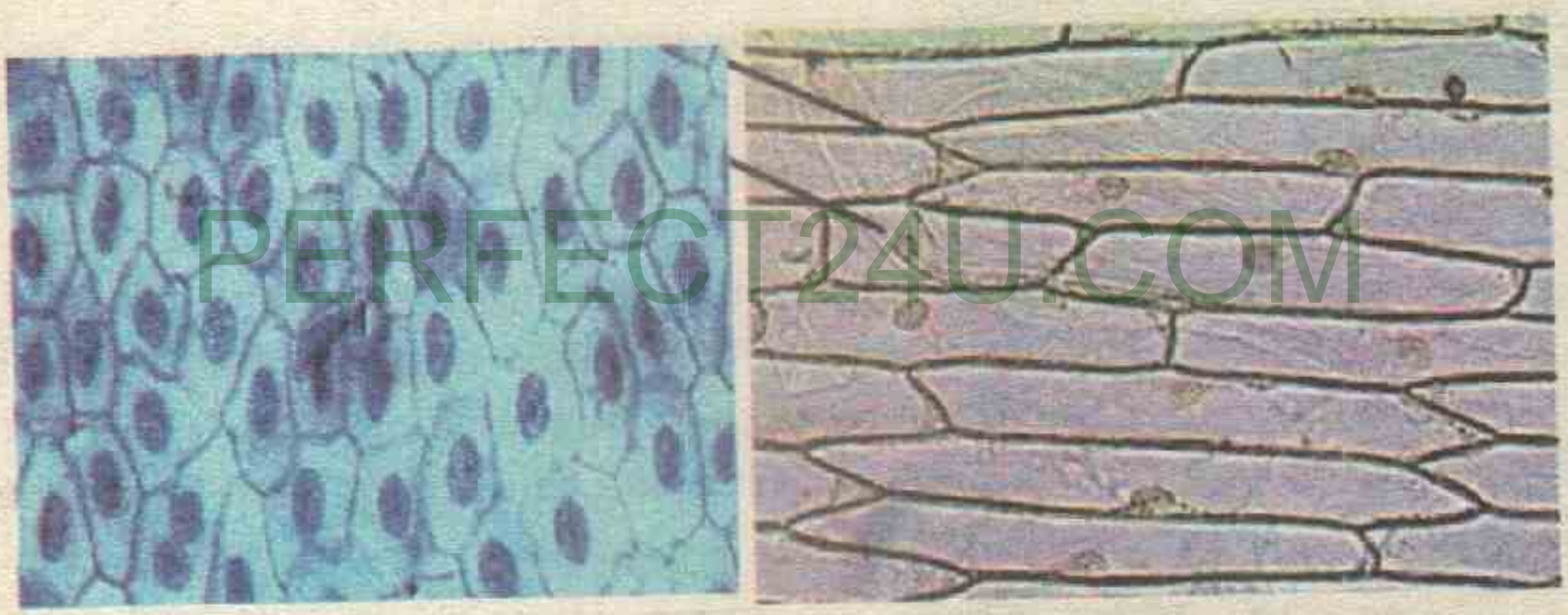
Following steps are taken while using a microscope:

1. Place the microscope carefully on a table.
2. Turn the coarse adjustment knob to raise the body.
3. Turn the nose piece until the objective lens comes into place.
4. Adjust the diaphragm and the mirror, until you see a bright white circle of light.
5. Place a slide on the stage. Use the stage clips to hold the slide in place.
6. Carefully turn the coarse adjustment knob to lower the body tube.
7. While looking through the eyepiece, adjust the coarse adjustment knob slowly until the specimen on the slide comes into focus.
8. Look through the eyepiece. Turn the fine adjustment knob to see the specimen more clearly.

Fig: 1.2 Using Microscope

Cell: The building block of life

A wall is made up of bricks. Its building block or structural unit is a brick. Likewise, all living things (plants and animals) are made up of small structural units, called the cells. Walls are built up of bricks joined together, similarly, plants and animals are built up of cells joined together. Every part of a living thing has different types of cells and perform different functions. Since, all the functions in living things are performed within the cells, therefore, the cell is considered as the structural and functional unit of all living things. Figure 1.3 shows the cells of a thin membrane of an onion and cells of a frog's skin.



Frog upper skin cells

Onion inner membrane cells

Fig: 1.3: Cells

Do you know?

The largest cell is the egg of an Ostrich.

Activity 1.1

Observe under the microscope a section of thin membrane of onion and draw the diagram of the cells you observe.

Animal and Plant cell

Although different cells are of different shape, size and structure but they have the same common basic structure. The general structure of an animal and a plant cell is given below.

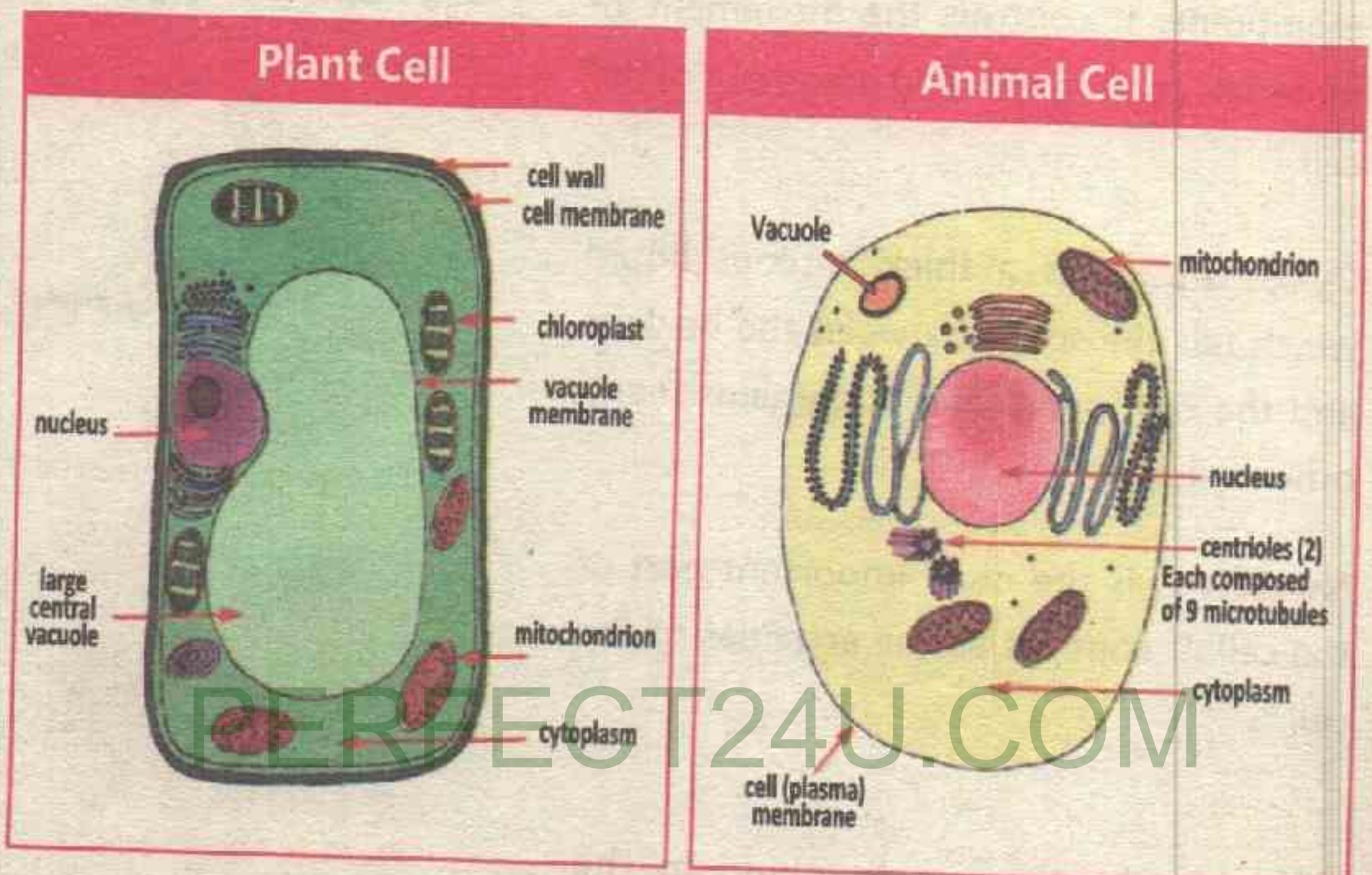


Fig 1.4: Structure of a Plant and Animal Cell

Activity 1.2

A. Look at the diagrams carefully and write down the parts of animal and plant cells, separately in two columns.
b. Observe the two diagrams and identify similarities and differences in the structure and shape of the two kinds of cells.

Important parts of a cell

Cell Wall

The outer most covering in a plant cell is called the cell wall. It is hard and protects the plant cell. Animal cells do not have cell wall.

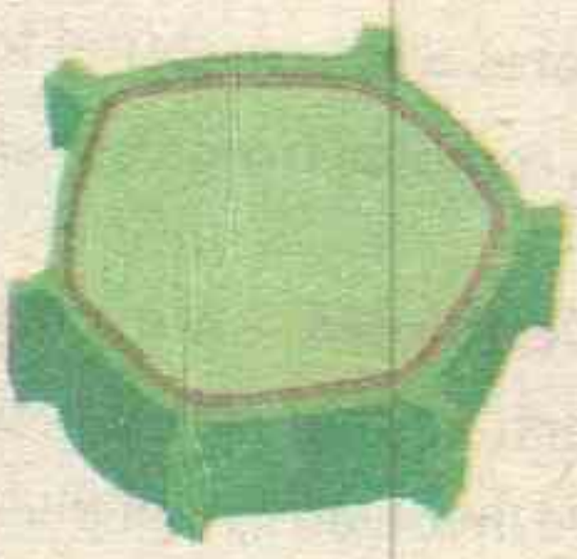


Fig1.5: Cell Wall

Cell membrane is present under the cell wall in plants but in animal cells it is the outer most covering. It is a living membrane. It controls the movement of materials coming into and going out of the cell.

Fig. 1.6: Cell membrane

Cytoplasm is a thick, viscous liquid which fills the space between the nucleus and the cell membrane. It contains many other cell parts.

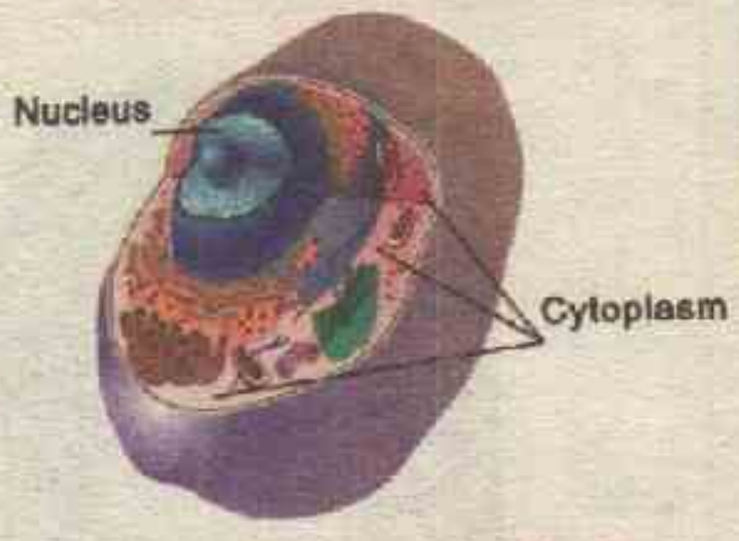


Fig. 1.7: Cytoplasm & Nucleus

Nucleus is the most important part of the cell. It controls all the activities of the cell.

Fig. 1.8: Mitochondria

Mitochondria are involved in the production of energy and are called the power house of the cell.

Fig. 1.9: Vacuole

Vacuole is a sac like structure which stores waste material for some time before its removal from the cell.

Fig. 1.10: Centriole

Centrioles are present in animal cells. Each animal cell has two centrioles which are involved in cell division.

Chloroplast is present in plant cells. Chloroplast contains green pigment called chlorophyll. The chlorophyll helps plants to prepare their own food by photosynthesis.

Fig. 1.11: Chloroplast

Science Tidbit

A unique property of all living cells is cell division. A parent cell divides into two cells. These cells grow to the size of their parent cell and again divide. In this way many cells are produced. Some cells divide slowly while others divide rapidly. A bacterial cell divides after every 20 minutes.

Unicellular and Multicellular organisms

Our body is composed of trillions of cells. Most animals and plants are made up of large number of cells. All animals and plants that you see around, are called multicellular organisms.

On the other hand the organisms which are made up of a single cell, are called unicellular organisms. You cannot see them without a microscope. Some examples of unicellular organisms are amoeba, paramecium, euglena and chlamydomonas.

Euglena is a small organism. It swims in water with the help of its flagellum.
Chlamydomonas is a small, pear shaped, green coloured plant. It swims with the help of two flagella. Amoeba is a small animal. It is found in water. It has no permanent shape.

Can You Name

Some multicellular organisms?

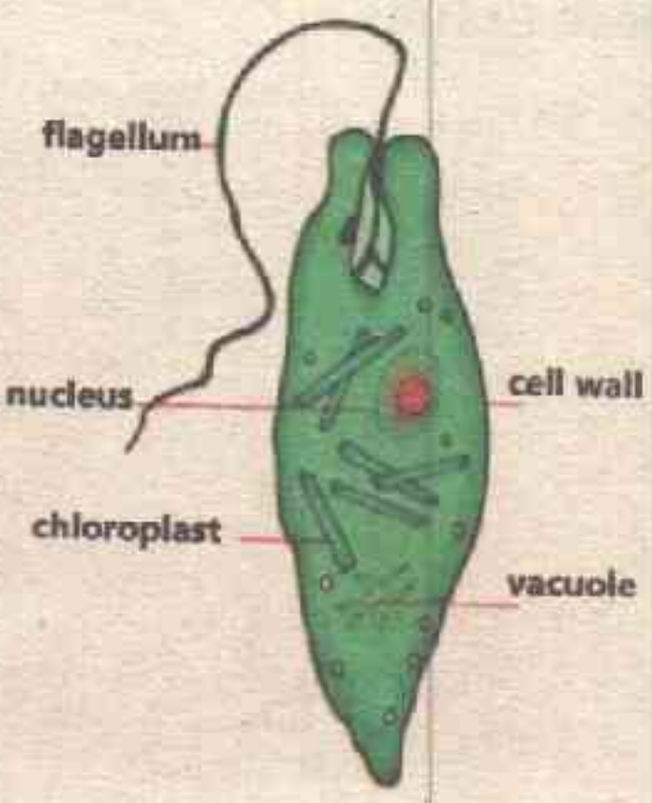
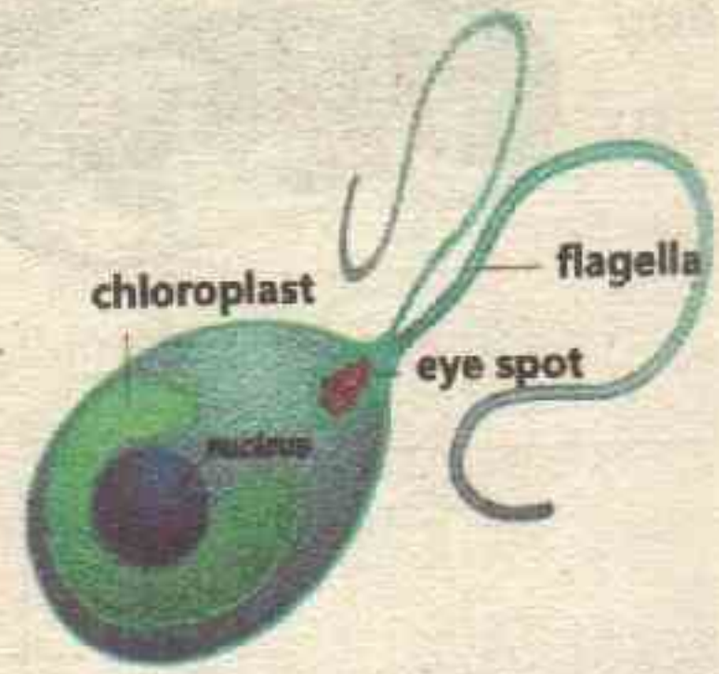
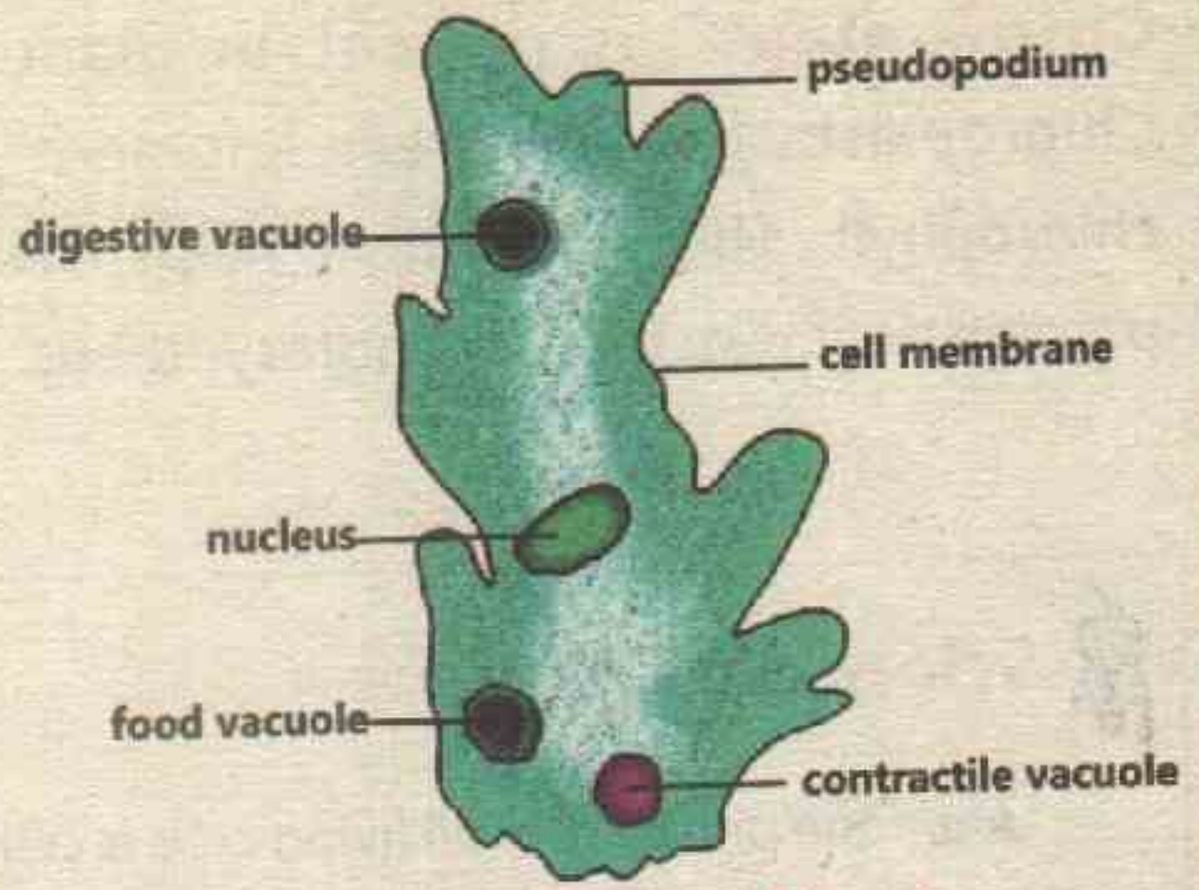


Fig. 1.12: Euglena



b. Structure of Chlamydomonas



c. Structure of Amoeba

Fig 1.13 : Unicellular Organisms

Activity 1.3

Make a model of a plant cell or an animal cell using art and craft materials, recycled materials. Label the basic cell parts.

Organism: From Cell to System

In unicellular organisms all the functions and the processes of life are performed by a single cell. In multi-cellular organisms different cells perform these functions. The cells which perform the same function, group together to make a tissue. Our muscles and blood are examples of these tissues.

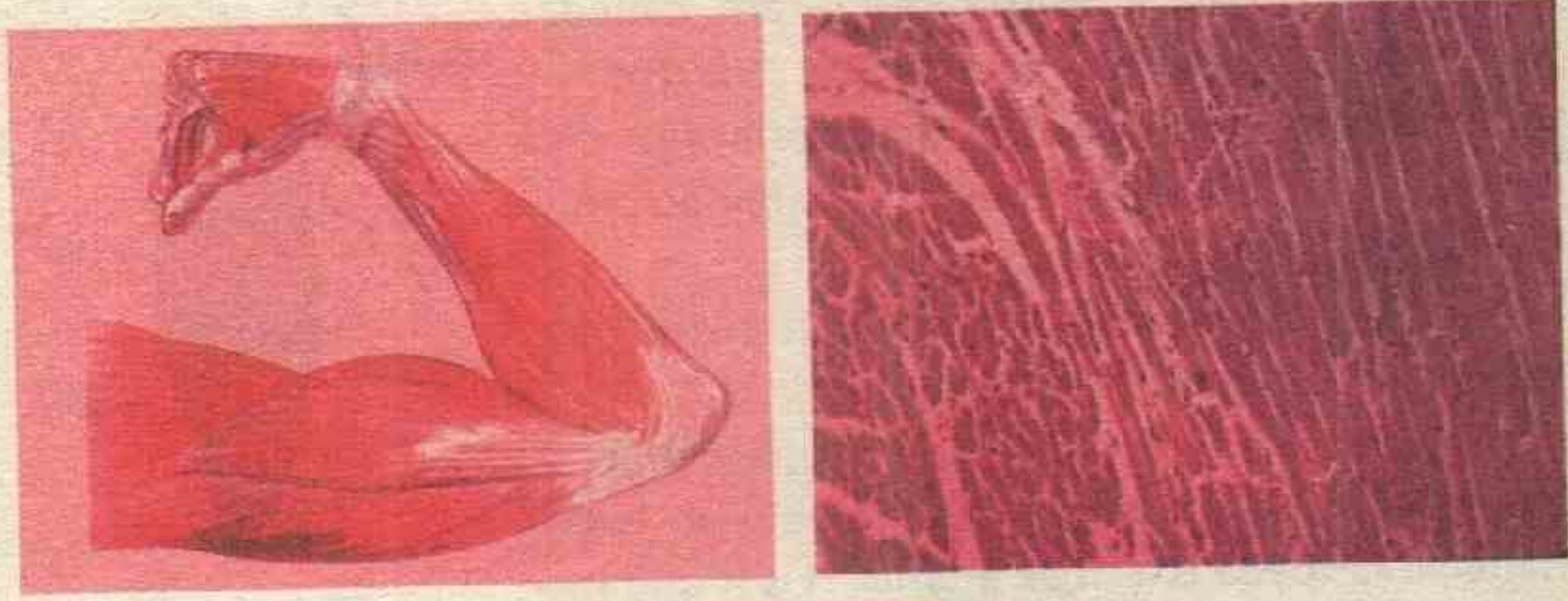


Fig 1.14: Human muscles and muscle tissues

In plants, the cells which perform photosynthesis group together to make the mesophyll tissues. In the stems and branches there are long tube-like cells which combine to make conducting tissues for transportation of water and mineral salts.

Different tissues work together to make an organ. For example our lungs, heart, eye, liver and stomach. These organs are made up of many types of tissues.

Similarly the roots, leaves, flowers and stems are the different organs of plants. Many organs work together to make a system.

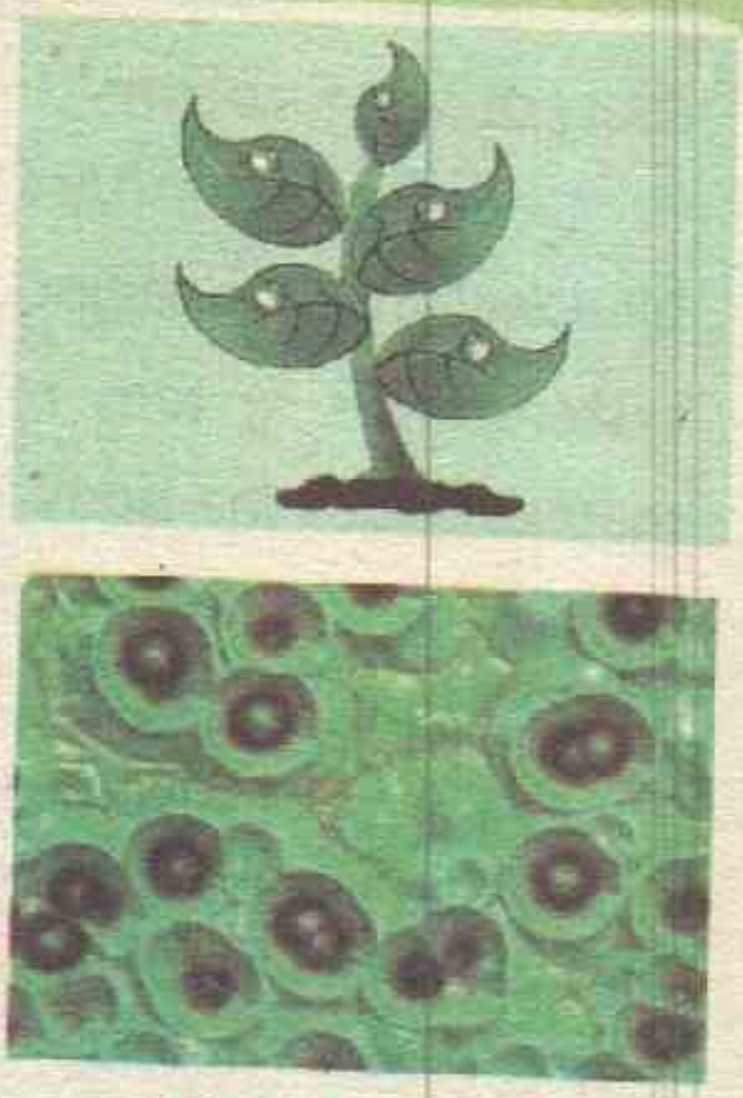
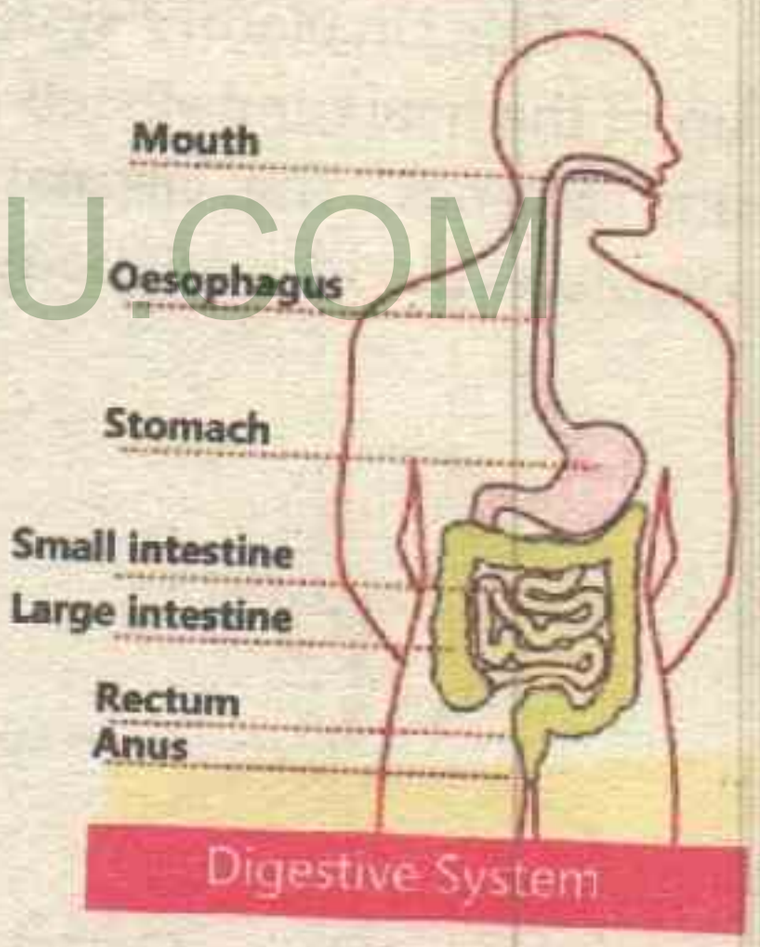


Fig 1.15 Plant and Plant tissues

Major Systems in Human Beings

Digestive System

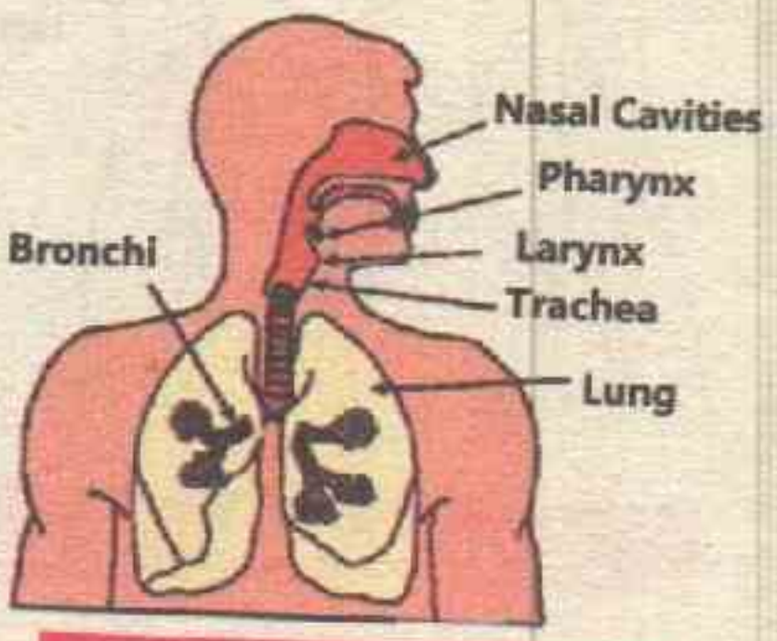
This system contains mouth, stomach, intestines, rectum and anus. They work together for the digestion of food.



Digestive System

Respiratory System

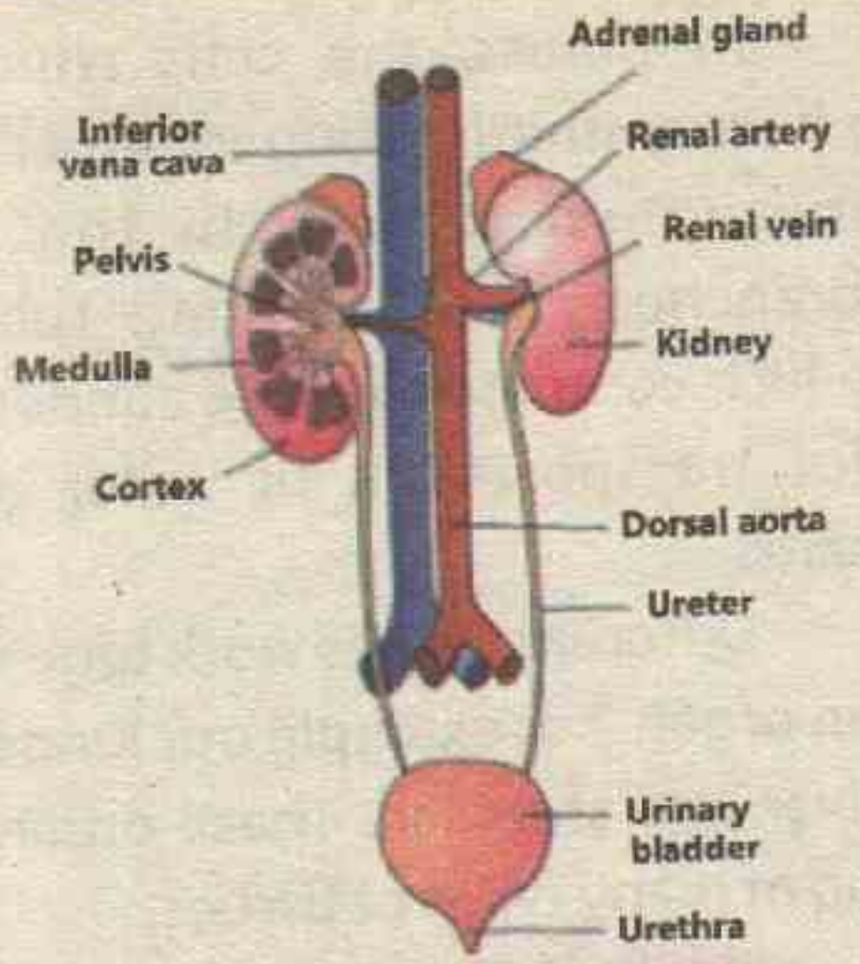
It is composed of nasal cavities, pharynx, larynx, trachea, bronchi and lungs as shown in the figure. This system helps in the production of energy from the food.



Respiratory System

Excretory System

Kidneys, ureters and urinary bladder are the major parts of this system. This system removes waste material from the body in the form of urine.



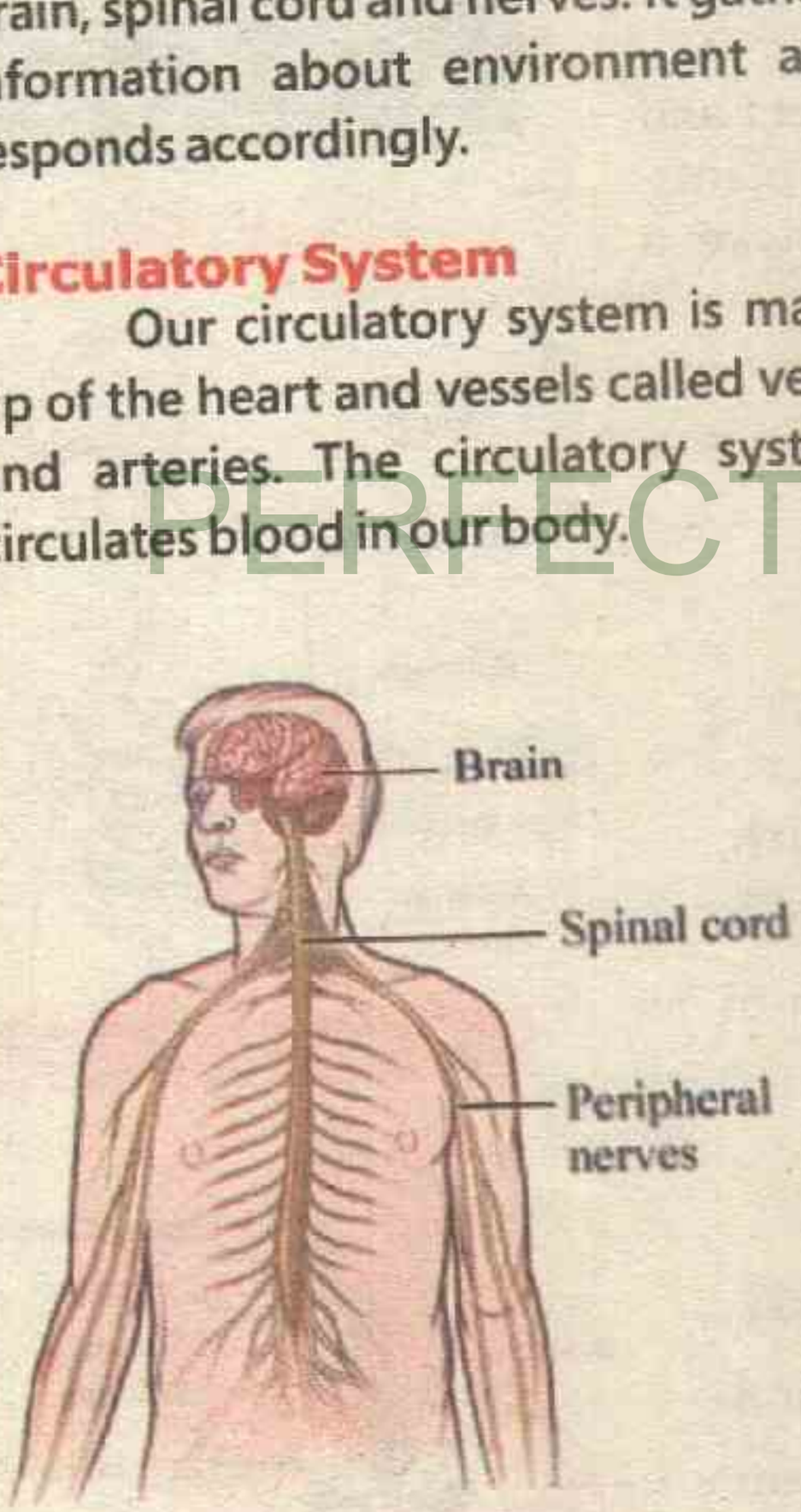
Excretory System

Nervous System

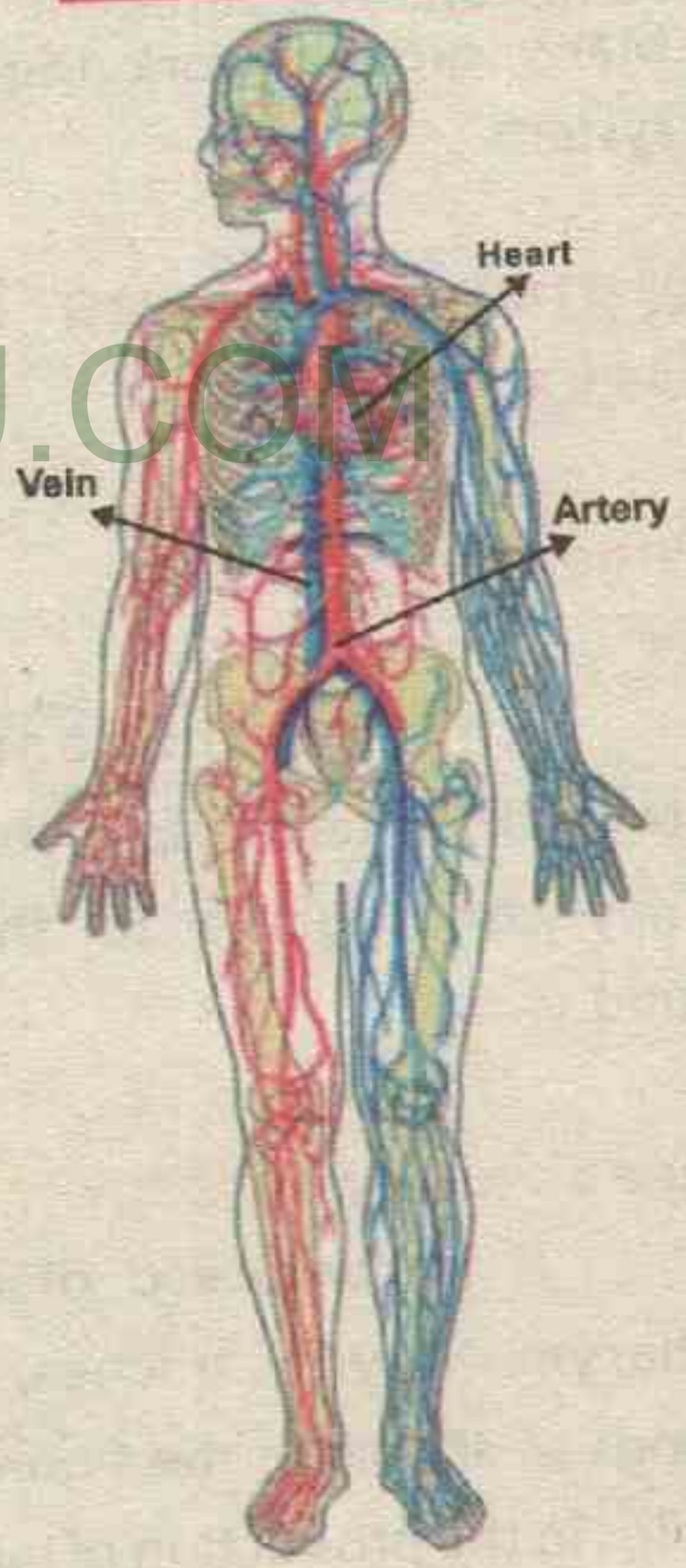
Nervous system is made up of brain, spinal cord and nerves. It gathers information about environment and responds accordingly.

Circulatory System

Our circulatory system is made up of the heart and vessels called veins and arteries. The circulatory system circulates blood in our body.



Nervous System



Circulatory System

Fig 1.16: Human Systems

Plant Systems:

A typical plant has two main systems i.e. root and shoot system.

Root System:

The root system lies under the ground which consists of a main root and its branches.

Shoot System:

It generally lies above the ground which consists of stem, branches, leaves, flowers and fruits.

? Can You Tell

What are the functions of the shoot system and the root system in a plant?

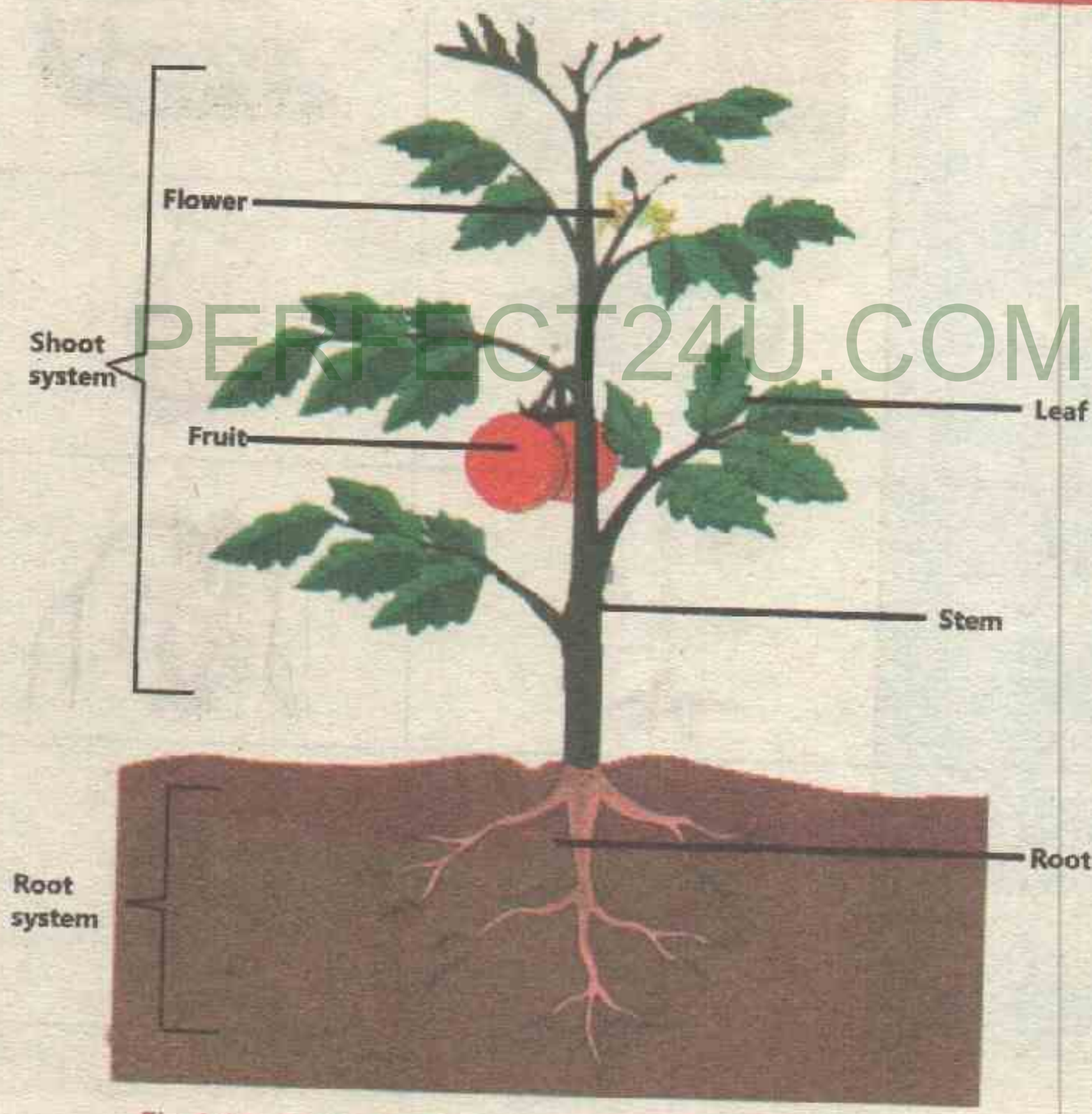
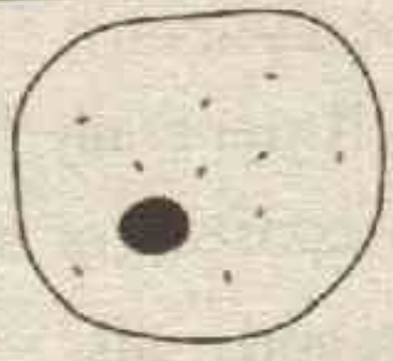
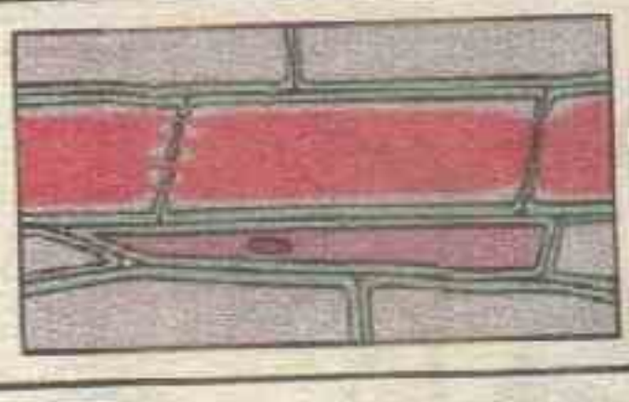
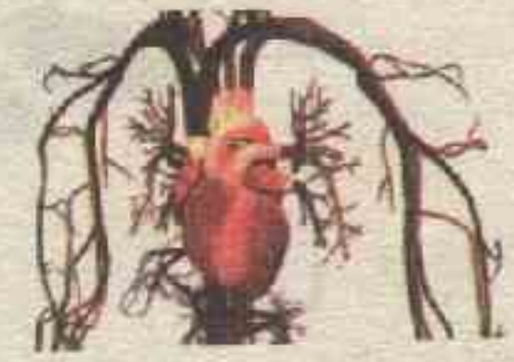


Fig 1.17: Plant showing Shoot system and Root System

Organization of Multicellular Organisms

Cell → tissue → Organ → Organ System → Organism

Cell		
Tissue		
Organ		
System		
Organism		

KEY POINTS

- Microscope is an instrument used to observe things which are not visible to the naked eye.
- A cell is the basic unit of structure and function of living organisms.
- Each cell has a specific function.
- Animal and plant cells have some common structures, like cell membrane, cytoplasm, mitochondria, vacuole, and nucleus.
- Plant cells have a cell wall, chloroplasts and a large vacuole.
- The body of unicellular organisms is composed of one cell and the body of multicellular organisms is made up of more than one cell.
- Cells work together to make a tissue, many tissues work together to make an organ.
- Many organs combine and work together to make a system.
- Many systems combine to make an organism.

EXERCISE

A. Fill in the blanks.

1. A cell is the _____ and functional unit of living organisms.
2. Centriole is present in _____ cell.
3. Cell membrane is the outer most covering in _____ cells.
4. Euglena is a _____ organism.
5. Plants prepare food in their _____.

B. Choose the correct answer.

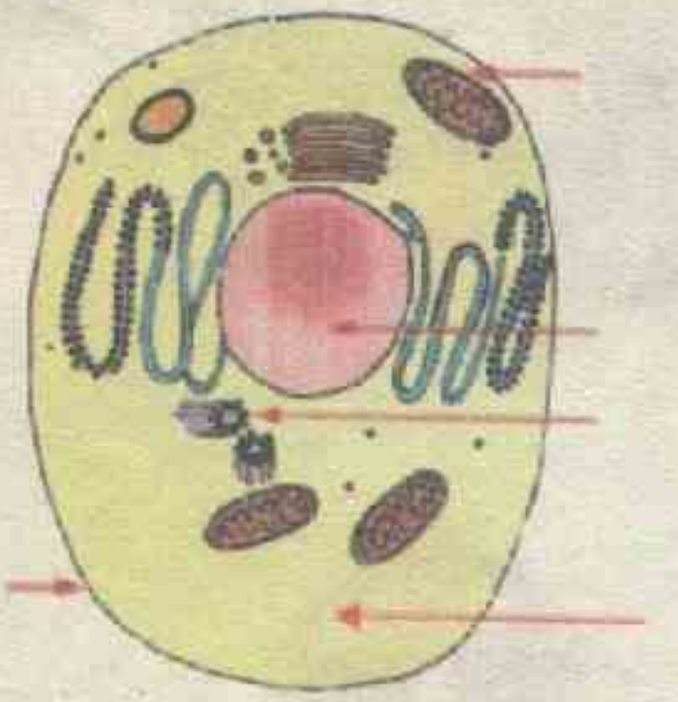
1. Muscle is a type of_____.
   a. cell b. tissue c. organ d. system
2. A branch on a stem is a part of _____ system.
   a. root b. branch c. shoot d. conducting
3. Which system of your body is responsible for the transport of digested food?
   a. digestive system b. circulatory system
   c. respiratory system d. skeletal system
4. Brain controls the body just like the _____ controls activities of a cell.
   a. mitochondria b. cytoplasm
   c. nucleus d. ribosomes
5. Which instrument can help to see amoeba clearly.
   a. hand lens b. microscope
   c. telescope d. both b and c

C. Match column A with Column B.

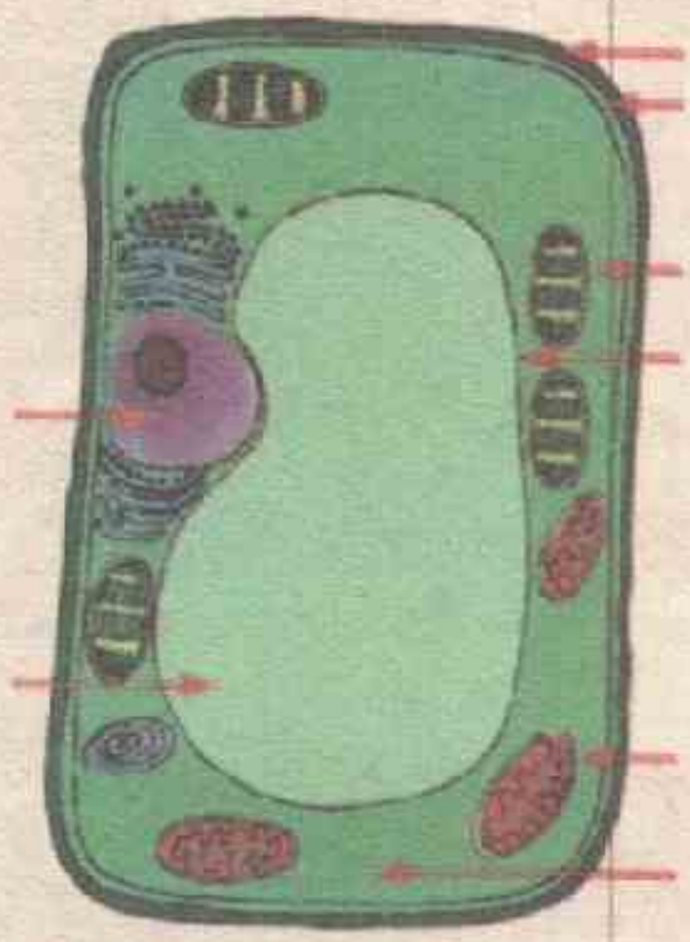
Column A	Column B
Vacuole	help in food preparation
Mitochondria	outer layer of plant cell
Nucleus	store waste material of cells
Chloroplast	control cell activities
Cell wall	power house of the cell

D. Label the following diagrams.

Animal Cell



Plant Cell



E. Answer the following questions.

1. What will happen to a person whose respiratory system is not working properly?

2. Describe basic organization of a multicellular organism.
3. Differentiate between an animal and a plant cell.
4. Draw the diagram of a microscope and name its different parts.

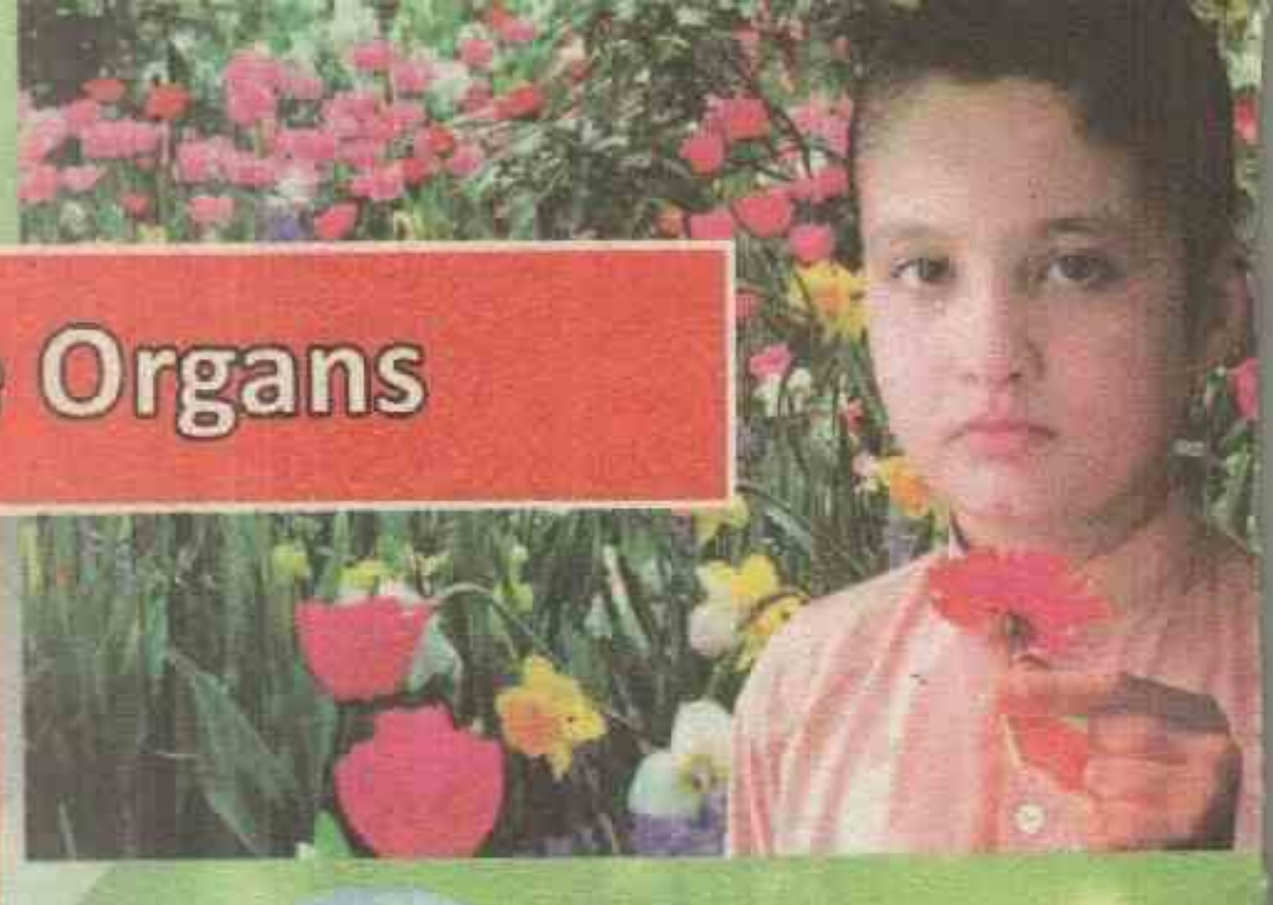
PROJECT WORK

Working in groups do the following:

Draw the organs involved in the human digestive system and order them in the right sequence on a chart or on a table.

Unit 2

Sense Organs



After studying this unit the students will be able to:

- Explain the structure and function of nose, tongue, ear, eye and skin.

Introduction

In previous grades, you have learnt about five senses in human body i.e. touch, taste, smell, sight and hearing. Similarly, you have also learnt about the functions of skin, eye and ear. Now, you have to learn about the structure and functions of sense organs i.e. nose, tongue, ear, eye and skin.

Sense Organs

a. Eye

Human eye consists of an eyeball, which is a hollow and spherical body. The eyeball is protected by the eyelid. It consists of three layers:

i. The Sclerotic layer is the outermost white part of the eye. It protects the inner parts of the eye. This layer bulges out to form a thin and transparent structure called the cornea. Behind the cornea is a coloured area called the iris. The iris has a small opening in its center called the pupil. Behind the pupil lies a lens which is attached to muscles.

ii. The Choroid is the middle layer of the eye. It is black in colour. The choroid is filled with blood vessels that bring oxygen and nutrients to the eye.

iii. The Retina is the inner most layer of the eyeball. It is made up of sensory cells on which the images of objects are formed. Behind the retina are optic nerves which take the signals to the brain and helps us to see objects.

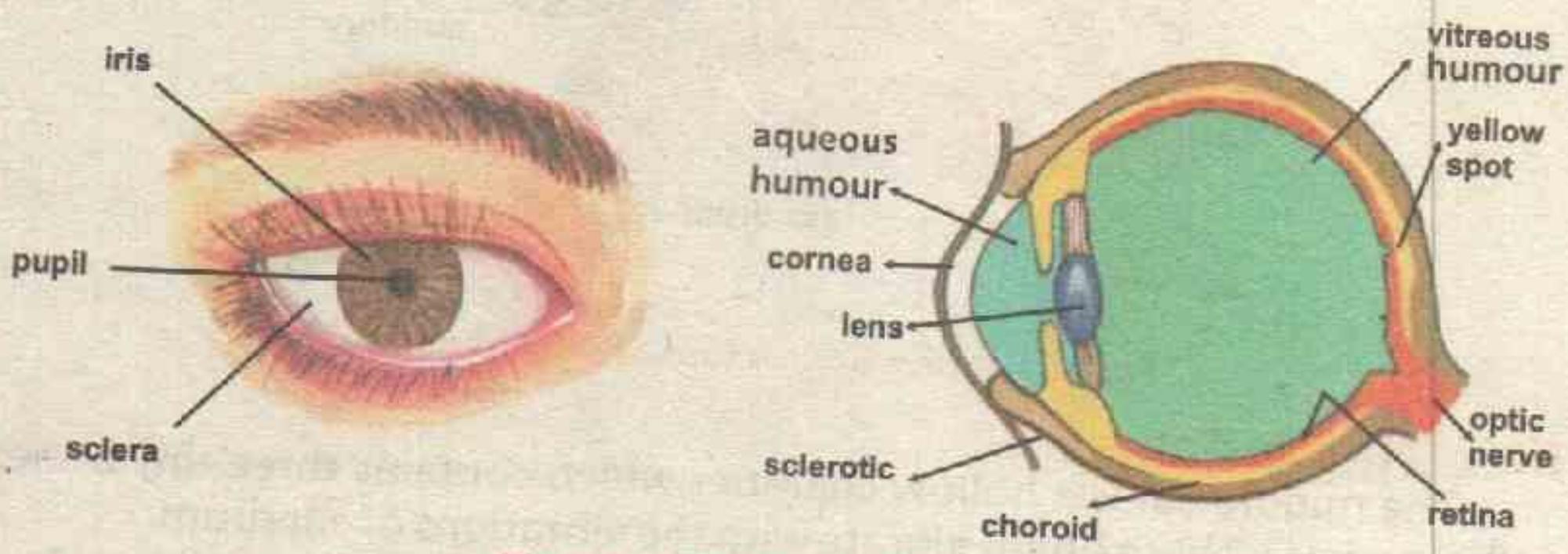


Fig 2.1 Structure of Human Eye

How the eye functions?

Light reflects from an object and enters the eye through the cornea. It then passes through the eye lens and is focussed on the retina where an inverted image of the object is formed. This image is sent to the brain through an optic nerve. The brain interprets and gives the sensation of an upright image of that object. The brain also works out the size and distance of that object.

Activity 2.1

Make a list of information that we can gather about our surroundings with the help of our eyes.

b. Ear

Ear is the sense organ of hearing. Human ear consist of three main parts i.e. outer ear, middle ear and inner ear.

i. Outer Ear:

The outer ear consists of two sub parts; Pinna and Ear canal. Pinna is an outer funnel like structure while the ear canal is a hollow tube that leads to a membrane called the ear drum.

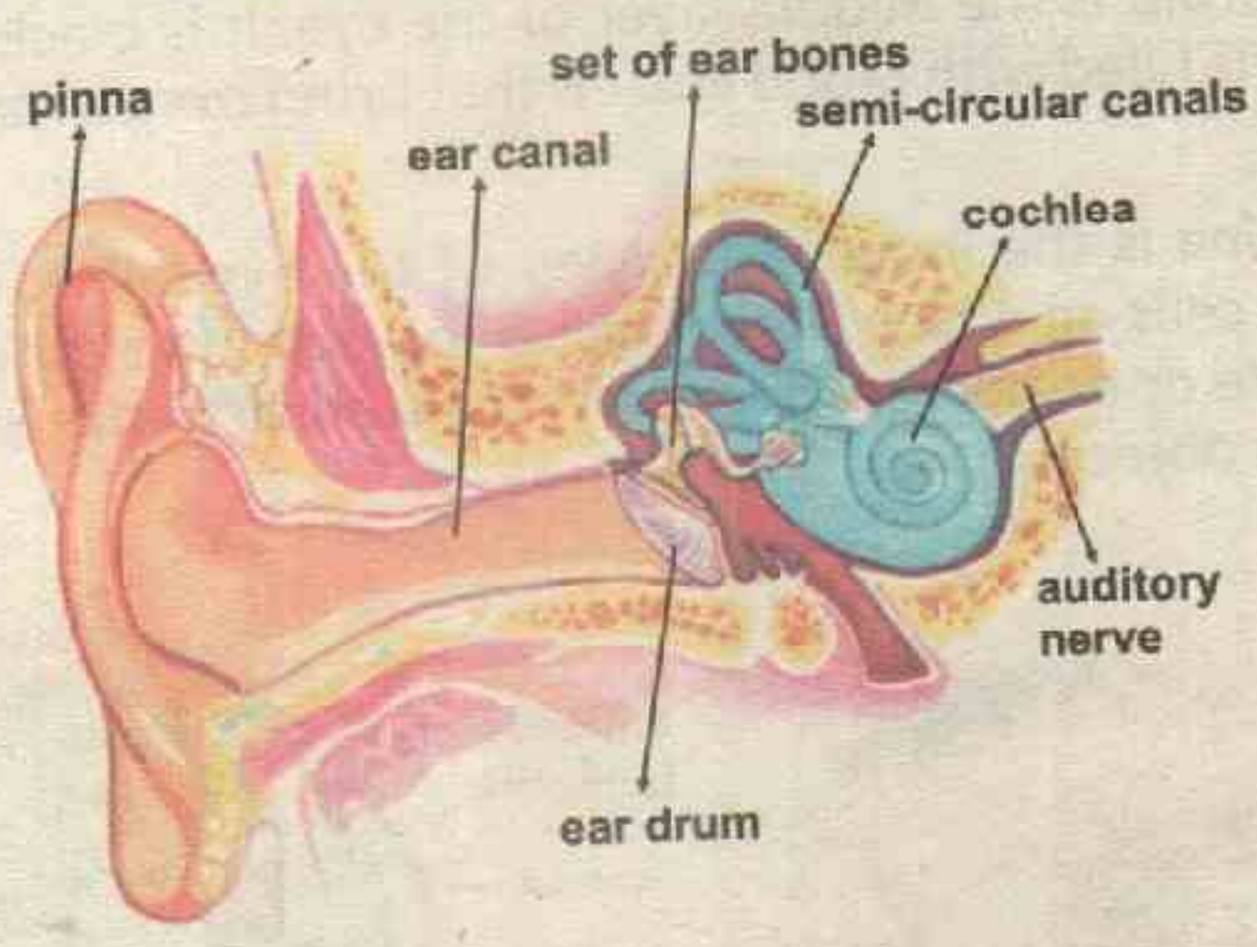


Fig 2.2 Internal Structure of the Human Ear

ii. Middle Ear:

The middle ear is a hollow chamber which contains three tiny bones called ossicles. These bones vibrate with the vibrations of ear drum.

iii. Inner Ear:

The inner ear consists of three semi-circular canals and a coiled (snail shell shaped) structure called cochlea. The cochlea is filled with a fluid having many tiny hair cells connected to auditory nerves.

How the ear functions?

Sound waves are collected by the pinna. It carries them to the ear canal. When these sound waves strike the ear drum, they cause vibrations in it. These vibrations are passed on to the three tiny bones in the middle ear. The bones transmit the vibrations to the inner ear. When the vibration enter the cochlea fluid, it sets the tiny hairs vibrating. They transmit the sound waves to the brain through the auditory nerve. Thus we hear the sound.

Do you Know

- Ear bones are the smallest bones of the body.
- The inner ear also helps in maintaining the balance of the body.

Activity 2.2

Make a list of information that we can get about our surrounding with the help of sense of hearing.

c. Skin

Skin is the outer cover of our body and is the largest sense organ. It is made up of two main layers.

i. Epidermis: It is the outer layer of the skin and contains three layers of cells. The outer layer of epidermis is hard and protects the inner organs.

ii. Dermis: It is the lower layer of skin which contains sweat and oil glands, blood vessels, fat, nerve endings and sensory cells called receptors.

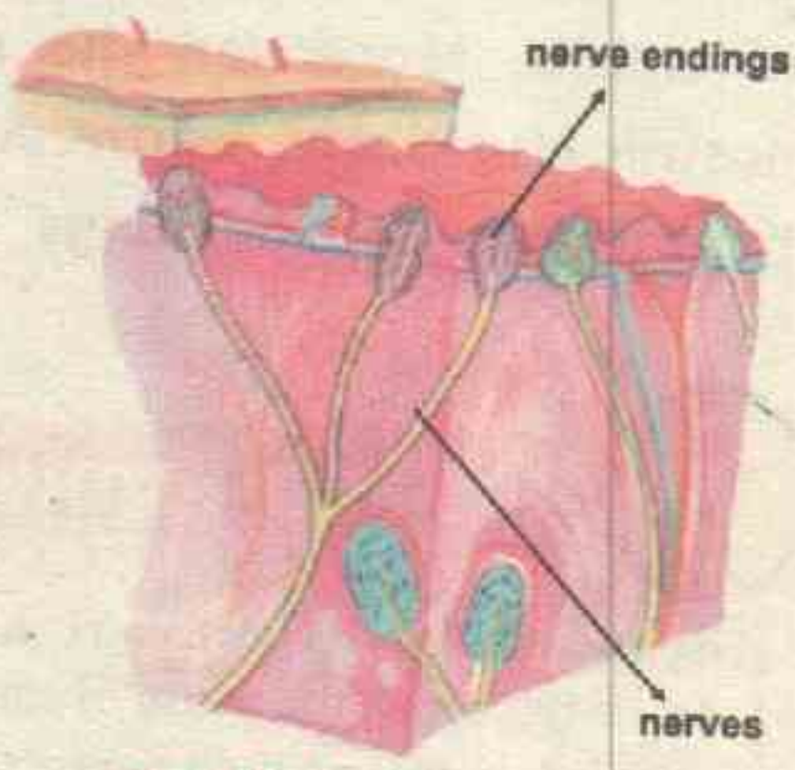


Fig 2.3 Structure of Skin

How the skin functions?

With the help of sensory cells the skin senses touch, pain, pressure and temperature. It protects the organs of the body. In sunlight it makes an important vitamin D.

Do you Know

The sensitive areas of your body are your hands, lips, face, neck, tongue, fingertips, and feet. There are about 100 touch receptors in each of your fingertips.

Activity

2.3

Make a list of information that we can get with the help of sense of touch.

d. Nose

Nose is the organ of smell and passageway for air into the lungs. It contains two cavities called nasal cavities or nostrils. Special cells called receptors are located in the upper part of the nostrils.

How the nose functions?

Substances that have a smell release vapours. When these vapours reach the receptors inside the nostrils, they send these messages to the brain through sensory nerves. The brain interprets these messages and thus we have the sense of different kinds of smells. Moreover, the inner layer of nostrils also cleans, warms and moistens air before it goes into our lungs.

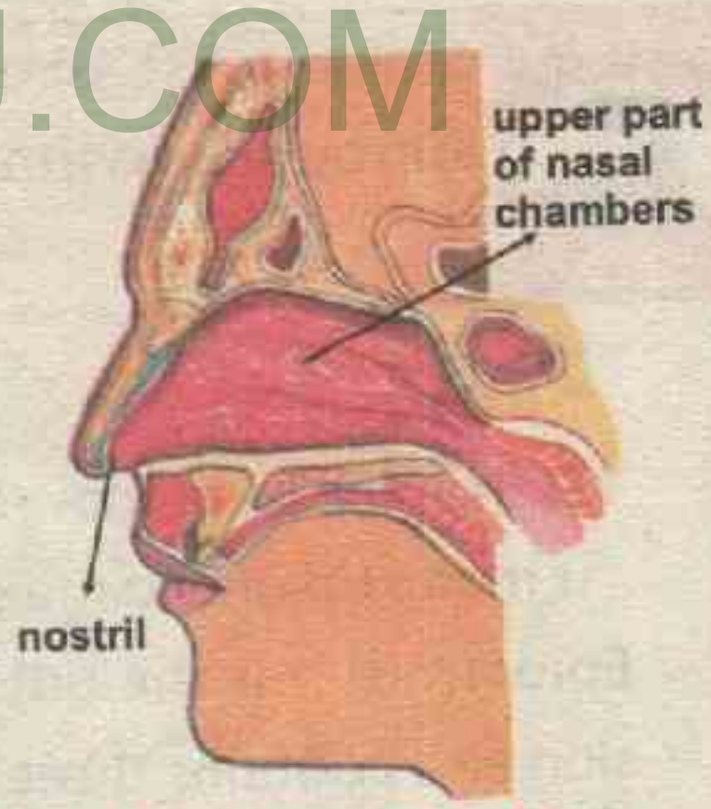


Fig 2.4: Structure of Nose

Do you Know

If your nose is at its best, you can tell the difference between 4000 - 10,000 smells! As we get older, the sense of smell gets weak. Children are more likely to have better sense of smell than their parents or grandparents.

Activity 2.4

Make a list of information that we can get with the help of sense of smell.

e. Tongue

The tongue is the sense organ for taste. It is a fleshy organ that is fixed at the back of the mouth but free for movement at the front. The tongue has taste receptor cells located on little bumps called taste buds.

Fig 2.5: Tongue showing regions for different tastes

Do you Know

- Taste is the weakest sense out of the five senses.
- We have almost 10,000 taste buds inside our mouth; even the roof of soft plate of our mouth.

How do we taste?

Food items react chemically with the taste receptor cells and the messages are sent to the brain through the nerves. The brain interprets these messages and thus we feel the sensation of taste.

KEY POINTS

- We have sense organs which help us to detect changes in the environment.
- The eye consists of three coats sclerotic, choroid and retina.
- The messages from eyes pass through the optic nerves to the brain.
- Ear is the organ of hearing and it consists of three parts outer ear, middle ear and inner ear.
- The message of sound passes through the auditory nerves to the brain and thus we hear the sound.
- The sense of touch is located in the skin.
- Touch cells are connected to the brain by nerves.
- The sensation of smell is detected by the cells present in nasal chamber.
- The tongue contains taste buds which help us to differentiate between different tastes.

EXERCISE

A. Fill in the blanks.

1. Receptor cells are present in _____ organs.
2. The layer of the eye that has sensory cells is called _____.
3. Vibration of the ear drum is due to _____ waves.
4. The sensation relating to sour and salty tastes are received by receptor cells located on the _____ of the tongue.
5. You can smell odorous substances through your _____.

B. Select the best answers for the following questions.

1. We can sense different stimuli due to
   a. sense organs b. blood
   c. environment d. nutrition

2. In the eye, sensory cells are located on
   a. choroid b. sclera
   c. iris d. retina

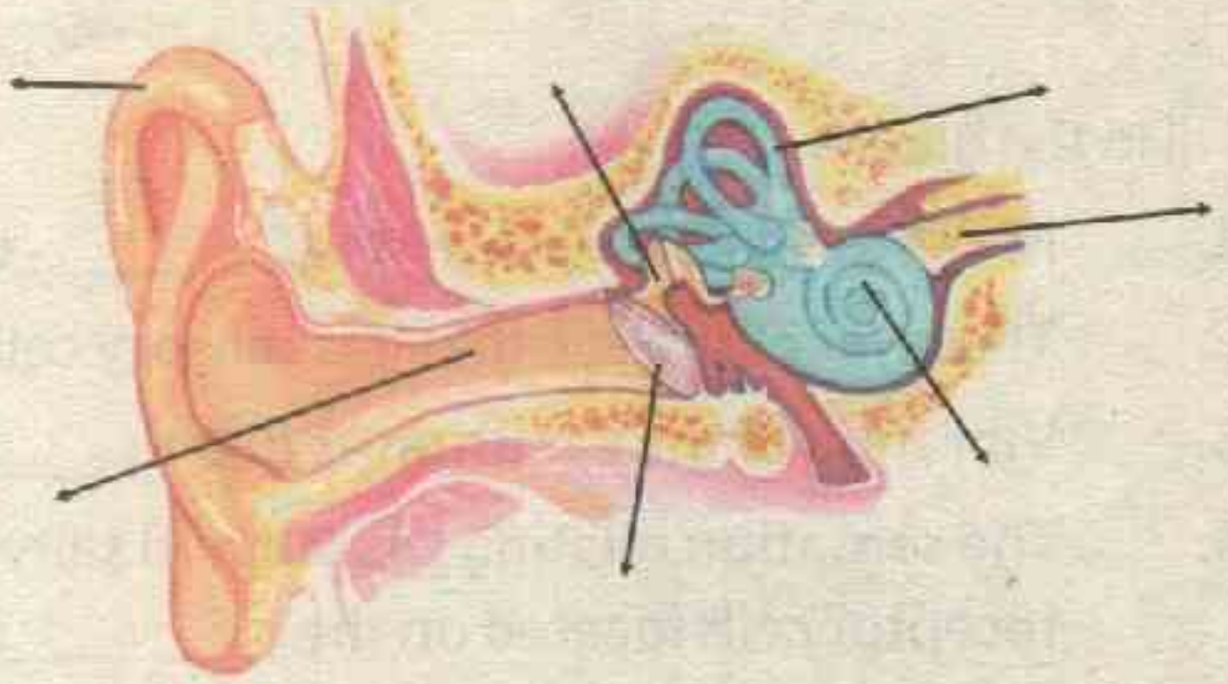
3. The optic nerves behind the retina take signals to the
   a. arm b. brain
   c. ear d. nose

4. Hearing is helped by
   a. optic nerve b. auditory nerve
   c. sensory nerve d. motor nerve

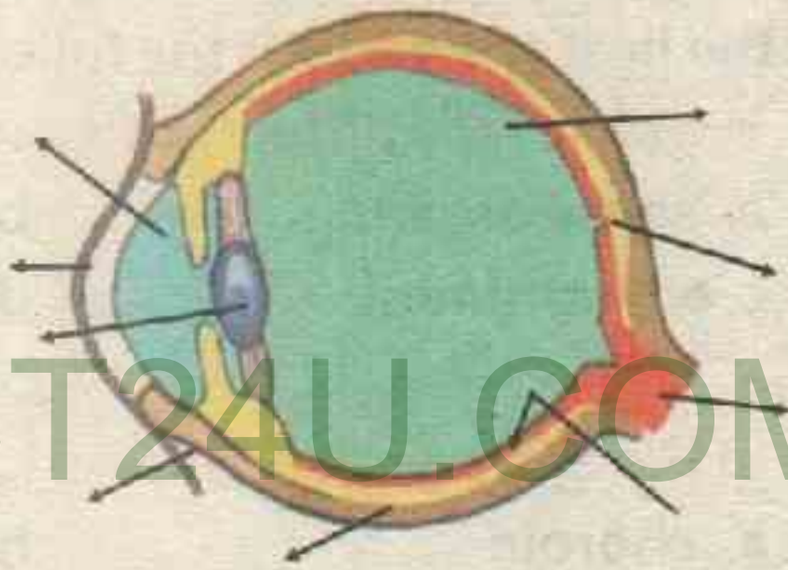
5. Which organ is used for tasting
   a. nose b. ear
   c. tongue d. eye

C. Label the following diagrams.

Human Ear



Human Eye



D. Answer the short questions.

1. Explain how we see different objects and pictures.
2. Why do we not feel the taste of a bitter almond till we have chewed it a bit?
3. Why do we find tea to be tasteless after we have eaten sweets or candies?

E. Answer the following questions.

1. Describe the structure of the human eye.
2. Classify the taste buds on the tongue, on the basis of different tastes.
3. Explain the mechanism of hearing.

Unit 3

Photosynthesis and Respiration in Plants

After studying this unit, the students will be able to:

- Describe the internal structure of a leaf.
- Define photosynthesis.
- Explain the importance of photosynthesis in plants.
- Describe the effects of different factors on the process of photosynthesis.
- Explain that the structure of leaves facilitates photosynthesis.
- Prove with the help of an experiment that photosynthesis takes place in a leaf.
- Explain the importance and process of respiration in plants.
- Compare and contrast the processes of Photosynthesis and respiration in plants.

Introduction

In previous grades, you have learnt about the factors (food, sunlight and water) necessary for the survival of animals and plants. All living things need food for their survival. They get energy from the food to perform different functions. Animals use prepared food while plants prepare food in their leaves through a process called photosynthesis. Similarly, all the living things get energy from the food through a process called respiration. In this unit, you will learn about photosynthesis and respiration in plants.

Internal Structure of Leaf

In previous grades, you have learnt about the structure of a leaf in terms of its shape and venation. Now you will learn about its internal structure. If a thin transverse section of a leaf is observed through a microscope, it has the following three main layers of tissues.

I. Epidermis:

Epidermis is the outer most layer that covers the upper and lower surfaces of the leaf. The cells of this tissue are closely packed. The upper surface of leaf is called upper epidermis while its lower surface is called lower epidermis. The lower epidermis has some small pores called stomata, which help in the exchange of gases.

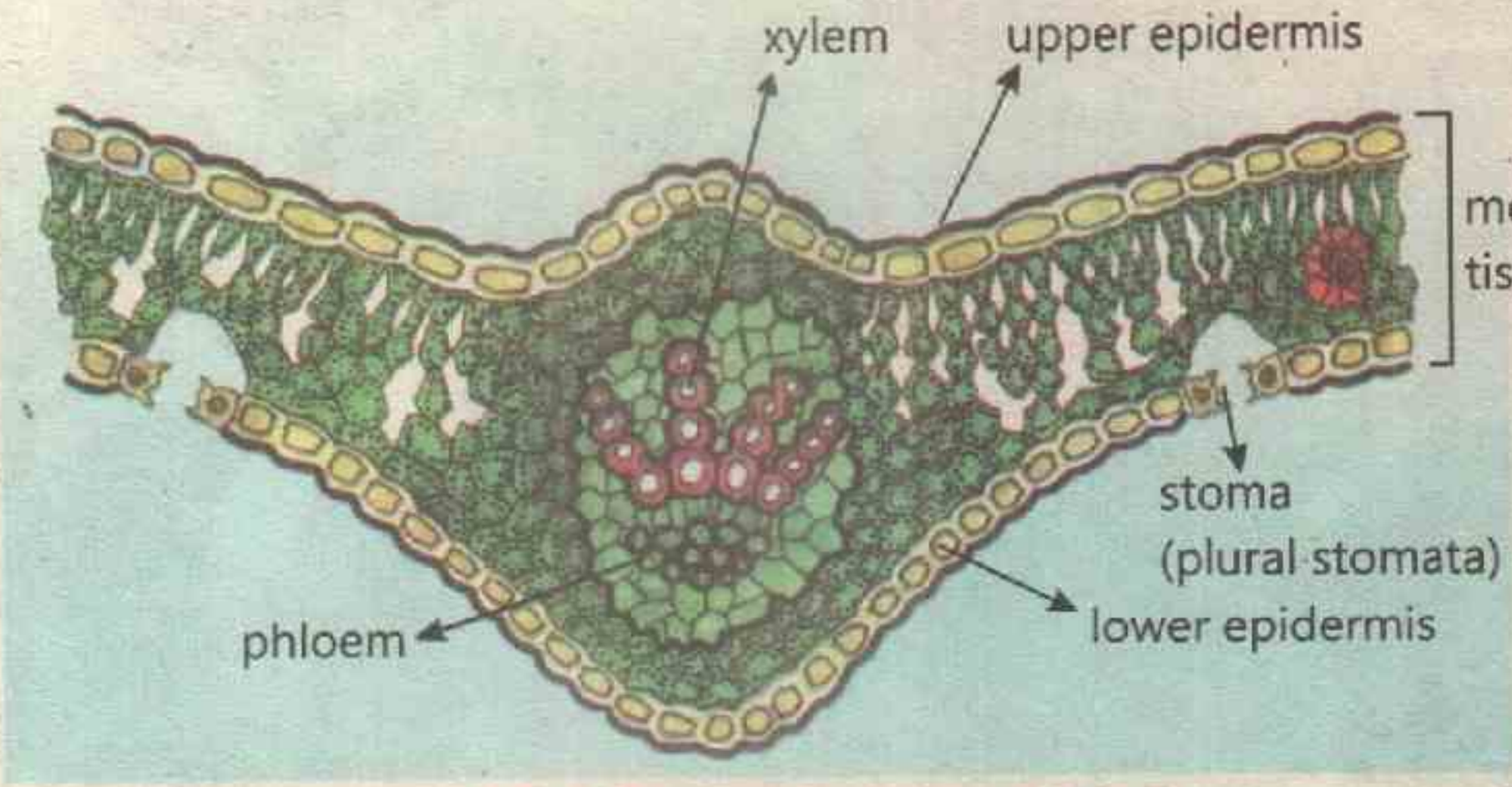


Fig. 3.1: Internal structure of a leaf

ii. Mesophyll:

Mesophyll is the tissue which lies between the upper and lower epidermis. It contains photosynthetic green pigment called chlorophyll.

iii. Conducting Tissues:

It lies at the centre of mesophyll tissue. It consists of conducting tissues; xylem and phloem. Xylem transports water and salts from the roots to upper parts of the plant. While phloem transports food from the leaves to other parts of the plant.

Photosynthesis

Plants prepare their own food by converting sunlight energy into chemical energy. This process is called photosynthesis. ("Photo" means light and "synthesis" means preparation) During photosynthesis, plants utilize carbon dioxide and water in the presence of sunlight to prepare their food. This food is in the form of carbohydrates (like glucose) and is prepared with the help of chlorophyll found in the leaves of plants.

Photosynthesis can be stated in the form of the following equation.

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

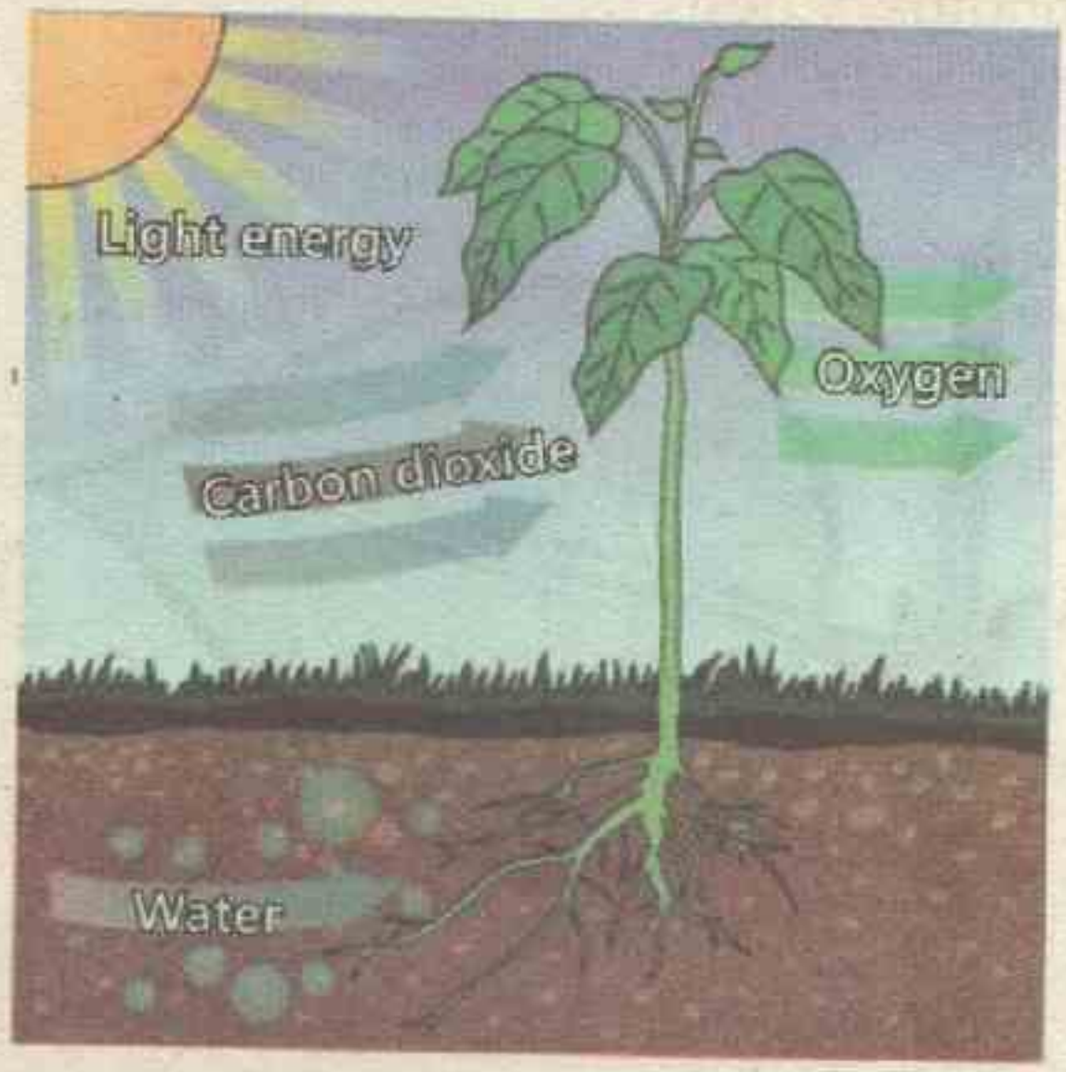


Fig 3.2
Plants need sunlight, carbon dioxide and water for photosynthesis

In addition to glucose, oxygen is also produced as a secondary product. Some of this oxygen is used within the plant itself and the remaining comes out of the leaves through stomata into the atmosphere. This oxygen is utilized by the animals for their survival. A part of the glucose is used as a food by the plant for energy. While the remaining glucose is converted into starch and is stored in different parts of plant i.e. stem, roots, fruits and seeds. Whenever needed, the starch is converted back into glucose.

How leaf structure helps in Photosynthesis?

Plant leaves are specially adapted for the process of photosynthesis. Their broad and flat structure provides a sufficient area for the absorption of sunlight and carbon dioxide gas. The leaves are thin, so the carbon dioxide gas reaches easily to inner cells for the process of photosynthesis. The stomata present at the lower surface of leaf allow carbon dioxide to enter the leaf for photosynthesis.

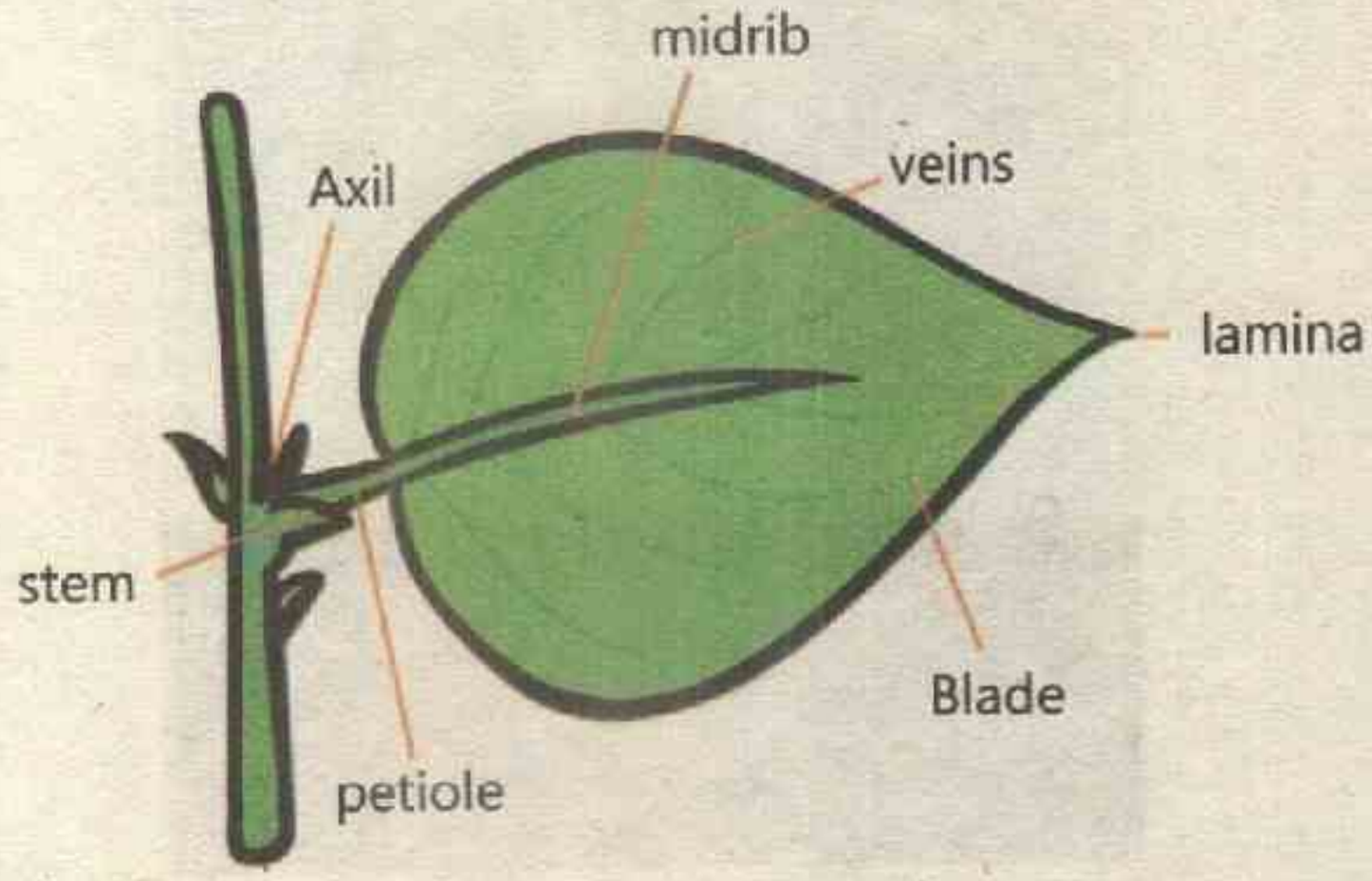


Figure 3.3 Parts of a leaf

Activity 3.1

Take a prepared slide of the transverse section (T.S) of leaf and study it under the microscope. Look for epidermis, stomata, mesophyll and conducting tissue. Study the different structures you observe in detail and draw a labelled diagram in your notebook.

Factors necessary for Photosynthesis

There are some factors which are necessary for the process of photosynthesis.

1. Light

Light energy from the sun is necessary for photosynthesis. During photosynthesis this energy is converted into chemical energy. Low light intensity, slows down the process of photosynthesis. At night or in the dark photosynthesis does not takes place.

2. Carbon dioxide

The concentration of carbon dioxide in the atmosphere ranges from 0.03 to 0.04%. During photosynthesis plants combine carbon dioxide and water to form glucose (food). A sharp increase or decrease in the concentration of carbon dioxide slows down the process of photosynthesis.

3. Temperature

A suitable temperature ranging from 25°C to 35°C is required for the process of photosynthesis. Temperature below or above this range slows down the process of photosynthesis.

4. Chlorophyll

The process of photosynthesis

Fig. 3.4 Light on plant

takes place in the green parts of the plant especially leaves. These green parts contain chlorophyll which absorbs sunlight. Without chlorophyll photosynthesis cannot take place.

Fig. 3.5 Chlorophyll

5. Water

Water is an essential factor in photosynthesis. Water combines with carbon dioxide to form glucose. Deficiency of water slows down the process of photosynthesis.

Activity 3.2

We know the product of photosynthesis is glucose. This glucose is converted into starch in leaves. So the presence of starch in leaves is a proof that photosynthesis is taking place. Let us see how we can prove it.

Take two plants A & B. Keep plant A in light and plant B in dark for two days. After two days, take leaves from both plants and put them in boiling water to kill them. Now put the leaves in a test tube containing alcohol and boil them in water beaker. This will remove chlorophyll present in them. Put these leaves in water to soften them. Now apply Iodine solution on the surface of leaves. When iodine combines with starch it gives dark-blue colour. Leaf from plant A will turn dark-blue showing that it contains starch. Plant B leaf will turn red- brown showing there is no starch present.

Respiration in Plants

Respiration is the process in which food (glucose) is broken down to release energy. Oxygen and glucose are used in this process and carbon dioxide and water are produced along with energy.

$$\text{Glucose} + \text{Oxygen} \longrightarrow \text{Carbon dioxide} + \text{water} + \text{energy}$$

The process of respiration takes place in all cells of living organisms.

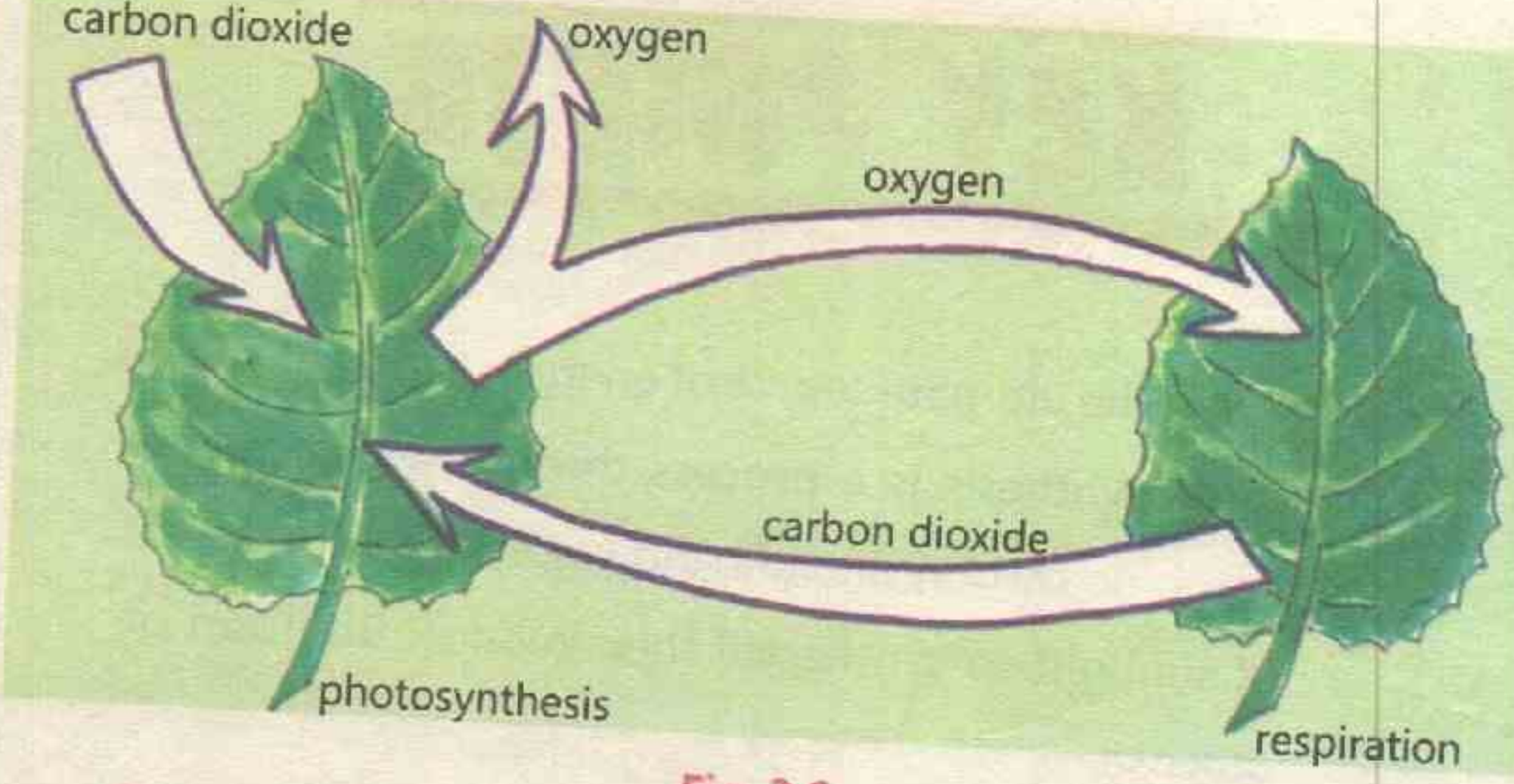


Fig. 3.6

Plants can use the product of respiration and photosynthesis.

Respiration is opposite to photosynthesis. All parts of the plant respire i.e leaves, stem, roots and even flowers.

Table: 3.1 Comparison between photosynthesis and respiration

Photosynthesis	Respiration
Occurs in the presence of light and chlorophyll in plant cells	Occurs at all times in animal and plant cells
Requires energy (light) to make sugar (glucose)	Releases energy from sugar
Glucose is formed	Glucose is broken
Carbon dioxide and water are the raw materials	Carbon dioxide and water are the waste products
Oxygen is given out	Oxygen is taken in
Occurs only in plant cell	Occurs in all animal and plant cells

KEY POINTS

- Sun is the ultimate source of energy for planet Earth.
- Photosynthesis is a process through which plants combine carbon dioxide and water in the presence of sunlight to synthesize their food in the form of glucose.
- The leaf surface, presence of chlorophyll and stomata are the features which help photosynthesis.
- Light, carbon dioxide, temperature, chlorophyll and water are the essential factors for photosynthesis.
- Respiration is the break down of food (glucose) to release energy.
- Respiration takes place in all the animal and plant cells.

EXERCISE

A. Fill in the blanks.

1. The main source of _____ is sunlight.
2. Mesophyll cells contain _____
3. Epidermal layer in a leaf contain small pores called _____
4. Normal temperature range for photosynthesis is _____ °C to _____ °C.
5. During photosynthesis light energy is converted into _____.

B. Choose the correct answer.

1. Plants make their own food through a process called:
   a. respiration b. photosynthesis c. fertilization d. pollination
2. Which of these is not needed in the process of photosynthesis?
   a. sunlight b. carbon dioxide c. chlorophyll d. oxygen
3. The small pores or openings in leaves that take in the carbon dioxide are called
   a. stomata b. lamina c. phloem d. petiole
4. The suitable range of temperature for photosynthesis is
   a. 5°C to 15°C b. 15°C to 45°C
   c. 25°C to 35°C d. 10°C to 25°C
5. What is given off by the plant during photosynthesis that animals need?
   a. oxygen b. carbon dioxide
   c. chlorophyll d. water vapours

C. Answer the following questions.

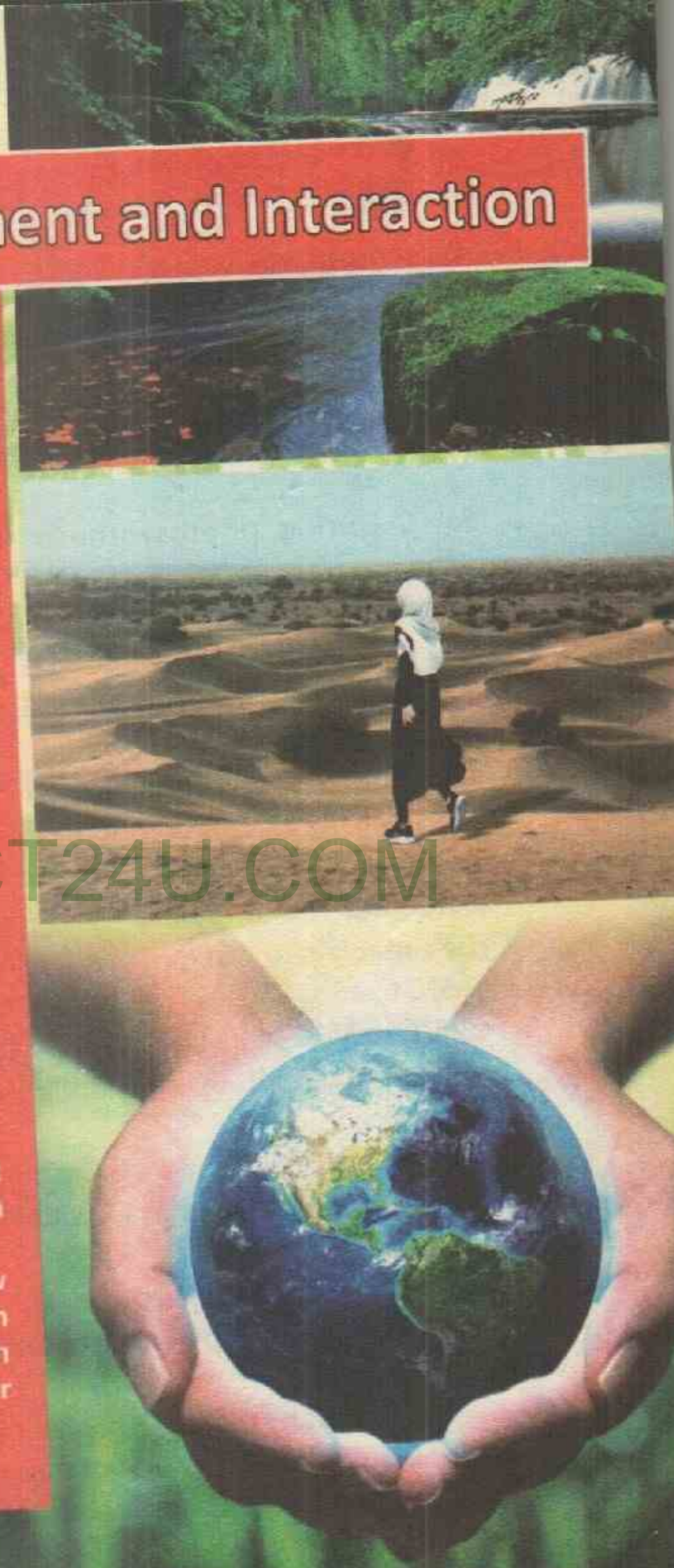
1. Discuss the importance of photosynthesis as a life supporting process.
2. Explain any three factors needed for photosynthesis.
3. Differentiate between photosynthesis and respiration.
4. What may happen to a plant if all stomata on its leaves are closed by using wax or vaseline?

Unit 4

Environment and Interaction

After studying this unit, the students will be able to:

- Identify the components of environment.
- Compare the physical factors, which make up the environment of a desert and a rain forest.
- Describe the relationship between biotic and abiotic components of the environment.
- Explain how abiotic factors affect the ability of plants to create their own food.
- Describe that living things depend on one another for food, shelter and protection.
- Explain the different relationships between organisms.
- Give examples of how organisms interact with each other and with nonliving parts of their environment.



Introduction

The area you live in and all the living and non living things in it, constitute your environment. Your class room environment includes the walls, the ceiling, the fan, the blackboard, your class fellows, your teacher, even the floor and the dust on the floor.

Fig. 4.1
Beetle and its environment

Activity 4.1

- Can you tell what would constitute your environment if you were in a park?
- Close your eyes for a minute and try to visualize the environment of a fish.
- Make a list of the living and non-living things in your environment at home.

Components of environment

An environment is constituted by both living and non-living things. The living things are called the biotic components and the non-living things are called abiotic components.

A. Biotic Components

Biotic components consist of:

i. **Producers:** These are green plants which produce food by photosynthesis.

ii. **Consumers:** Consumers are the animals which consume food prepared by the producers.

iii. **Decomposers:** These are micro-organims (bacteria and fungi), which breakdown dead bodies of plants and animals.

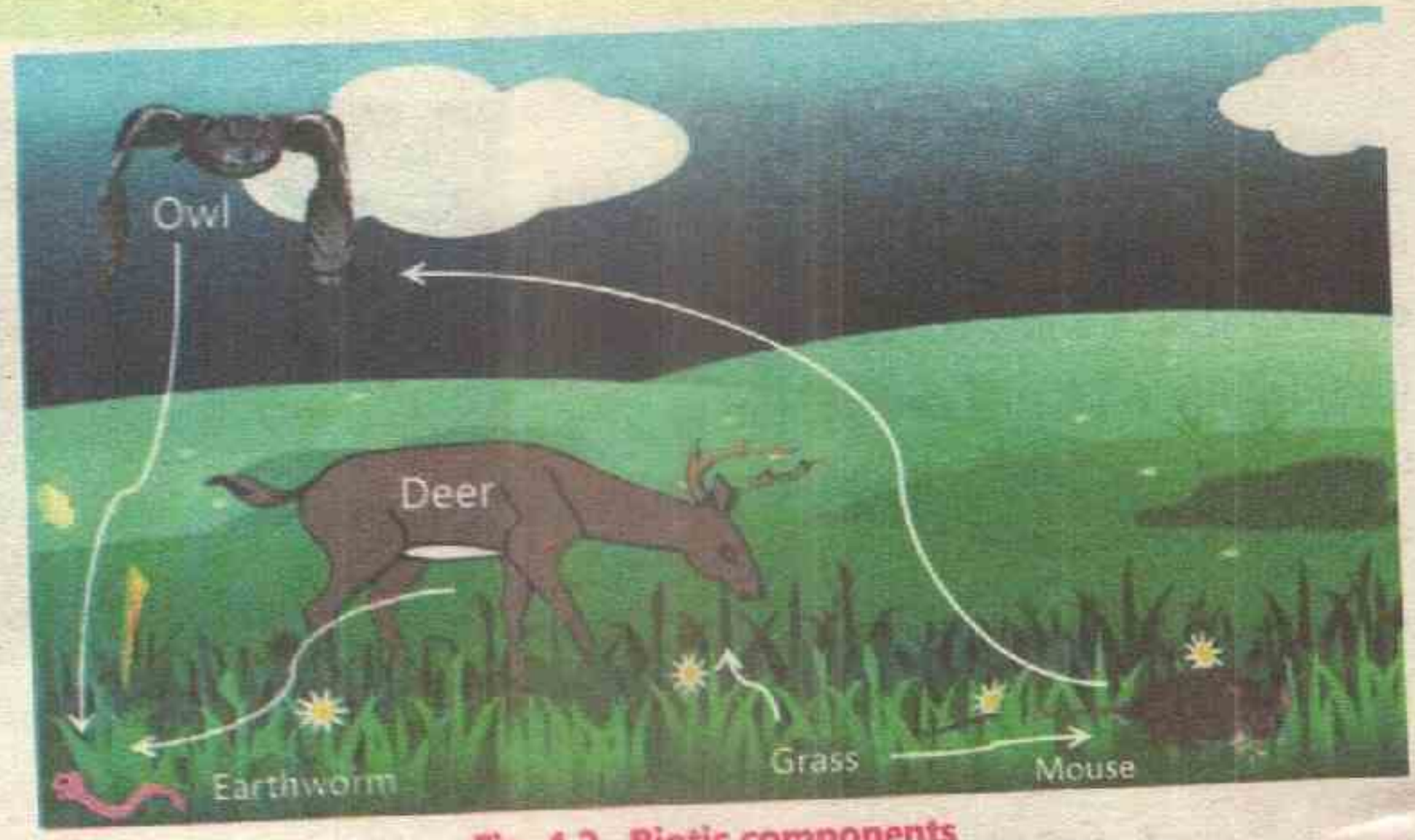


Fig. 4.2 Biotic components

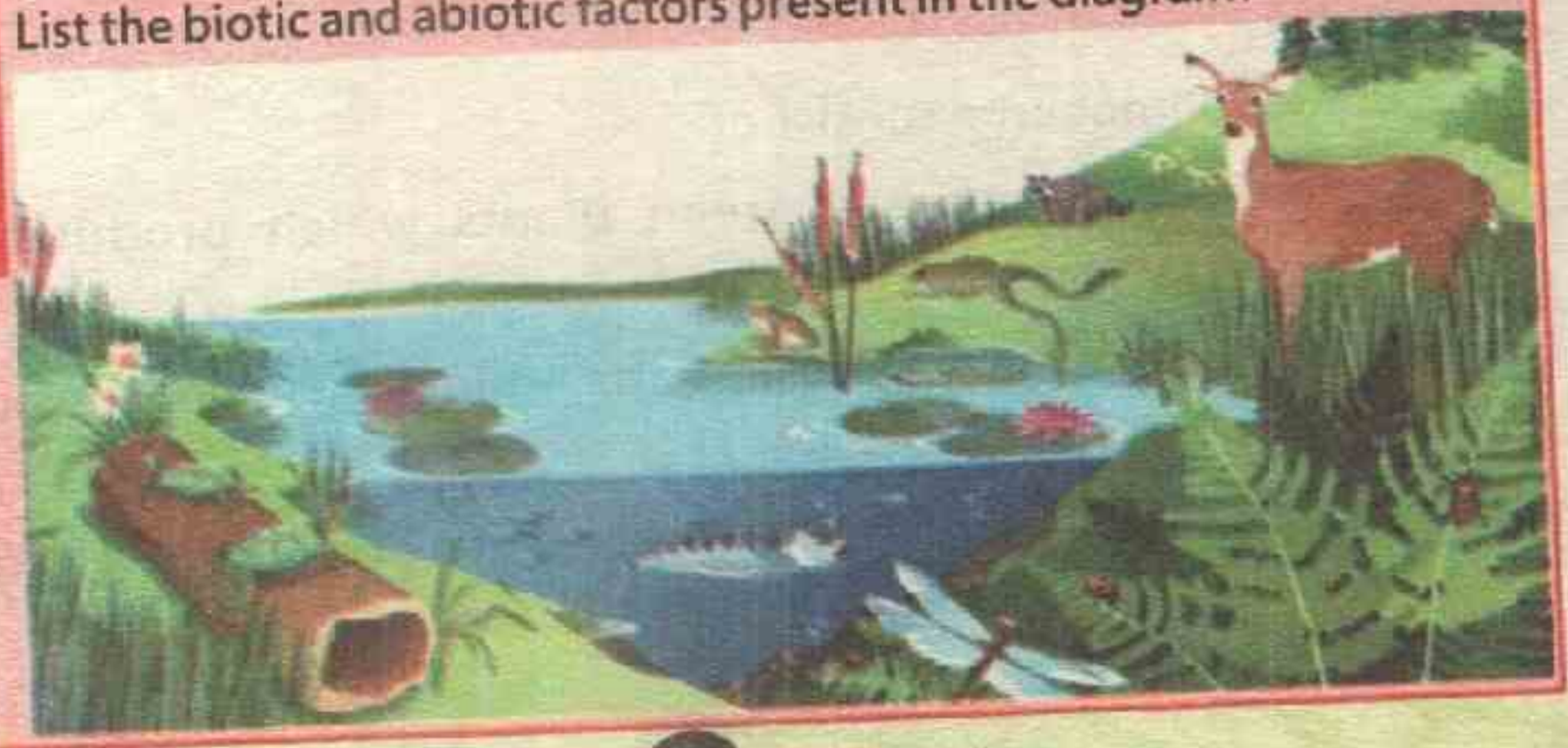
B. Abiotic Components

These are non-living parts of the environment. They include sunlight, air, water, soil, sand, stones, temperature, minerals etc. These are essential for the growth and survival of all living things.

Fig. 4.3 Abiotic components

Activity 4.2

Diagram shows a pond environment.
List the biotic and abiotic factors present in the diagram?



Interdependence of biotic and abiotic component

In the previous unit, you learned that the process of photosynthesis depends upon abiotic factors like carbon dioxide, sunlight, water and temperature. Plants produce food for their own use as well as for other animals. The waste material of plants and animals is again used up by the plants and the cycle goes on. In this way, the biotic factors depends on the abiotic factors for survival and growth.

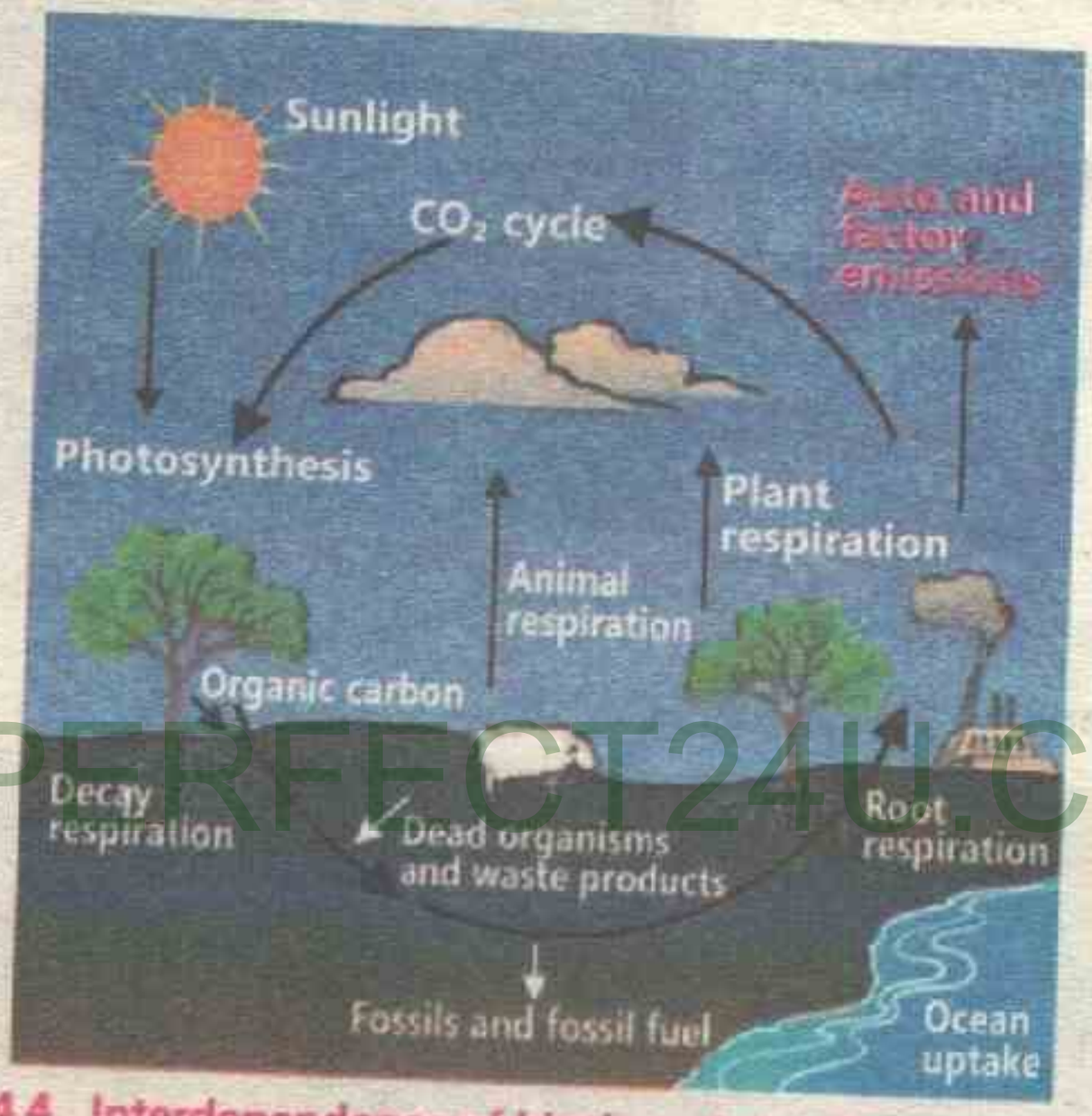
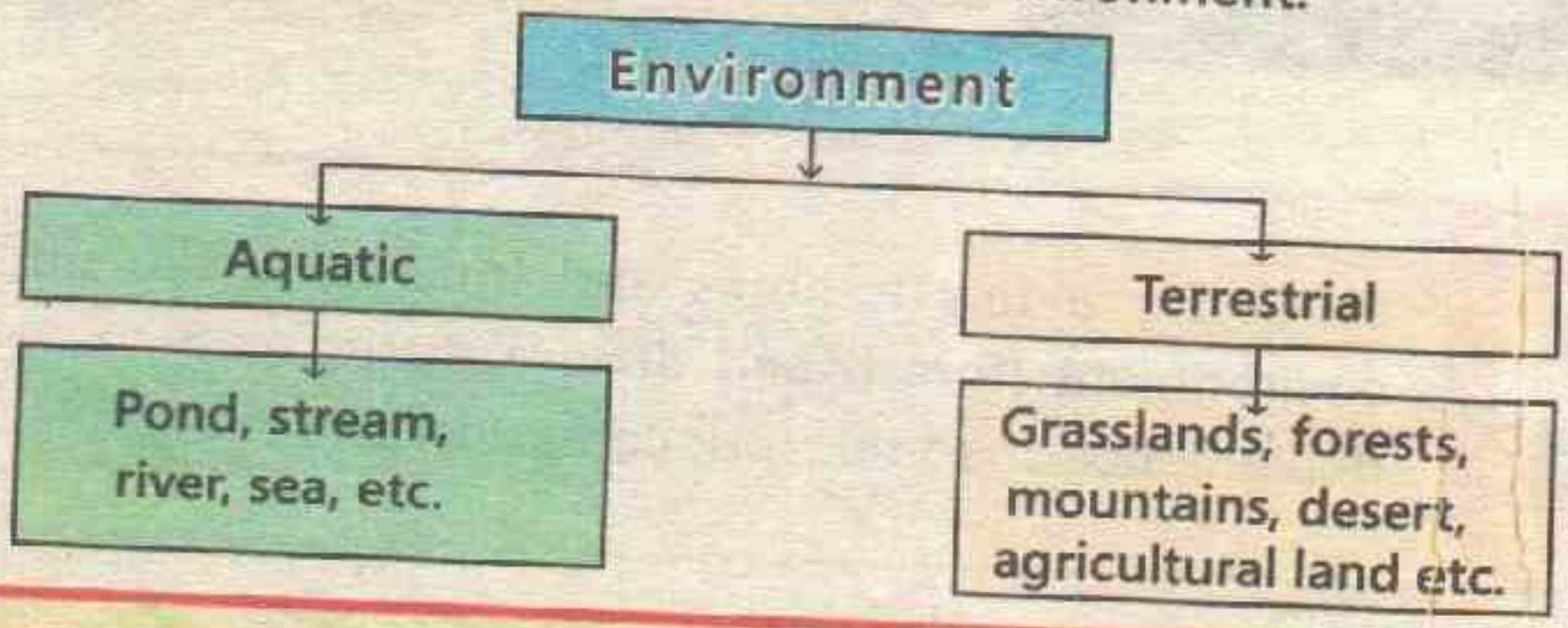


Fig. 4.4 Interdependence of biotic and abiotic components

Do you know?

There are two major types of natural environment.



Dependence of living things on one another

In any environment, biotic components (plants and animals) depend upon each other for their food. Many animals such as birds, squirrels, monkeys and a variety of insects, mostly live on trees. Trees provide them shelter from weather and from enemies. Trees also provide food in the form of fruits, nuts, leaves, bark, and roots. Even dead trees provide shelter and food to many insects. Can you give any example of dependence of living things on one another?

Fig. 4.5: Monkeys on tree

Fig. 4.6: Grasshopper on a leaf

Activity 4.3

Think for a few minutes and imagine a lion in its environment (forest) and draw a diagram to show its dependence on some biotic components.

Comparison between a Desert and a Rainforest Environment

Environments differ with respect to their physical features.

Rainforest	Desert
1. Rainforests receive alot of rainfall around the year. 2. The climate is warm and humid through out the year. 3. Rainforests have dense vegetation. There are many trees growing very close to one another. 4. The soil is rich in decomposed material and the rate of decomposition is fast.	1. Deserts are found in dry regions where the total annual rainfall is less than 250mm. 2. In deserts, water is scarce and humidity in the air is very low due to the dry climate. The temperature during the day is very high and drops very quickly during the night. 3. Vegetation is rare and patchy. Plants are spaced apart. Due to low vegetation very few animals can survive in such a dry environment. 4. The rate of decomposition of plants and animals is low in deserts.

Relationships amongst Organisms

All living things require energy to live. This energy is obtained from food. Plants prepare their own food while animals depend on plants or other animals for their food. Animals in an environment interact with one another. The interaction between the different animals/ organisms may be mutually beneficial or harmful for interacting organisms.

Fig 4.7: Tiger preying a deer

Interaction between organisms are of many types. Some of them are :

a. Predation

Predation is the interaction between two animals in which one (predator) kills and feeds on the other (prey). You may have seen a cat grabbing and killing a rat, a lion preying a deer and a sparrow eating an insect. All these are examples of predation or predator prey interaction. Can you think of more examples of predator - prey relationships?

Point to Ponder

A lion does not eat grass or leaves. It preys on other animals. How does the lion depend upon plants for its food ?

b. Parasitism

In parasitism, one organism (the parasite) feeds on another organism (the host) by living on or in its body. The parasite gets its food from the tissues of the host and causes it harm. Mosquitos feeding on human blood and tapeworm inside the intestines are examples of parasitism.

Fig. 4.8
Mosquito feeds on human blood

c. Mutualism

Mutualism is the relationship between two organisms in which both are benefitted and none of them is harmed. For example, a certain kind of bacteria lives in the intestines of human beings. The humans cannot digest all of the food they eat. Bacteria present in the human digestive system eat the food and make it digestible for the humans. Thus bacteria benefit by getting food and shelter, and the human benefits by being able to digest the food he/she eats.

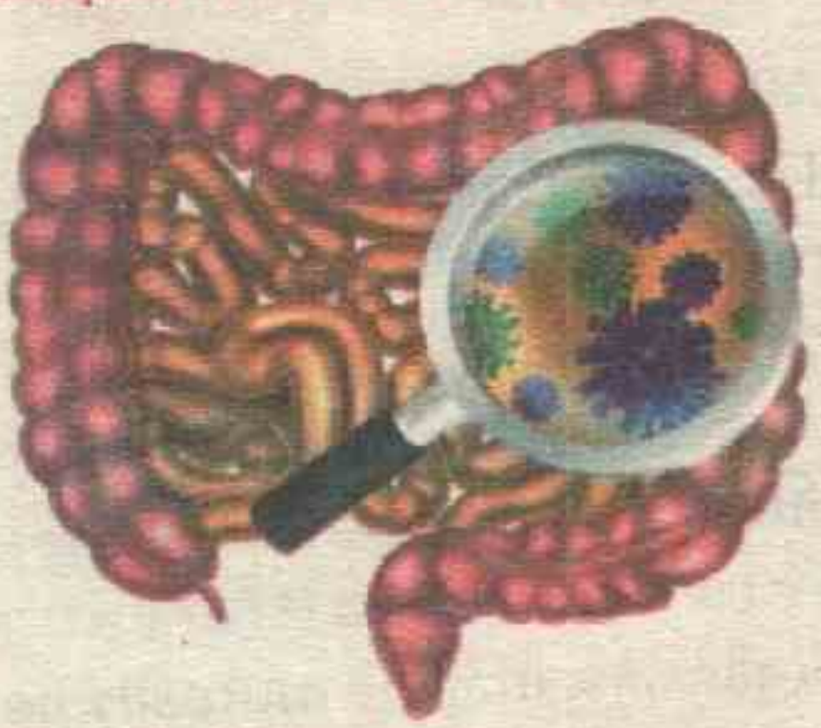


Fig. 4.9 Bacteria in human intestine

KEY POINTS

- Everything that surrounds us is our environment.

- Abiotic components of environment consist of sunlight, temperature, rainfall, water, soil etc.

- Biotic components of environment consist of primary producers, consumers and decomposers etc.

- In an environment there is an interdependence between biotic and abiotic components.

- Interaction between the organisms may be useful or harmful for one or both interacting organisms.

EXERCISE

A. Fill in the blanks.

1. Non-living components of environment are called _____ component.
2. In an environment _____ are regarded as producers.
3. Lion is regarded as a _____ in a predator-prey relationship.
4. One of the examples of parasites in human body is _____.
5. Bacteria in the _____ of human being is an example of mutualism.

B. Choose the correct answer.

1. Identify the abiotic component in the following.
   a. lion b. apple c. water vapours d. beetle
2. The relationship between two organisms where both are benefitted and neither is harmed is called _____.
   a. predation b. parasitism c. mutualism d. none of these
3. Thar is an example of _____ environment.
   a. tropical rainforest b. desert c. aquatic d. grassland
4. Mosquito feeding on human blood is an example of:
   a. predation b. parasitism c. mutualism d. none of these
5. There are _____ major types of natural environment.
   a. five b. three c. two d. four

C. Answer the following questions.

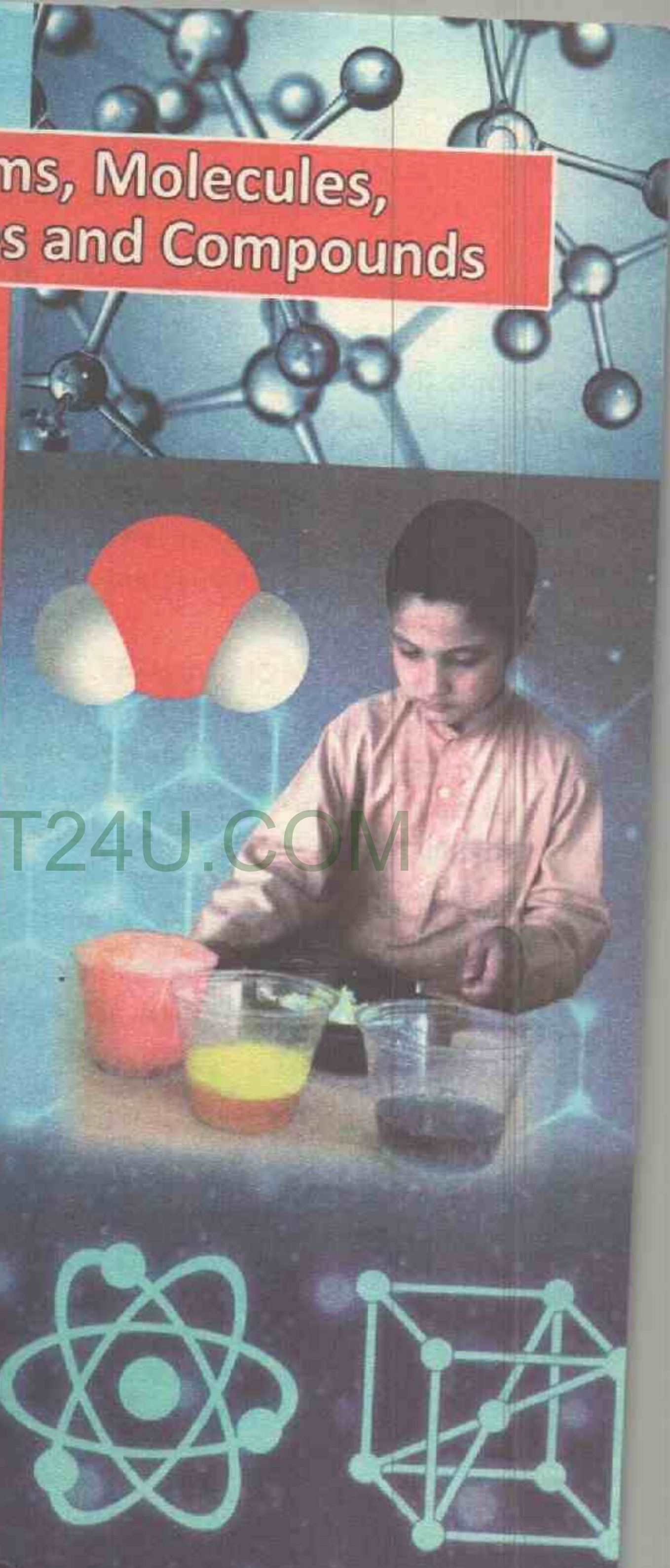
1. Define environment and identify its abiotic components.
2. Evaluate the interdependence between living things and non-living things.
3. Why does vegetation in tropical rainforests differ from the vegetation in deserts?
4. What will happen to an environment having no producers?

PROJECT WORK

Work in groups. Each group should find examples of predation, parasitism and mutualism. Make a chart and display it in the classroom.

Unit 5

Atoms, Molecules, Mixtures and Compounds



After studying this unit, the students will be able to:

- Differentiate between an atom and a molecule. Recognize the symbols of some common elements.
- Classify elements into metals and non-metals. Relate the physical properties of elements to their uses.
- Differentiate between elements and compounds and compounds and mixtures.
- Identify examples of compounds and mixtures from their surroundings.
- Explain uses of common mixtures in daily life. Explain why air is considered as a mixture of gases.
- Identify the sources of carbon dioxide and how its level can be maintained in nature.
- Separate mixtures using a variety of techniques.
- Choose a technique to separate and identify different components in dyes.
- Demonstrate with an experiment to separate soluble solids from mixtures.
- Use safety measures to conduct science experiments.

Introduction

All the objects that we see around us are made up of matter. Matter is anything that has mass and occupies space. Living things and non-living things are examples of matter. Matter is made up of atoms. Atom is the smallest particle of matter. We cannot see atoms because they are so small. In this unit, we will be looking at different types of substances such as atoms, molecules, mixture and compounds, their properties and uses.

Do you Know

In 1661, Robert Boyle suggested the name **element** for the basic substances. In 1803,John Dalton suggested that each element was composed of its own kind of particles, which he called atoms.

Atoms and Molecules

In previous grades, you have learnt about the states of matter. Everything around us is made up of matter. If you look at a wall, you will see that it is made up of bricks. These bricks are the building blocks of the wall. In the same way,atoms are the building blocks of matter. We know that an atom is the smallest particle of an element, which can take part in a chemical reaction. Atoms of some elements can exist in pure atomic form in nature for example, helium and neon whereas, atoms of some elements cannot exist as single atom for example hydrogen and

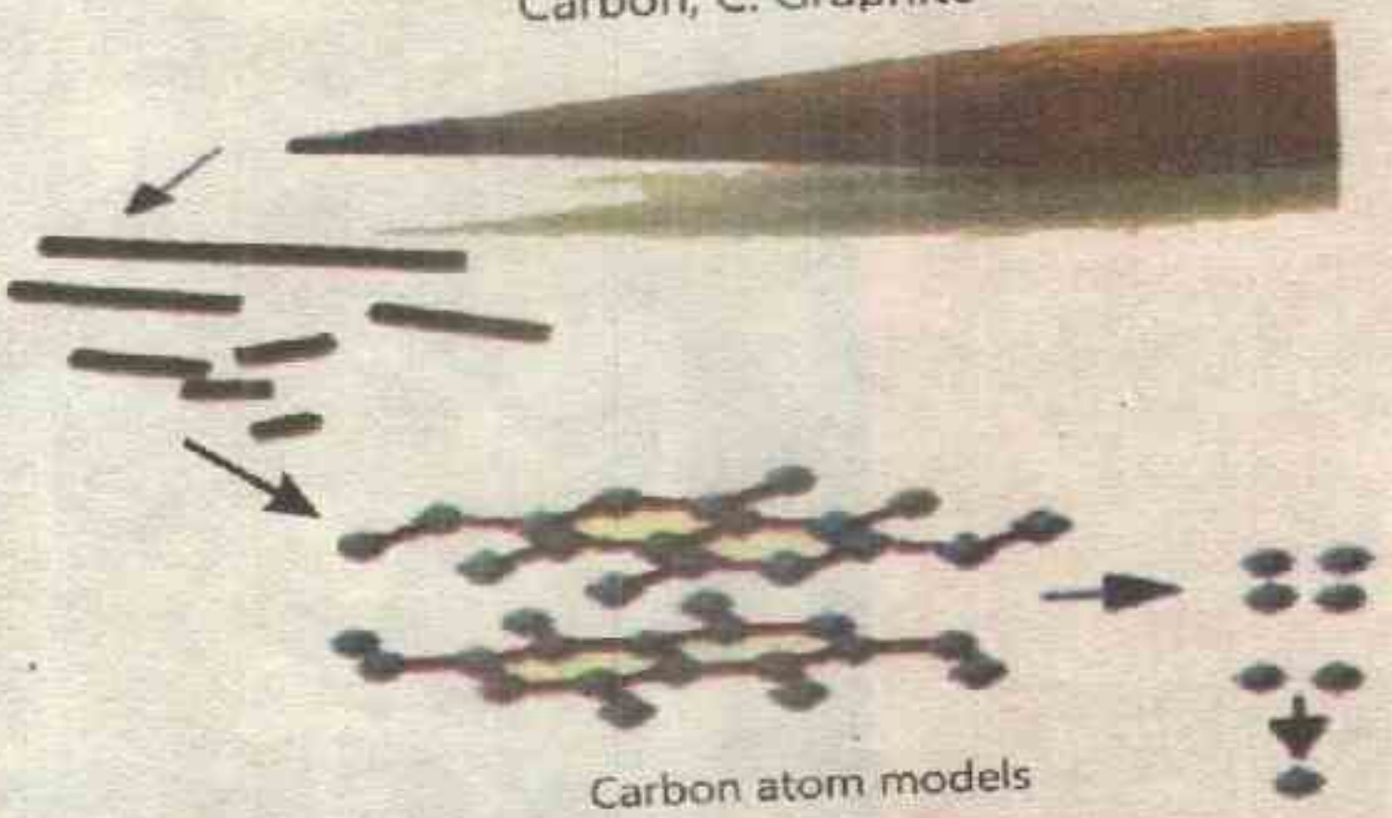
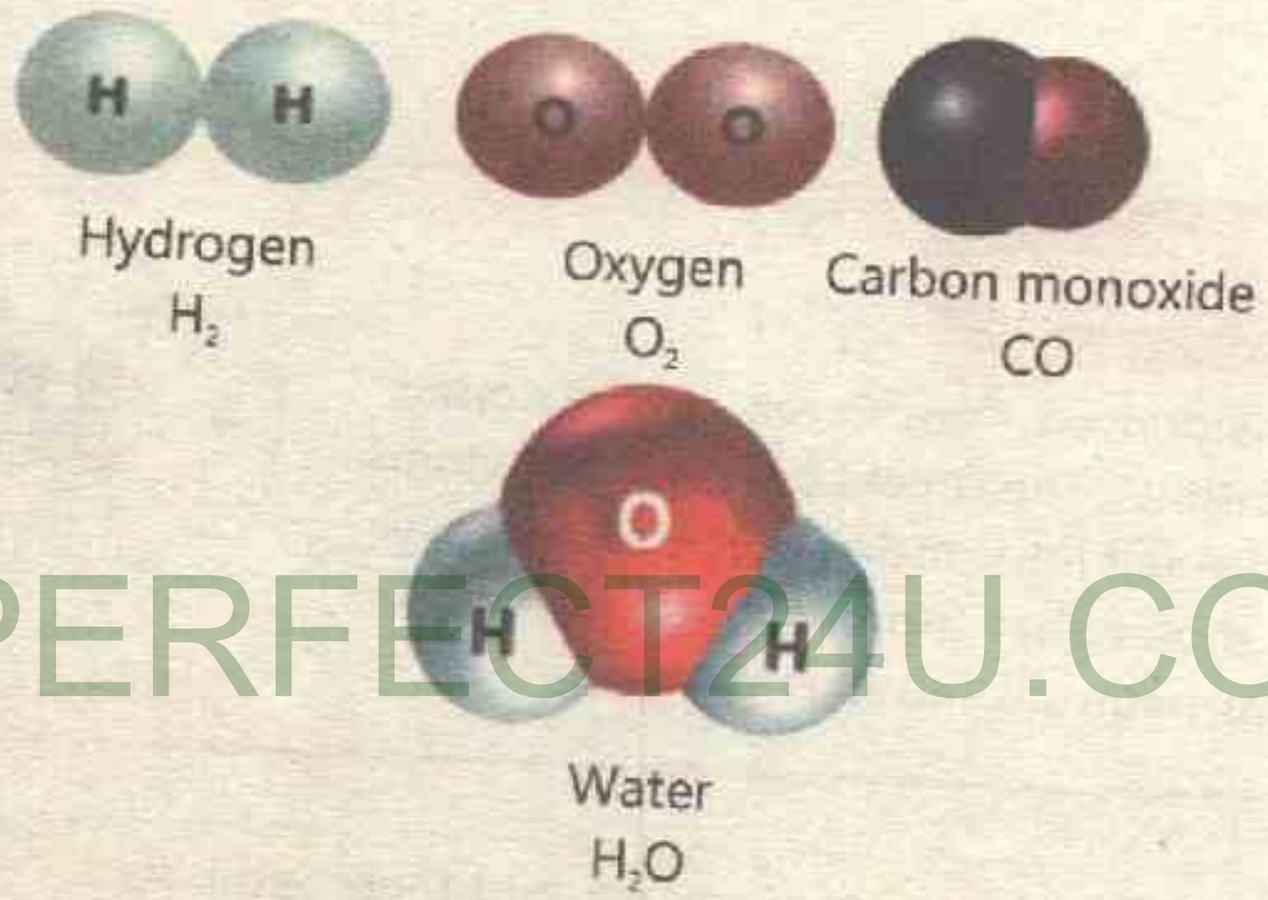


Fig. 5.1: Example of Atom

oxygen. They always combine with their own atoms or with other atoms and form compounds, for example, H_2, O_2 and H_2O etc.

Molecule

The smallest particle of a substance which can exist independently and shows all the properties of that particular substance is called a molecule. A molecule is formed by the chemical combination of two or more atoms. For example, Hydrogen (H_2), Oxygen (O_2), Carbon monoxide (CO) and water (H_2O) molecules.



Hydrogen
H_2

Oxygen
O_2

Carbon monoxide
CO

Water
H_2O

Fig. 5.2 Examples of Molecules

Common Elements and their Symbols

As you know that an Element is a substance that cannot be broken down into further simpler substance by either chemical or physical methods. An Element is composed of only one kind of atoms. The atoms of the same element are similar in chemical properties. The atoms of different elements are different chemically from

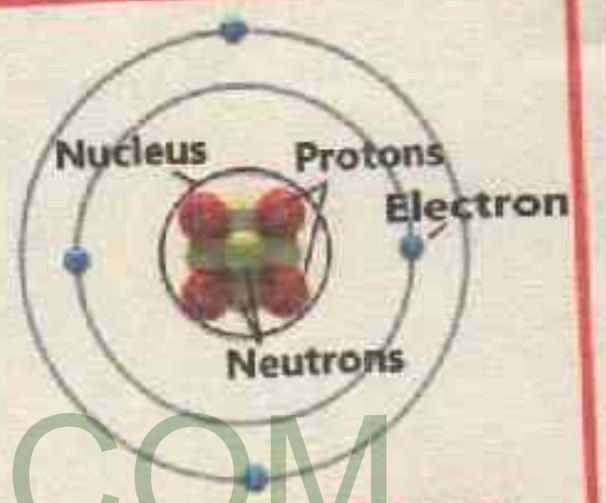
Do you Know

There are 118 known elements up till now. Among these, 92 are naturally occurring elements while the rest have been prepared synthetically in the laboratory. The whole universe is made of these elements.

each other. For example, helium, gold, and sodium are all elements. Elements are represented by symbols. Symbol is a short name of an element. A Symbol is derived from English, Greek or Latin name of that element. Symbols of Elements usually consist of one or two letters. If the symbol of an element consists of one letter then it is written as a capital letter. For example, symbol of hydrogen is H; symbol of oxygen is O. If the symbol of an element consists of two letters, then the first letter is written as capital and the second in small letter, for example symbol of Calcium is Ca and Chlorine is Cl.

Do you Know

The word "atom" is derived from Greek word "atomos" which means "indivisible". The Greeks believed that atoms could not be sub-divided into smaller particles. However, modern research shows that atom consists of smaller particles, i.e. protons, neutrons and electrons etc.



Structure of Atom

Table 5.1: Names of elements and their Symbols

S.No	Element	Symbol	S.No	Element	Symbol
1.	Carbon	C	2.	Oxygen	O
3.	Aluminum	Al	4.	Bromine	Br
5.	Calcium	Ca	6.	Helium	He
7.	Gold (Aurum)	Au	8.	Iron (Ferrum)	Fe
9.	Sodium (Natrium)	Na	10.	Silver (Argentum)	Ag

Activity 5.1

Prepare a list of 10 common elements around you.

Classification of Elements

Elements are broadly classified into two types.

1. Metals
2. Non- metals

Metals

Metal is a substance that is lustrous (shiny) and opaque. Metals can pass electricity and heat (conductors). They can be beaten into thin sheets and foils without breaking (malleable). They can be drawn into thin wires(ductile). They usually melt at high temperature. They produce bell like sound when struck (sonorous). All metals are solid except Mercury. Examples of things that are made up of metals are shown in figure 5.3.

Fig.5.3: Examples of metallic things

Non-metals

Non-metals have a dull surface and low density except diamond (carbon). They cannot be beaten into thin sheets and foils (non-malleable). They cannot be drawn into thin wires (non-ductile). They cannot pass electricity and heat except graphite (carbon). They may be solid, liquid or gas.

Out of 118 elements, twenty elements are generally classified as non-metals; most are gases (hydrogen, helium, nitrogen, oxygen etc.); one is a liquid (bromine) and few are solids (carbon, phosphorus, sulfur and iodine). Common examples of things that are made up of non-metals are shown in figure 5.4.

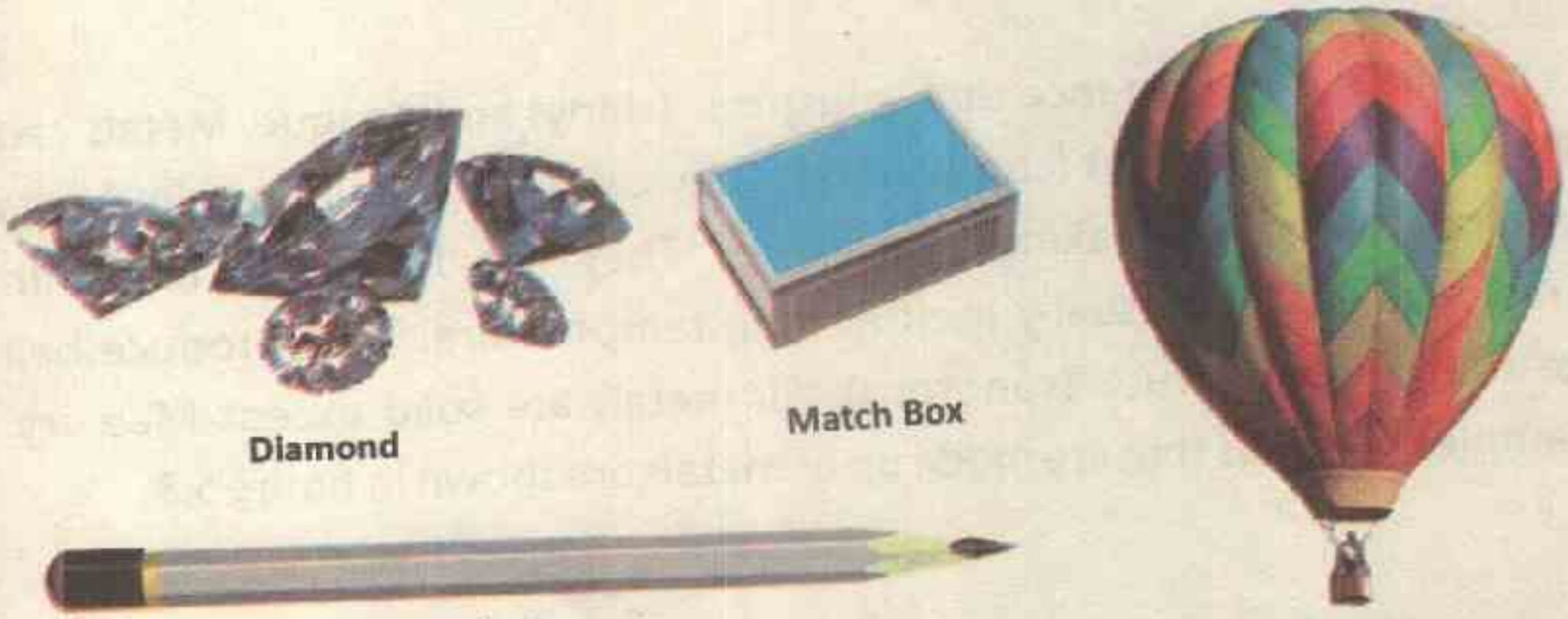


Fig. 5.4: Examples of Non-Metallic things

Uses of metals and non-metals

The uses of metals and non-metals are given as follows:

Uses of Metals

Gold and Silver:

They are used in jewellery due to their hard and shiny appearance.

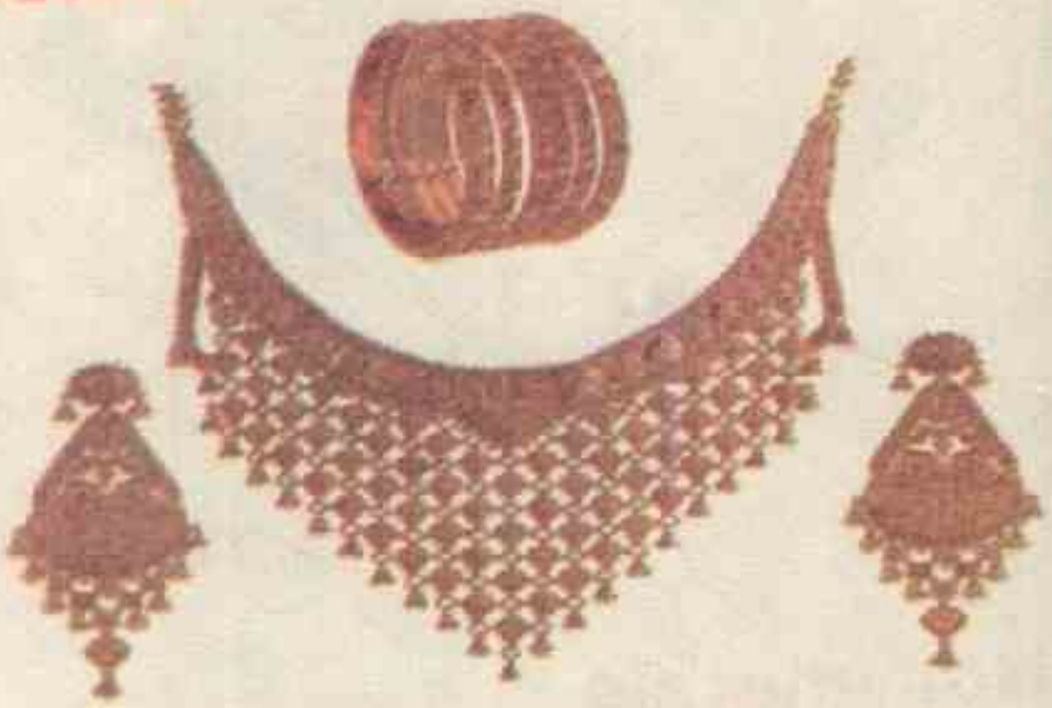
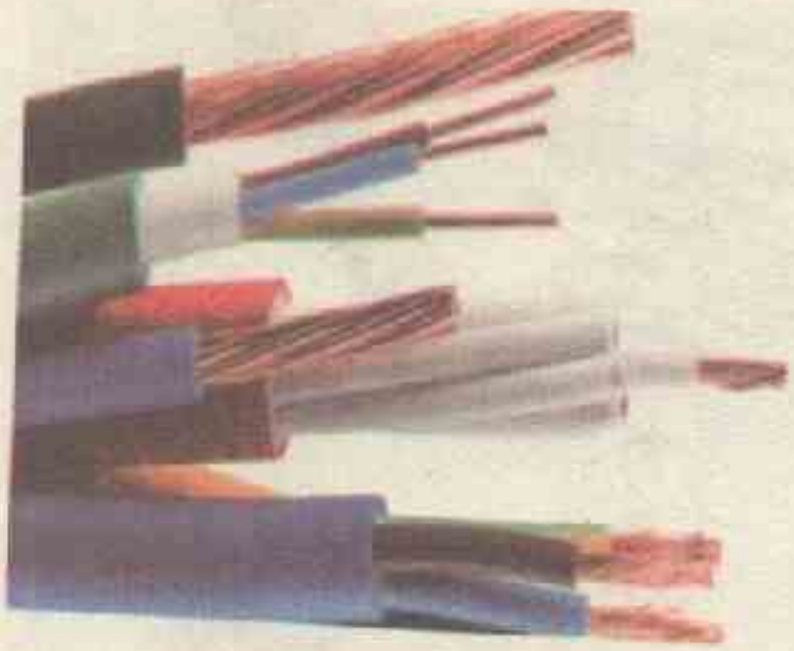


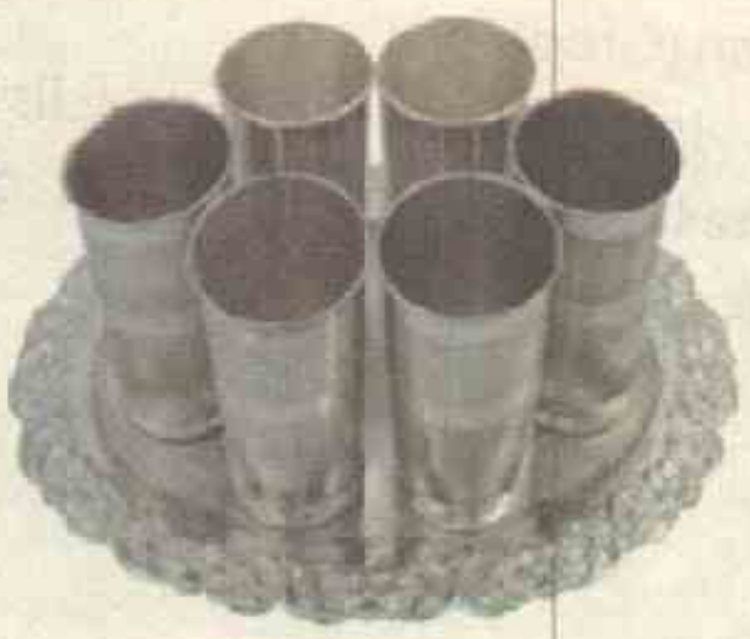
Fig 5.5: Gold Jewellery

Copper and Aluminum:

They are used in electrical wires and utensils because they are malleable, ductile and good conductors of heat and electricity.



Copper Wires



Aluminum Utensils

Fig 5.6

Iron: It is strong and hard. It is used to build bridges and buildings.

Fig 5.7 Uses of Iron

Uses of Non-metals

Carbon (Diamond): It is used as gem in rings and ornaments due to its shiny appearance.

Fig 5.8: Diamond Jewellery

Carbon (Graphite):

It is used as lead in pencils due to its softness and leaving mark on paper surface.

Fig 5.9: Lead in Pencil

Phosphorous:

It is used in the preparation of matches due to rapid burning property.

Fig 5.10: Match Box

Silicon:

It is used in glass preparation due to transparent nature of its compounds.

Fig 5.11: Glass

Compounds

Compounds are pure substances which are formed by the chemical combination of two or more different elements in a fixed ratio. For example, water is a compound of hydrogen and oxygen.

Molecules of a compound have all the properties of that compound. All the molecules of a compound are the same. The molecules of one compound are different from the molecules of the other compounds. Some common compounds along with their constituent elements are given in the table 5.2.

Table 5.2:Compounds and their Constituent Elements

Name of the compound	Constituent elements
Water	Hydrogen, Oxygen
Table salt	Sodium , Chlorine
Carbon dioxide	Carbon, Oxygen
Washing soda	Sodium , Carbon, Oxygen
Baking Soda	Sodium , Hydrogen, Carbon, Oxygen

Activity

Make a list of five compounds that are used in our daily life.

5.2

Table5.3 : Difference Between Elementsand Compounds

S.No.	Element	Compound
1.	An element is a pure chemical substance made up of same type of atoms.	A compound contains atoms of different elements chemically combined together in a fixed ratio.
2.	An element cannot be broken down into simpler substances by chemical reactions.	A compound can be separated into simpler substances by chemical methods/reactions.
3.	An element is represented by a symbol.	A compound is represented by a formula.
4.	Examples are, Iron, copper, silver, gold, nickel etc.	Examples are, Water (H_2O), Sodium chloride (NaCl), Sodium bicarbonate ($NaHCO_3$) etc.

Mixture

A mixture is an impure substance formed when two or more than two substances are physically combined with each other in any proportion. The components from which a mixture is formed, keep their original properties. A mixture can be easily separated by physical means into its components. Sugar solution (a mixture of sugar and water), salt solution (a mixture of salt and water) are the examples of mixture.

Fig 5.12: Example of Mixture

Some common uses of mixtures

Table 5.4 : Mixture and its Uses

Mixture	Uses
Air	Mixture of different gases , used for respiration and burning purposes.
Ice- cream	Mixture of milk, sugar, starch and flavor, used as refreshment.
Tea	Mixture of water, sugar, tea and milk, used as common drink.
Ink	Mixture of different dyes used for writing purposes.
Alloys	Mixture of different elements e.g. Brass, (alloy of zinc and copper) used for making decoration pieces and hardware items.

Activity 5.3

Make a list of five mixtures used in our daily life.

Do you Know

The percentage of gases in air are approximately
Nitrogen 78%,
Oxygen 21%
Noble gases 0.9%
Carbondioxide 0.03%
Water vapours (variable percentage)

Table5.5: Difference between Compounds and Mixtures

S. No.	Compound	Mixture
1.	It is formed by chemical combination of two or more elements	It is formed by physical combination of two or more elements or compounds
2.	Ratio of the constituent is fixed	Ratio of the constituent is not fixed
3.	Energy is released or absorbed during its formation	Energy is neither released nor absorbed during its formation
4.	Its components can be separated by chemical methods.	Its components can be separated by physical methods.
5.	**Components lose their original properties.**	Components maintain their original properties.

Air is a mixture of gases

Air is a mixture of different gases. The main gases present in air are nitrogen, oxygen, carbon dioxide and other gases (inert gases).

How do we know that air is a mixture?

I. Air is a mixture of different gases e.g. oxygen. nitrogen, carbon dioxide and argon and water vapours. Its composition changes from place to place and time to time. For examples, the percentage of oxygen becomes lesser at high altitudes. Similarly, the percentage of water vapours is different at above sea level and in a desert.

ii. The component gases present in air can be separated by physical methods (Fractional distillation).

iii. The gases present in air, show (or retain) their properties.

Point to Ponder

When you add an aspirin tablet to water, would it be a mixture or a compound?

Aspirin in Water

Sources of Carbon dioxide

Main sources of carbon dioxide are given below.

i. Humans, animals and plants breath it out during respiration. Respiration is the process by which living organisms take in oxygen and release carbon dioxide.

ii. Substances containing the carbon are burnt in air e.g. burning of fuels like coal, petroleum and natural gas etc.

iii. Dead bodies of plants and animals are decomposed by microorganisms.

iv. Volcanoes eruption also cause carbon dioxide production.

Do you Know

Carbon dioxide is an important gas because it is used in the process of photosynthesis. In this process, carbon dioxide and water combines and produces carbohydrates and oxygen gas.

Maintenance of carbon dioxide level in nature

It is important to maintain a certain level of CO_2 in the air. Nature maintains the level of CO_2 in the air through the following processes:

i. Carbon dioxide is absorbed by plants, as it is used in preparation of their food.

ii. Carbon dioxide is soluble in water. The oceans and rivers are the major sink of Carbon dioxide to maintain its level.

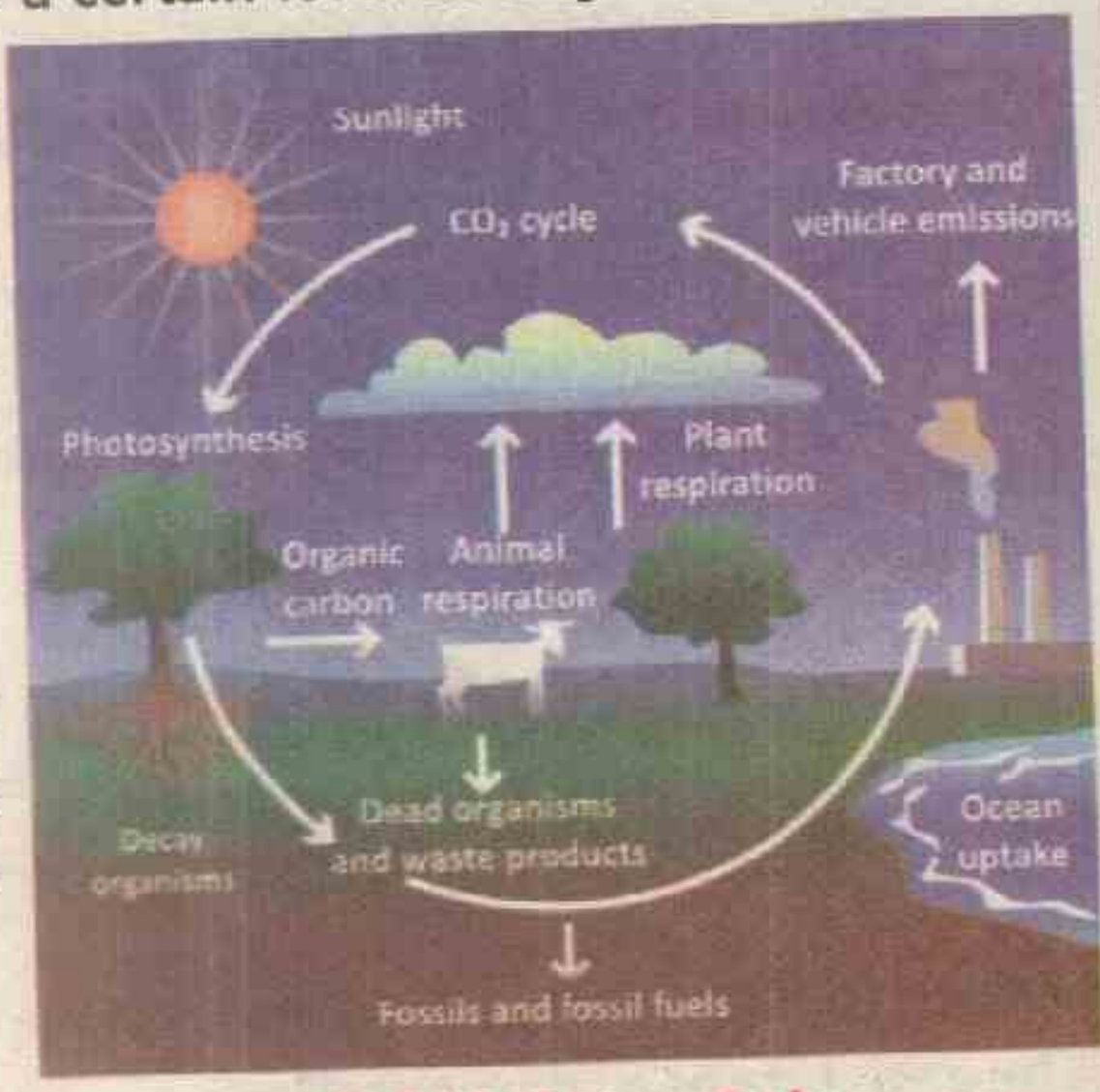


Fig 5.13: Carbon Cycle

Separation of components of a mixture

We have seen that a mixture is formed by mixing together two or more different substances physically. Each component of the mixture keeps its original properties. Therefore, we can take advantage of this property to separate mixtures. Some of the methods used for separating mixtures in to their components are listed below.

1. Filtration
2. Sublimation
3. Distillation
4. Chromatography

1. Filtration

This method is used to separate insoluble particles from liquids. For example, chalk dust can be separated from water by using filter paper. As the mixture is passed through the filter paper, it allows the liquid to pass through the filter paper leaving behind the chalk particles on the filter paper.

The clear liquid that passes through the filter paper is called filtrate, while the particles left behind on the filter paper are called the residue (chalk dust).

Do you Know

Other methods which are used for separating mixtures are,

1. Evaporation to dryness
2. Fractional distillation
3. Crystallization
4. Precipitation
5. Decantation
6. Magnetization and
7. Separation of immiscible liquids.

Activity 5.4

Separate the components of a mixture by filtration

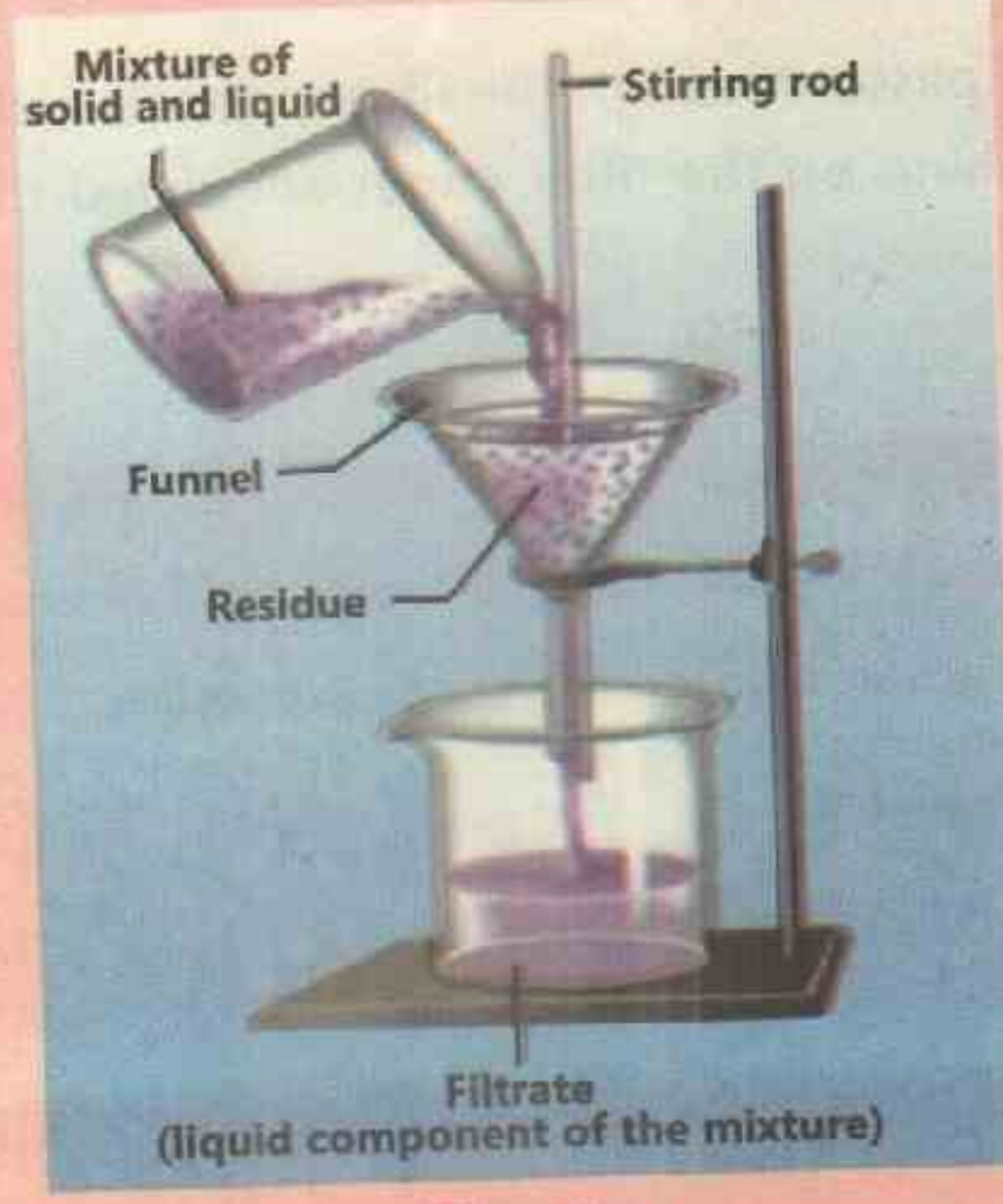
You will need: Beaker, Funnel, Filter paper, Stirring rod, Water, and sand.

Steps:

i. Take water in a beaker and add sand to it, to get a mixture.
ii. Take a filter paper, properly fold it and place it in the funnel.
iii. Fix the funnel in the filtration stand.
iv. Place a clean beaker underneath the funnel.
v. Hold a glass rod into the funnel, so that it is directed to the center of the filter paper.
vi. Pour the mixture slowly, in intervals, while stirring it.
vii. Keep the mixture below the edges of the filter paper.
viii. Allow the mixture to filter.
ix. You will observe that sand particles are left behind on the filter paper as residue .
x. Filterate will be collected in a beaker.

Observation:

(i) What did you learn from it?
(ii)Why sand is left behind in the filter paper.



Filtration

2. Sublimation

Sublimation is that process in which some solid substances, when heated, change directly to the gaseous state without passing through the liquid state. On cooling they become a solid again. Examples of such solid substances are Iodine, Ammonium Chloride and Naphthalene etc.

These substances can be separated from other solids by sublimation. These substances are also purified industrially by the same method.

Activity 5.5

Separate a Solid Mixture by Sublimation

You will need:

China dish, sand, naphthalene (kafoor), funnel, tripod stand, filter paper, sand bath and spirit lamp/burner

Steps

i. Take a mixture of naphthalene and sand in a china dish.
ii. Place the china dish over the sand bath.
iii. Cover the china dish with perforated filter paper.
iv. Invert a funnel over a china dish, having a cotton plug.
v. Heat the sand bath with the spirit lamp gently.
vi. Naphthalene evaporate as white fumes (vapours).
vii. These fumes condense on the inner surface of the funnel.
viii. Remove the funnel carefully and scratch the crystals of naphthalene.
ix. Sand is left in the china dish.

Sublimation

Observation:

Report the activity in your own words in your notebook. What did you learn from it?

3. Distillation

Distillation is a separating technique of miscible liquids, used to recover a solvent from a solution. The solution is heated in distillation flask so that the solvent vaporizes. The vapours formed are passed down a condenser, which is cooled by circulating water into its outer jacket. This condenses (cool) the vapours into a liquid. This method of obtaining a pure solvent from a solution is called distillation.

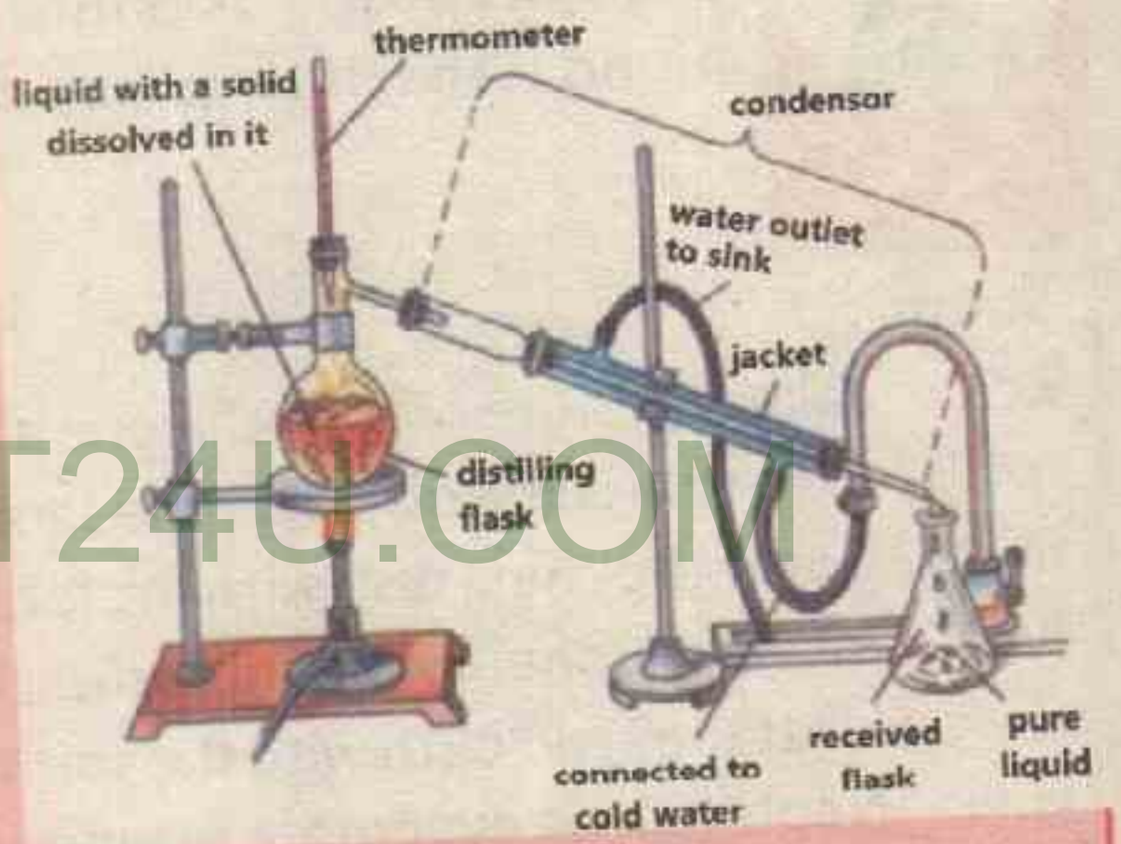
The pure solvent is called the distillate. It is then collected in a receiver. The solute and other impurities are left behind in the distillation flask.

Activity 5.6

You will need:

- Distillation flask,
- Condenser,
- Receiving flask,
- Tripod stand,
- Solution (impure water), and
- Thermometer

A distillation Apparatus



Distillation

Carry out the following steps:

i. Take some solution (impure water) in a distillation flask.
ii. Setup the apparatus as shown in the diagram.
iii. Attach the condenser with the supply of cold water by means of tap water.
iv. Start heating the distillation flask.
v. After some time, the solution (impure water) starts boiling and converts into vapours.
vi. These vapours are passed down the condenser, cooled and condensed back into liquid. The receiver flask receives pure water.
vii. The impurities are left behind in the distillation flask.

Observation:

i. Report the process in your own words in your notebook.
ii. What are miscible and immiscible liquids?

4. Chromatography

Chromatography is a modern technique used for the separation of mixtures. The word chromatography is derived from the Greek words "Chroma" which means "colour" and "graphein" means "to write" because this method was used originally to separate coloured substances. This method uses a solvent moving over a porous or adsorbent medium (e.g. paper) to separate a mixture of solutes. There are various types of chromatographic techniques. The most common and simple technique is paper chromatography.

Activity 5.7

Separate Ink (Black and Blue Ink) by Paper Chromatography

You will need:

Filter paper/ chromatographic paper, Large beaker, **black & blue ink markers and Alcohol & Acetone**

Carry out the following steps:

i. Take a strip of filter paper about 5 cm wide.

ii. Draw a line using pencil about 2 cm on one end of filter paper strip. Do not use pen for this step.

iii. Put small dots in on the middle of the pencil line by means of black and blue marker separately.

iv. Pour the chromatography solution (Alcohol and Acetone) in the beaker.

v. Carefully place the paper into the beaker so that the marker dots are just above the chromatography solution.

vi. Allow the paper to sit in the solution until the liquid reaches the top of paper strip.

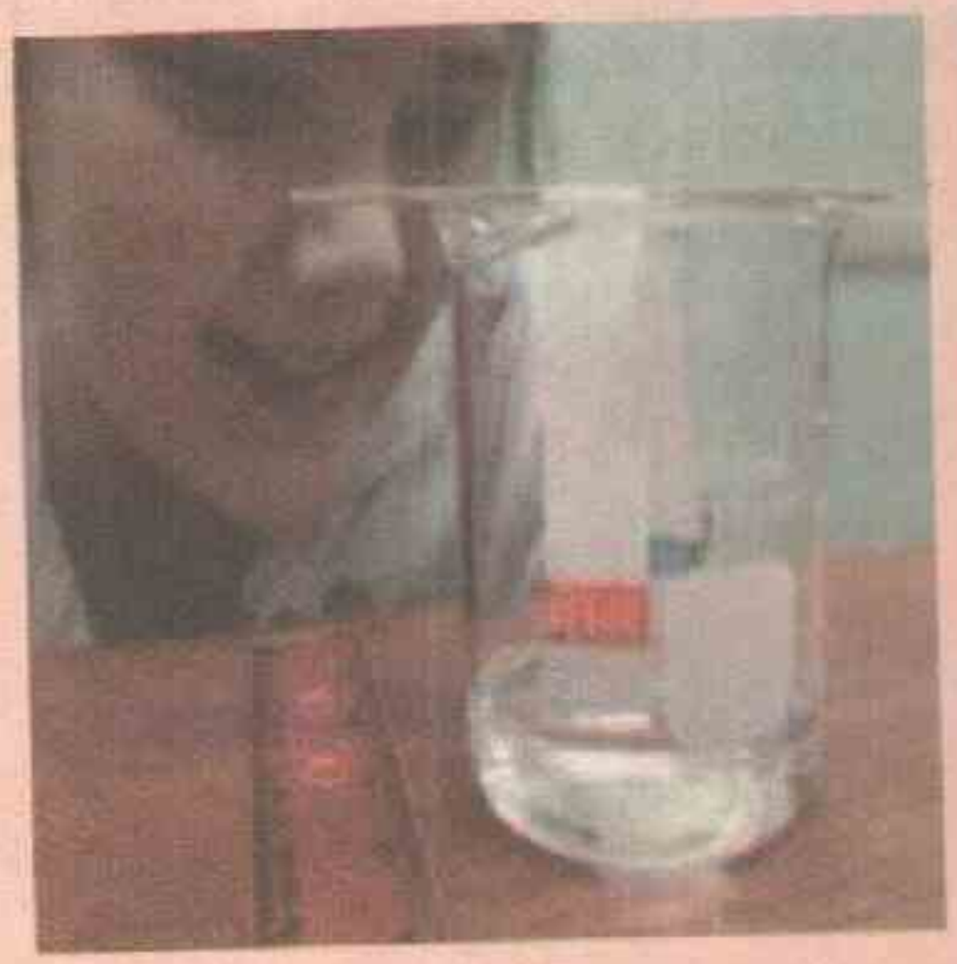
vii. Do not move or shake the set-up during this time. This may take about half an hour.

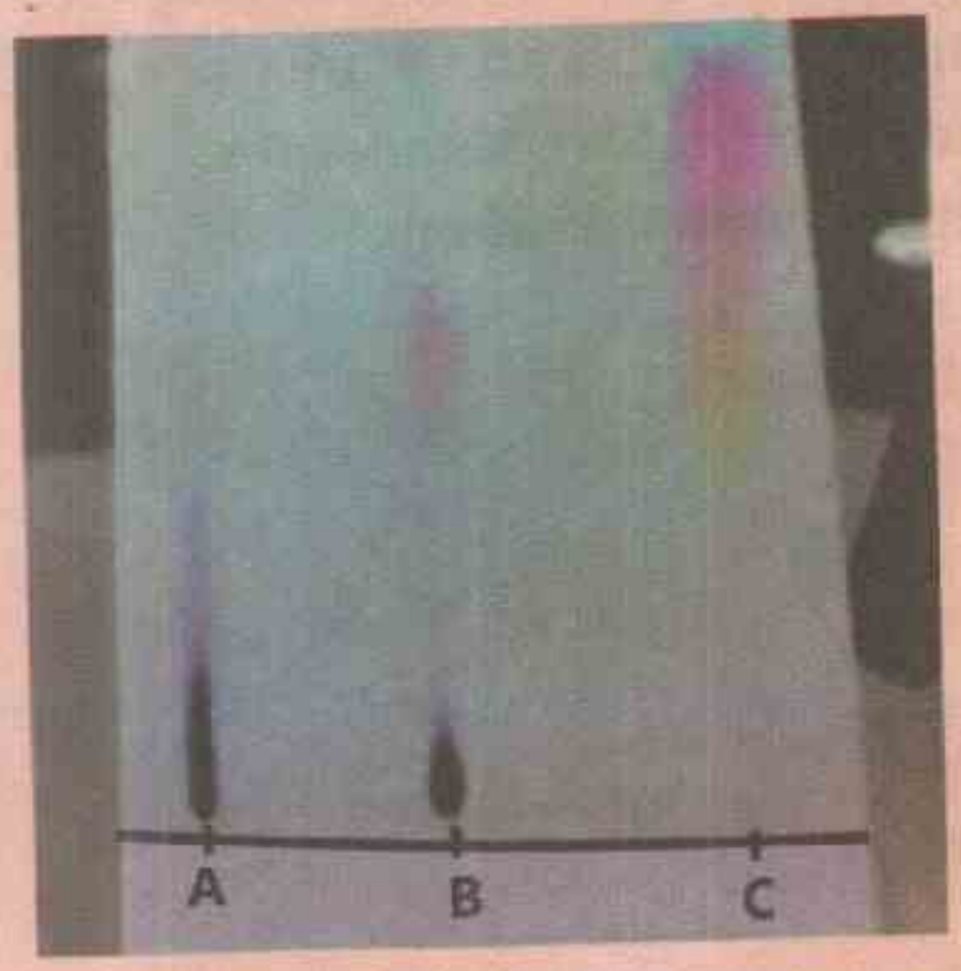
viii. Remove the paper and allow it to dry.

Observation:

Observe the different colours present in the black and blue inks and report your observation in your notebook.

Also, note the precautions, which you have taken during the activity.





Point to Ponder

Think for a moment, that mixture can be separated into its parts. How can a compound be separated into its parts?

Safety measures to conduct science experiments

Safety is a key in any scientific activity. We know that almost all the chemicals have toxic effect and are hazardous to human health. Therefore during experiments the chemicals and reagents must be handled carefully in laboratory. The students should be ensured to strictly follow the safety precautions given below:-

- Never enter a science laboratory without a teacher's permission
- Always listen the instructions carefully.
- Keep the doors and windows of the laboratory open during experiments.
- Do not eat or drink in the laboratory.
- Do not touch any chemical in the laboratory, unnecessarily.
- Do not suck any solution into the pipette with your mouth. Use pipette filler to measure the solution with pipette.
- Always keep your sink clean and do not throw your experimental waste in it.
- Turn off the gas and water taps as soon as your experiment is over.
- Bring your own safety glasses and lab-coat for use.
- Report any accident to the teacher in time.
- Never run in a science laboratory.
- Wash your hand with soap before leaving the laboratory.

KEY POINTS

- Atom is the smallest particle of an element that takes part in chemical reactions. It may or may not exist free in nature.
- Symbol is a short name of an element.
- A molecule is formed by the chemical combination of two or more atoms.

- Compound is a substance, which is formed by the chemical combination of two or more than two different elements in a fixed ratio.
- A mixture is formed when two or more than two substances are physically combined with each other in any proportion.
- Mixture can be separated into its components by physical methods, such as filtration, distillation, sublimation, Chromatography etc.

EXERCISE

A. Select the best answer from the following.

1. The symbol used for sodium is _____
   a) S b) Sd
   c) Na d)N

2. The constituent elements of washing soda are _____
   a) carbon and oxygen b) sodium and oxygen
   c) sodium and carbon d) sodium, carbon and oxygen

3. Which of these is not a mixture?
   a)water b) air
   c) tea d) alloy

4. Which method is usually used to separate coloured substances from each other?
   a) Simple distillation b) Evaporation
   c) Chromatography d) Crystallization

5. The particles left behind on the filter paper in the filtration process are called _____
   a) filtrate b) residue
   c) distillate d) none of them

6. Which atoms are found in CH_4(methane)?
   a) 4 carbon and 4 hydrogen b) 1 carbon and 1 hydrogen
   c) 1 carbon and 4 hydrogen d) 4 carbons and 1 hydrogen

7. The correct order for obtaining salt from a mixture of sand, salt and water is:
   a) dissolving – filtration – evaporation
   b) evaporation – filtration – dissolving
   c) filtration – dissolving – evaporation
   d) dissolving – evaporation – filtration

B. Answer the following questions.

1. How many atoms of the different elements are there in the formulae of the compounds given below?
   (i) Carbon dioxide, CO_2 (ii) Water, H_2O
   (iii) Methane, CH_4 (iv) Vinegar, CH_3COOH
   (v) Sugar, $C_{12}H_{22}O_{11}$

2. Which of the substances listed below are?
Oxygen, sea water, calcium, argon, water, air, carbon monoxide, iron, sodium chloride, diamond, brass, copper, tea, sulphur, milk, nitrogen, ammonia.

a. metallic elements? b. non-metallic elements?
c. compounds? d. mixtures?

3. At room temperature and pressure, which of the substances listed below is?
Bromine, carbon dioxide, helium, steel, air, oil, marble, copper, water, sand, tin, bronze, mercury, salt.

a. a solid element? b. a liquid element?
c. a gaseous mixture? d. a solid mixture?
e. a liquid compound? f. a solid compound?
g.a gaseous element? h. a gaseous compound?

4. Define the following terms, using specific examples to help your explanation:

a. element b. metal c. non-metal d. compound
e. molecule f. mixture

5. Make a list of some common mixtures, stating what they are composed of.

6. Devise a method for obtaining salt (sodium chloride) from salt solution in the school laboratory.

PROJECT WORK

a. Take iron fillings and sulphur powder on a paper and mix them. Then hold the magnet over it.
i. What will happen?
ii. What does it show?
b. Now add iron fillings and sulphur powder in a test tube and heat them until a black solid is formed.
i. Can you separate the components from this black solid product?
ii. What does it show?

Unit

6

Air

After studying this unit, the students will be able to:

- Recognize the importance of air.
- Identify the composition of air.
- Relate the properties and uses of gases in air with the composition of air.

Introduction

Air is essential for the survival of all forms of life on earth. You cannot imagine any kind of life in the absence of it.

You have learnt in the previous unit that air is a mixture of different gases. In this unit, you will be able to identify these different gases present in air and the uses of these gases.

The Air

Look around you. Can you see air? Can you feel it? Air cannot be seen by human eye, but its presence is often noticed in every day happenings such as:

i. The rustling of tree leaves.
ii. The flight of the kite.
iii. The breeze can be felt when you switch on the fan.
iv. You can feel the breeze when you ride a bicycle.

Can you think of some more instances where you can feel air?

Fig 6.1: Air

The wind or breeze we feel is actually the movement of air.

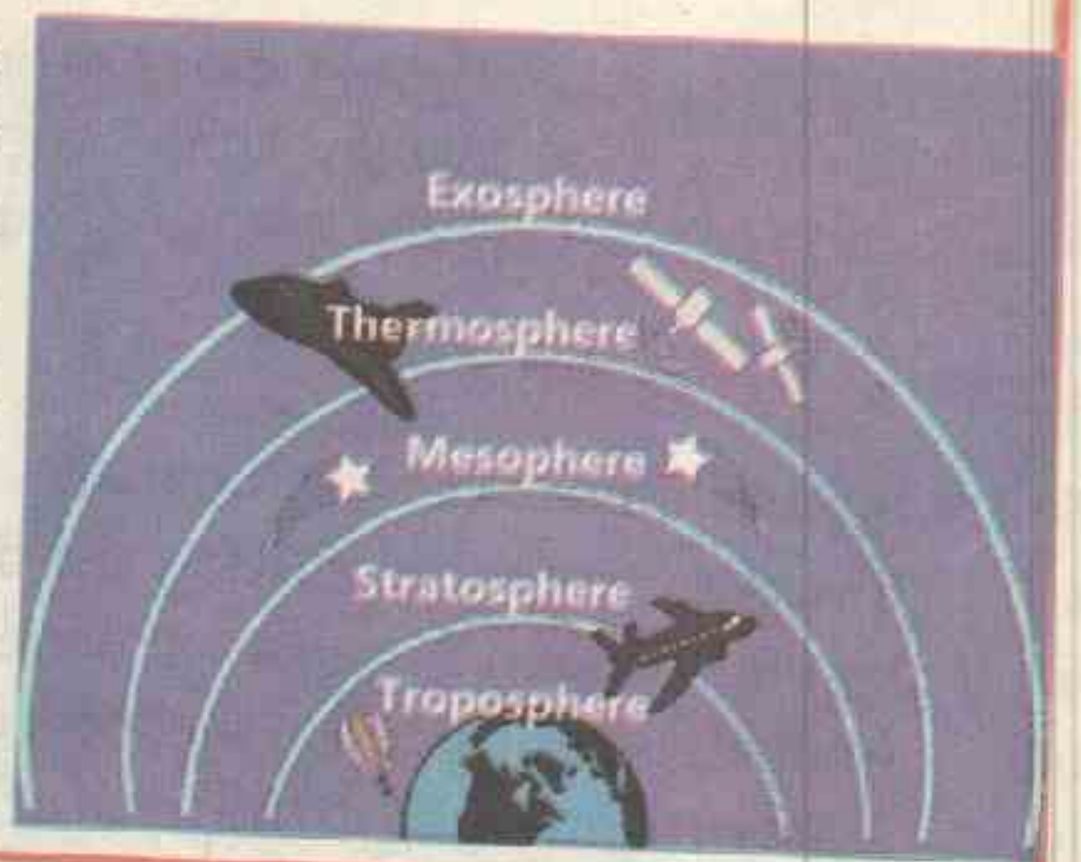
The surface of earth is surrounded by a thick layer of air (gases),which reaches a height of about 400 km. We call this thick layer of gases as "atmosphere".

Human beings and animals move freely and breathe in the atmosphere.

You know that air is a matter because it occupies space and has weight.

Do you Know

The atmosphere is made up of five layers: the troposphere, the stratosphere, the mesosphere, the thermosphere and the exosphere. We live in the troposphere, which is the lowest layer and is about seven miles thick. The second lowest layer is the stratosphere, which blocks some of the Sun's heat coming to Earth so that we don't get overheated down here.



Importance of Air

i. No life is possible on earth without air. All living things require air to breathe.
ii. Air acts as a propagating medium for sound.
iii. Air supports water cycle.
iv. Air helps in pollination of seeds.
v. Air maintains temperature on the earth surface.
vi. Air supports the flight of aeroplanes and birds in the atmosphere.

Composition of air

Air is mixture of the following gases:

a. Nitrogen (78%)
b. Oxygen (21%)
c. Carbon dioxide (0.03%)
d. Noble Gases (about 0.9 %)
e. Water vapours (variable percentages)

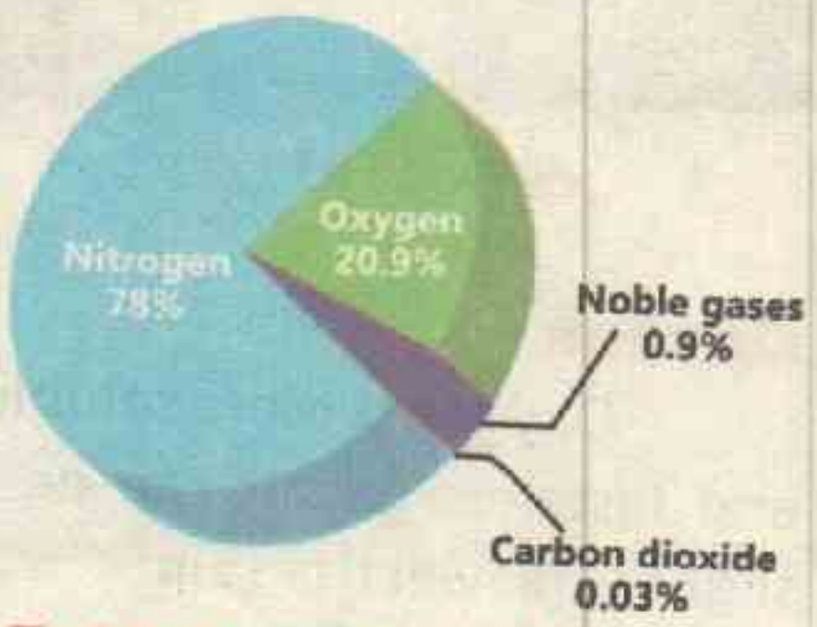


Fig 6.2: Composition of Air

Properties and Uses of Gases in Air

A brief account of each of these gases is as follows:

Nitrogen

Nitrogen is the main component of air. It is a colourless and odourless gas. It is slightly lighter than air. It is obtained form air by liquefaction of air. It neither burns nor support burning.

Uses of Nitrogen

Following are some uses of nitrogen gas:

i. It slows the burning, rusting and decay processes.
ii. Liquid nitrogen is used as coolant.
iii. Animals use nitrogen in the form of proteins
iv. Plants use nitrogen in the form of nitrates (fertilizer).
v. Compounds of nitrogen are used in the preparation of fertilizers, medicine etc.

Liquid Nitrogen Fig 6.3: Fertilizer

Oxygen

Oxygen is more soluble in water than air. It is a colourless, odourless and tasteless gas. It can be separated from air by its liquefaction. It is slightly heavier than air.

Uses of oxygen

Following are some uses of oxygen gas:

i. It is essential for breathing.

ii. It is responsible for the process of burning, decaying and rusting.

iii. Liquid oxygen is used as a fuel in space shuttle.

iv. Oxyacetylene flame is used in cutting and welding of metals.

v. It is used in hospitals for patients having problems in breathing.

Patient using Oxygen in Hospital

Fig 6.4: Oxyacetylene flame used in welding

Activity

6.1

You will need:

Candle

Match box

Glass

Carry out the following:

i. Take a candle and light it with match box.

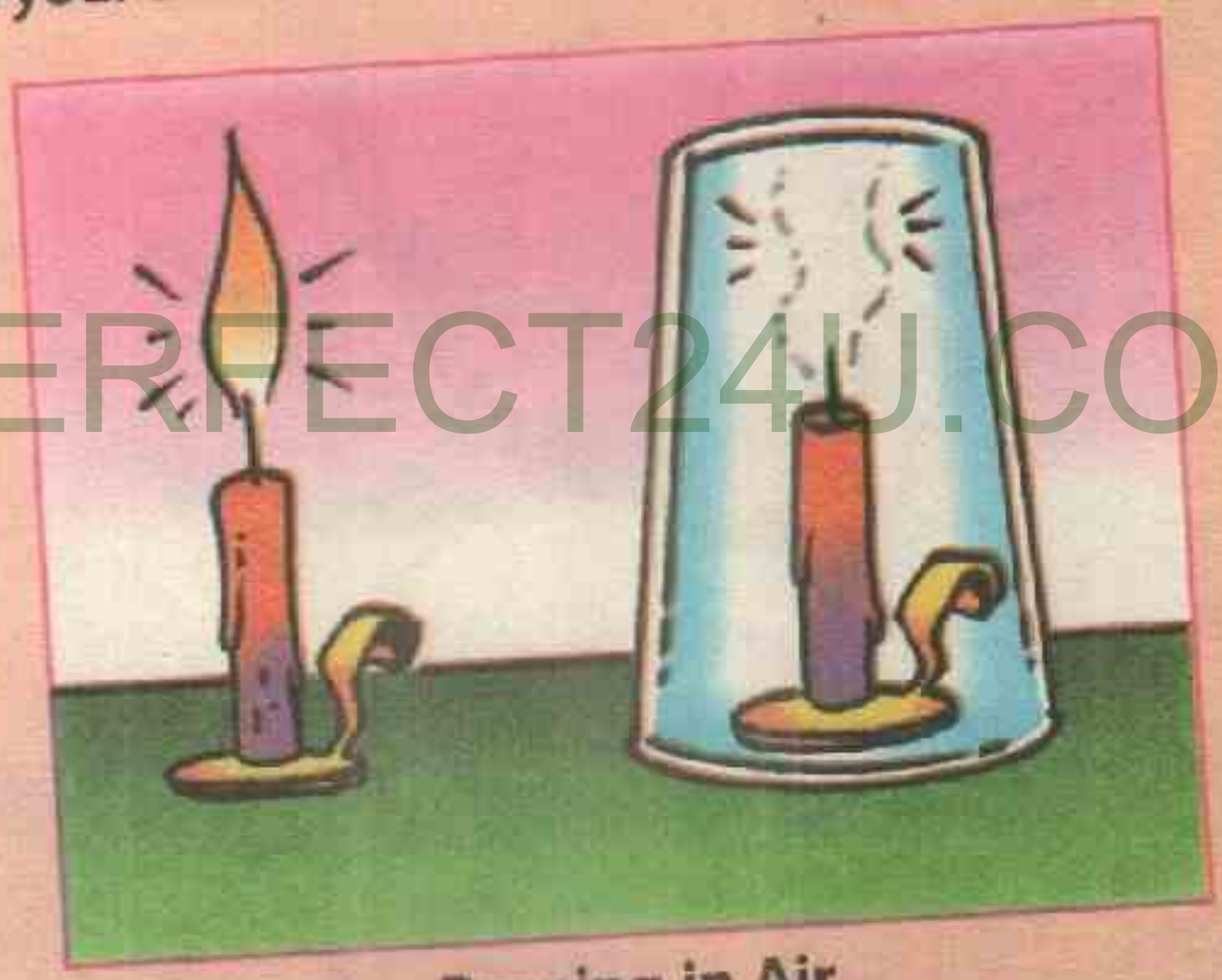
ii. Place it carefully on the table.

iii. You will notice that candle is burning.

iv. Now take the glass jar and place it carefully on the candle.

v. What do you notice? Why does the flame go out?

vi. Record your observation in your notebook.



Burning in Air

Carbon dioxide

Carbon dioxide is present in air in very small amount. It is a colourless and odourless gas. It is fairly soluble in water. It is heavier than air. It neither burns nor helps in burning.

Uses of Carbon dioxide gas

Following are some uses of Carbon dioxide gas:

i. It is used in fire extinguishers.

ii. It is used in soft drinks.
iii. In the preparation of baking and washing soda, carbon dioxide is used.
iv. It is used by plants during photosynthesis to prepare their food.

Human beings and animals inhale oxygen and exhale CO_2. On the other hand plants absorb CO_2, as they prepare their food during photosynthesis. This is how the balance of CO_2 is maintained in the air.

Fig 6.5:
Fire extinguishers

Activity 6.2

You will need:
Straw
Glass
Lime water (Calcium Hydroxide i.e. $Ca(OH)_2$

Carry out the following:

i. Take a glass and fill it half with limewater.
ii. Blow the exhaled air from your mouth with the help of straw.
iii. After some time, the limewater turns milky.
iv. Why, does the limewater turn milky?
v. Discuss in groups.

Air we Exhale has Carbon dioxide

Rare gases (inert gases)

Air contains some other gases in a very small fraction called rare or inert gases. These gases are chemically inactive. They are also known as noble gases. These gases are colourless and odourless. These are helium, neon, argon, krypton and xenon. Among them argon is present in maximum amount (almost 0.9 % by volume of air). The remaining gases are present in a very small amount in air.

Uses of inert gases

Following are some uses of inert gases:

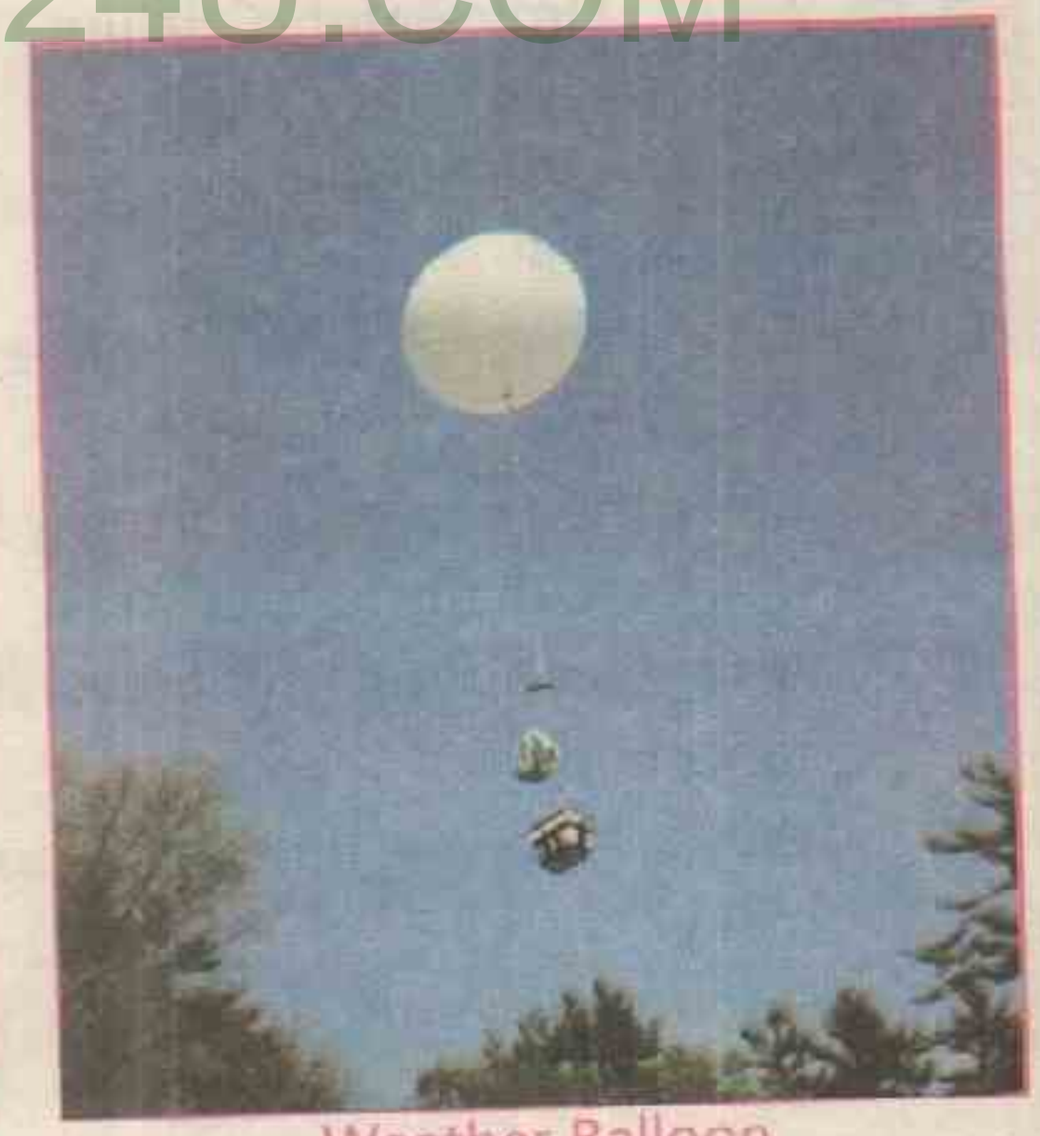
i. **Argon is filled in the electric bulbs.**

ii Mixture of helium and oxygen is used for respiration by deep-sea drivers.

iii. Neon signs are used in advertising boards.

iv. Helium is used for filling weather balloons.

Neon Signs



Weather Balloon

Fig 6.6

Water vapours in air

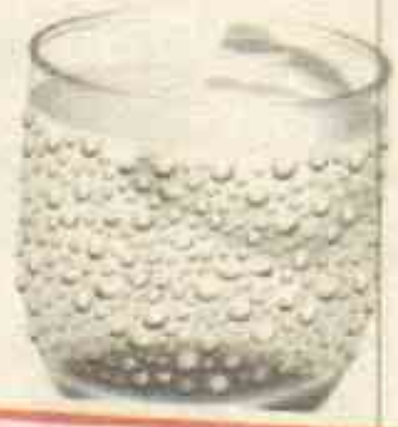
Water from sea, lakes, rivers etc. is changing into vapours continuously. These vapours are suspended in the air. When water vapours are cooled, they change back into liquid and appear in the form of clouds, rain, snow and fog.

The amount of water vapours in air, changes from place to place and time to time. The amount of water vapours near the sea and rivers are more than the dry places on earth. Similarly, more water is converted into vapours in summer than in winter season due to high temperature.

Fig 6.9: Water vapour in air

Do you Know

If you leave a glass of cold water for a while, you will see droplets of water around it. These droplets are called water vapours.



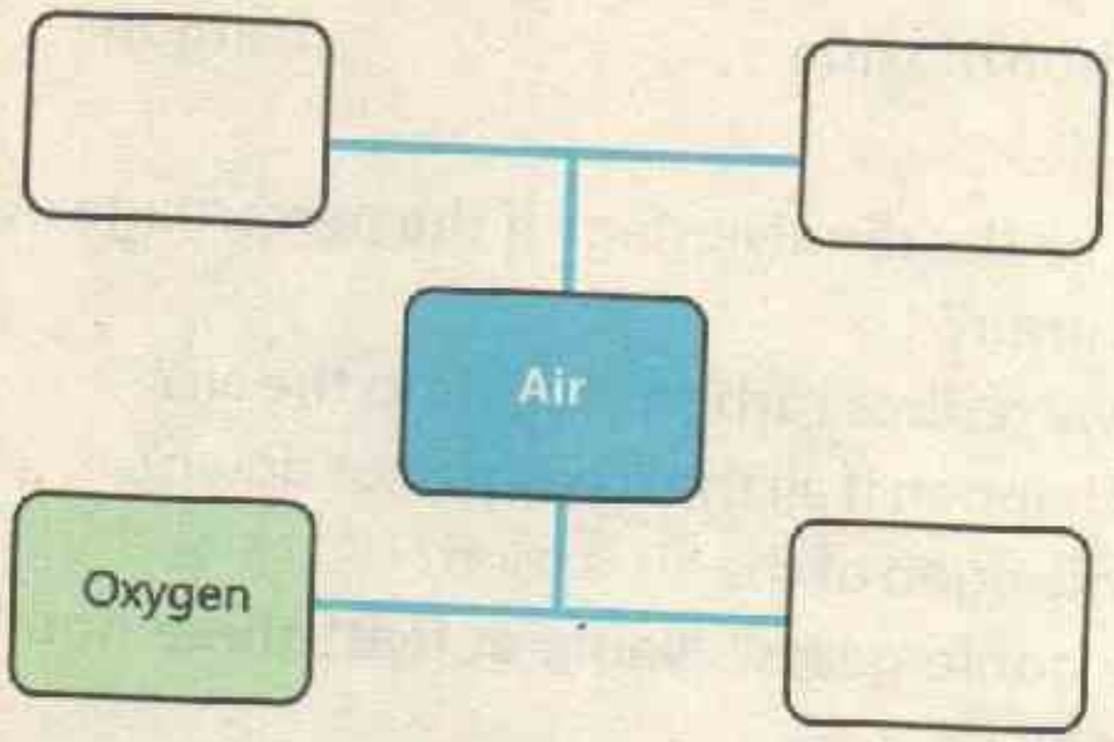
KEY POINTS

- Air is necessary for life on earth.
- Air contains nitrogen, oxygen, carbon dioxide, inert gases and water vapours.
- Air contains 78% nitrogen, 21% oxygen, 0.03% carbon dioxide and about 0.9% inert gases.

- Nitrogen is used as coolant.
- Oxygen is produced during the process of photosynthesis.
- Plants absorb carbon dioxide and convert it into glucose.
- Carbondioxide is used in fire extinguishers and soft drinks.

EXERCISE

A. Fill the boxes with names of constituent gases of the air.



B. Select the best answer from the following.

1. Which of these gases are present in maximum amount in air?
   a) oxygen
   b) nitrogen
   c) chlorine
   d) carbon dioxide

2. Oxygen is not necessary for?
   a) combustion
   b) rusting
   c) respiration
   d) photosynthesis

3. Carbon dioxide is used in?
   a) soft drinks
   b) fire Extinguishers
   c) photosynthesis
   d) all of them

4. Which is true for nitrogen?
   a) used as dry ice
   b) used as coolant
   c) used in respiration
   d) used in combustion

5. What is the volume of oxygen and carbon dioxide in air?
   a) 21% carbon dioxide and 0.03% oxygen
   b) 0.03% carbon dioxide and 78 % oxygen
   c) 78% carbon dioxide and 21%oxygen
   d) 0.03% carbon dioxide and 21% oxygen

6. Inert gases are not used in?
   a) electric bulbs
   c) sign boards
   c) photosynthesis
   d) weather balloons

7. Which gas in air is necessary for burning process.
   a) oxygen
   b) nitrogen
   c) carbon dioxide
   d) argon

C. Answer the following questions.

1. What will be the disadvantage if the percentage of carbon dioxide is increased in air?
2. How can we reduce carbon dioxide in the air?
3. What will happen if all the trees are cut down?
4. How the nitrogen of the air is used?
5. What are noble gases? Name at least three noble gases which are present in air.
6. Complete the given table by writing one suitable answer.

Gases / Properties	Nitrogen	Oxygen	Carbon dioxide	Water vapours
Percent by volume in air				
Uses				

PROJECT WORK

A student burnt a candle in air. He saw flame, during burning of the candle. This continued till all the candle was burnt out. At the end he saw nothing left?

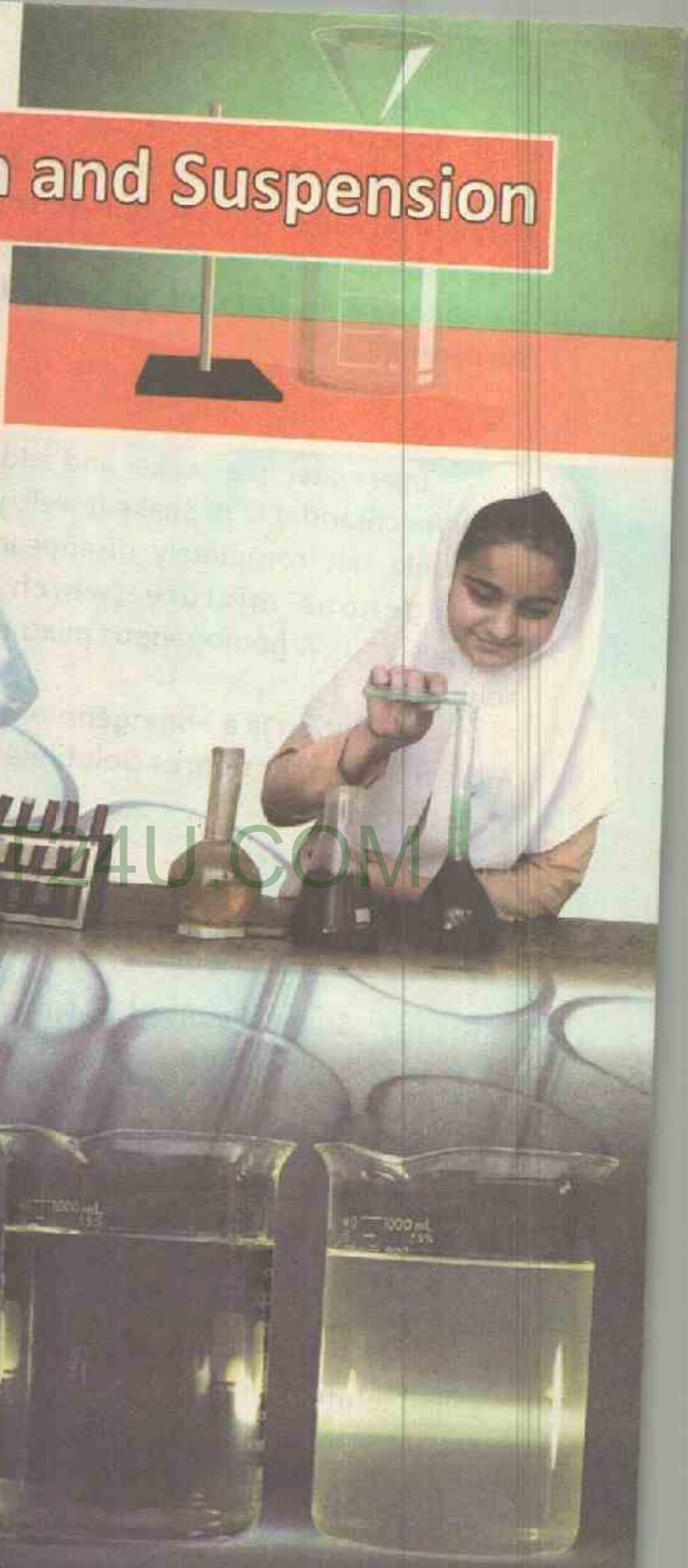
a. What happened to the candle after burning?
b. What do you think is necessary for burning of the candle?
c. Can you guess the chemical name of this burning process?
d. Can you give the name of those gases which are formed during burning process?
e. Can this burning process be reversed? Give reasons.

Unit

7 Solution and Suspension

After studying this unit, the students will be able to:

- Differentiate between solute, solvent and solution.
- Identify solute and solvent in a solution.
- Explain the formation of solution by the particle model.
- Distinguish between aqueous, dilute and concentrated solutions.
- Demonstrate the use of water as a universal solvent.
- Prepare saturated and unsaturated solutions.
- Define solubility.
- Investigate the effect of temperature on solubility using a variety of compounds.
- Differentiate between solutions and suspensions.
- Identify uses of solutions and suspensions in daily life.



Introduction

You have already learnt about different types of mixtures in unit V, they all are examples of solution. You might have enjoyed a glass of mango juice or a cup of tea or perhaps you are fond of perfumes. All these things are solutions. In this unit, you will study in detail about solutions and suspensions.

Solution

Take water in a beaker and add some table salt (Sodium chloride) in it. Shake it well, you will see that the table salt completely disappears and makes a homogenous mixture (which has uniform composition). A homogenous mixture is also called a solution.

Fig 7.1:
Salt dissolved in water

A solution is a homogenous mixture of two or more than two substances. Solutions can exist in three states of matter.

For example

Gas: The air is a solution of several gases.

Liquid: Sugar dissolved in water is an example of liquid solution.

Solid: Brass is a solid solution of zinc and copper metals.

Fig 7.2
Brass screw

A solution consists of a solvent and a solute.

Solute

The component of solution which is present in smaller quantity, is called solute.

Solvent

The component of solution which is present in larger quantity, is called solvent.

For example, salt solution is made by dissolving salt in water. In this solution, salt is solute and water is the solvent.

Fig 7.3 Solution

Point to Ponder

Can you name some solvents, other than water?

Aqueous solution

The solution, which is formed by dissolving a substance (solute) in water (solvent) is called an aqueous solution. In aqueous solution, water is present in greater amount and is called as solvent. For example, table salt (sodium chloride) in water. The solution, in which solvent is something other than water is called non aqueous solution. For example, in different perfumes, alcohol is used as solvent.

Activity 7.1

Aqueous and non- aqueous solution

You will need:

Two glasses, Table salt (Sodium chloride), Mustard oil, Water

Carry out the following:

i. Take water in one glass and mustard oil in the other glass.
ii. Add the salt to both and shake it well.
iii. Notice the difference.
iv. Identify the glass, which dissolves the table salt.
v. Report your observation in your notebook.

Suspension

A suspension is a heterogeneous mixture (which does not have a uniform composition) of undissolved solute in a given solvent. The particles of solute are bigger in size and can be seen with human eye. The particles of suspension settle down, if kept undisturbed for some time. The particles of suspension can be separated by the process of filtration. For example, chalk and sand in water.

Activity 7.2

Difference between solution and suspension

You will need:

- Two glasses/ beakers
- Sugar
- Chalk
- Water

Carry out the following steps:

i. Take a small amount of water in two beakers.
ii. Add some powdered chalk to one beaker and sugar to another.
iii. Stir it well and leave both the glasses undisturbed for some time.
iv. Observe both the glasses carefully.
v. Identify that glass which contains a suspension.
vi. Report your observation in your notebook.

Chalk Suspension

Sugar Solution

Fig 7.4
Solution and Suspension

Titbit

Many medicine bottles contain an insoluble solid in water. The bottle has to be shaken well before use to produce a suspension, so that the solid is spread evenly throughout the bottle and the patient takes the correct amount of the medicine.

Uses of Solution and Suspension in Our Daily Life

Some of the uses of solutions and suspension in our daily life are given as follows.

Table 7.1 : Uses of Solution and Suspension in Our Daily Life

S. No	Item	Use in daily life
1.	Paint	It is a suspension. Paints are used as protective coating, to cover the metallic surfaces.
2.	Blood	It is a suspension. It is an important part of our body. It carries food and oxygen to different parts of the body.
3.	Medicine	A number of medicines are available in the form of suspensions.
4.	Juices	Solutions and suspensions are used as juices in daily life. For example, fruit juices
5.	Carbonated drinks	Carbonated drinks are solutions used as soft drinks.

Particle model of solution

Matter is made up of small particles (atoms, Ions or molecules). Particle model of solution can best be explained on the basis of particle model theory. The particle model theory explains the nature of matter and their interaction with other substances. The main points of the particle model theory are:

1. All matter is made up of small particles.
2. The particles of matter are always in motion.
3. The particles have spaces between them.
4. Adding heat to matter makes the particles move faster.

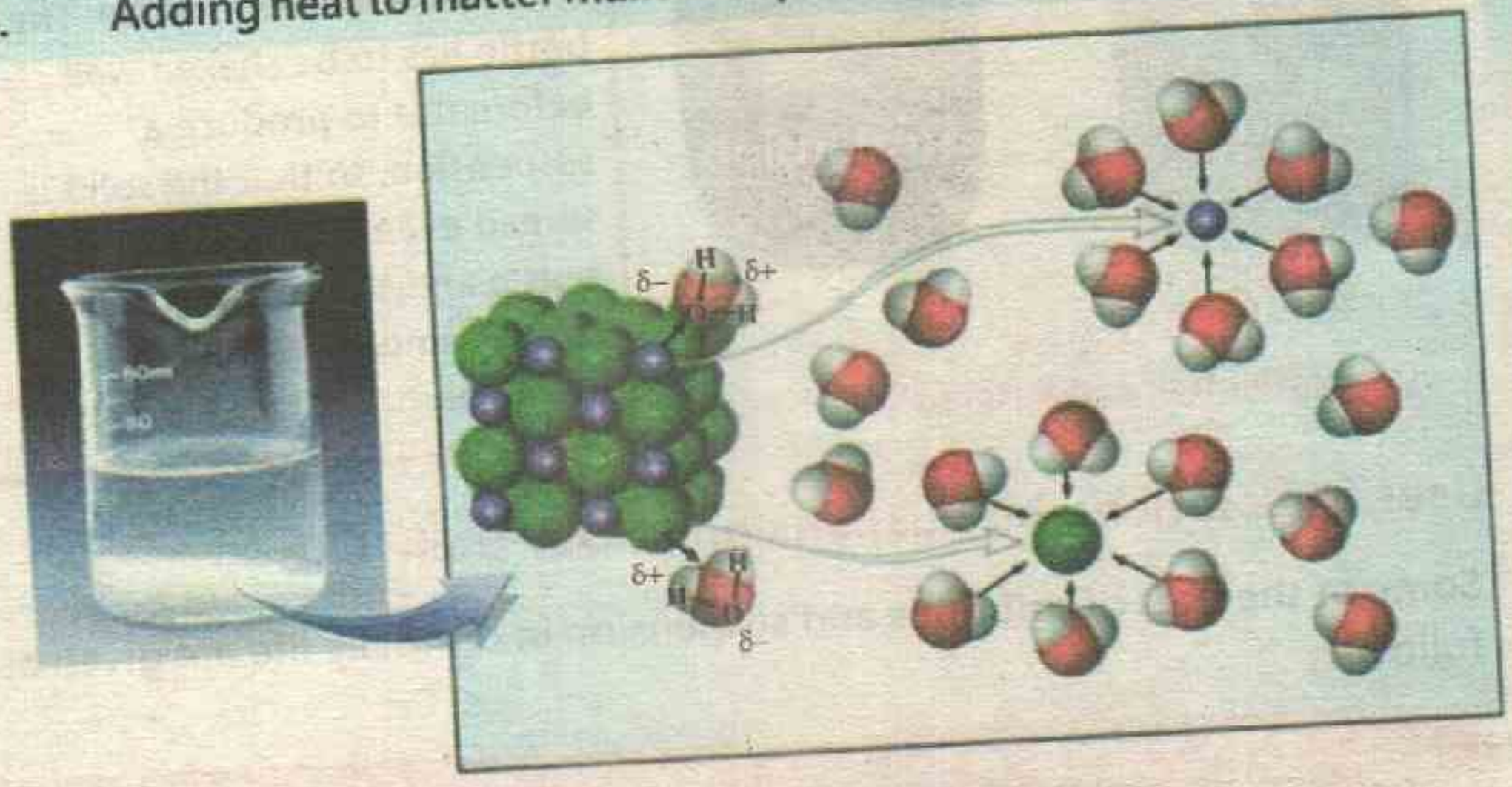


Fig 7.5: Particle model of solution

The particle model of matter provides a useful way to visualize solutions. When a solid (solute) is added into a liquid (solvent), the solubility of the solute depends on the solute and solvent interaction. The solubility and non-solubility of the solute depends on the attractive forces between solute-solute and solute and solvent particles.

If force of attraction between solute-solute particles is weaker than the solute-solvent particles, the solute will be soluble in solvent. But if force of attraction between solute-solvent particles is weaker than the solute-solute particles then the solute will be insoluble in solvent.

Water as a universal solvent

Water is called the "universal solvent" because more substances dissolve in water than in any other liquid. It means that wherever water goes, either through the air (water vapors), the ground (rivers, streams) or through our bodies (blood, food), it dissolves chemicals, minerals and nutrients.

Fig 7.6: Water as universal solvent

The chemical composition and physical characteristics of water make it an excellent solvent. A water molecule has an oxygen atom and two hydrogen atoms. The hydrogen side of each water (H_2O) molecule is different from the oxygen side. This difference in water molecule makes it attractive for other substance This attraction is responsible to make water a universal solvent. For example, salts, sugar, alcohols etc. can be dissolved in water.

Point to Ponder

Water is universal solvent, but it cannot dissolve substances like oil, why?

Dilution of solution

The solutions are classified as dilute or concentrated, on the basis of amount of solute present in solvent.

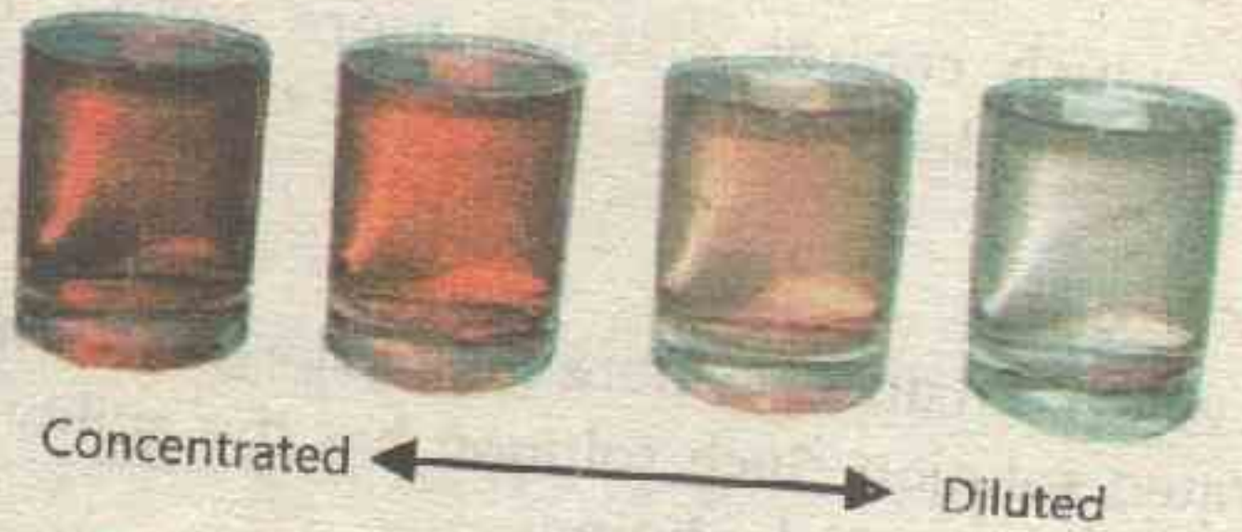


Fig 7.7: Dilute & Concentrated Solutions

Dilute solution

Dilute solutions are those solutions, which contain small amount of dissolved solute in the solution.

Fig 7.8
The two beakers contain the same amount of solute

Concentrated solution

Concentrated solutions are those solutions which contain large amount of dissolved solute in the solution.

For example, concentrated solution of sugar. It shows that the addition of solvent (water) will decrease the concentration and addition of solute (sugar) will increase the concentration.

Fig 7.9: Concentrated and dilute solution

Saturated solution

A solution, which cannot dissolve more solute at a given temperature, is called saturated solution.

Unsaturated solution

A solution, which can dissolve more solute at a given temperature is called an unsaturated solution. Such solution has the ability to dissolve more solute to become a saturated solution.

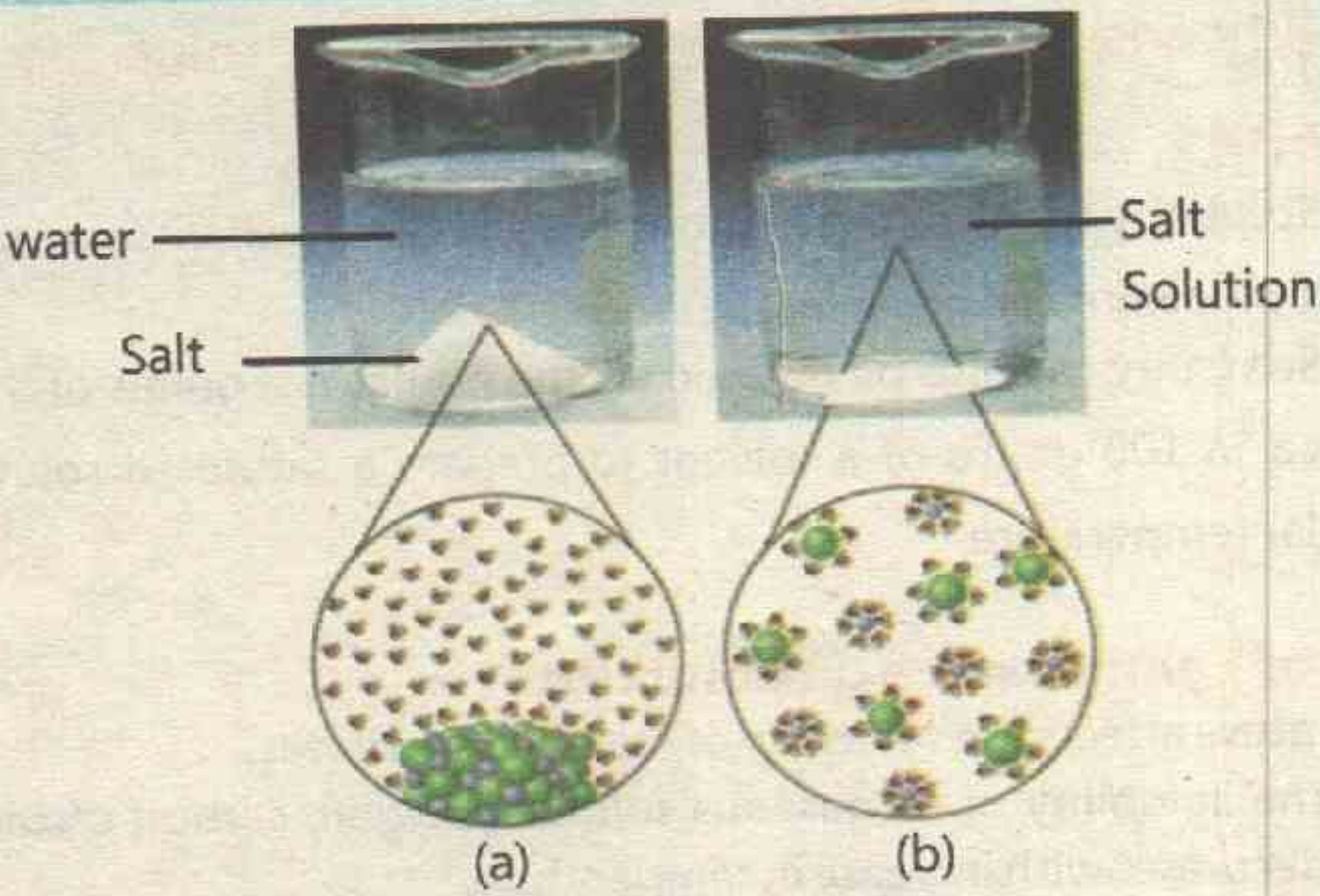


Fig 7.10 Saturated and Unsaturated Solutions

Saturated and Unsaturated Solutions

Activity 7.3

Differentiate between saturated solution and unsaturated solution

You will need:
Two glasses, Sugar, Water
Carry out the following:

i. Take some water in both the glasses and label them as A and B.
ii. Add some sugar to both glasses A and B.
iii. Stir it well and add more sugar (solute) to glass B.
iv. Again add more sugar (solute) to glass B and stir it to dissolve.
v. Add further amount of sugar (solute) to glass B.
vi. Leave both the glasses undisturbed for some time.
vii. Observe both the glasses carefully.
viii. What do you observe in glass B.

Observation:

Identify the glasses containing the saturated solution and unsaturated solution.

Report your observation in your notebook.

Solubility and effect of the temperature on solubility

Solubility

Solubility refers to the amount of solute that will dissolve in a given amount of solvent at a given temperature.

Solubility can also be defined as, the number of grams of the solute dissolved in 100 grams of a solvent to prepare a saturated solution at a particular temperature.

Effect of Temperature on Solubility

Temperature affects the solubility of most of the solutes.

i. The solubility of all gaseous solutes (oxygen, carbon dioxide etc.), decrease with increase in temperature.

ii. The solubility of heat absorbing solutes increase with an increase in the temperature, such as, potassium nitrate (KNO_3) and calcium chloride ($CaCl_2$).

iii. The solubility of heat releasing substances decreases with an increase in temperature, for example calcium oxide (lime).

iv. The solubility of table salt (NaCl) does not greatly change with an increase in temperature.

Fig 7.11: Solubility

Point to Ponder

As temperature increases, solubilities of gases decrease.

What will happen to aquatic life if the water they live in becomes too warm?

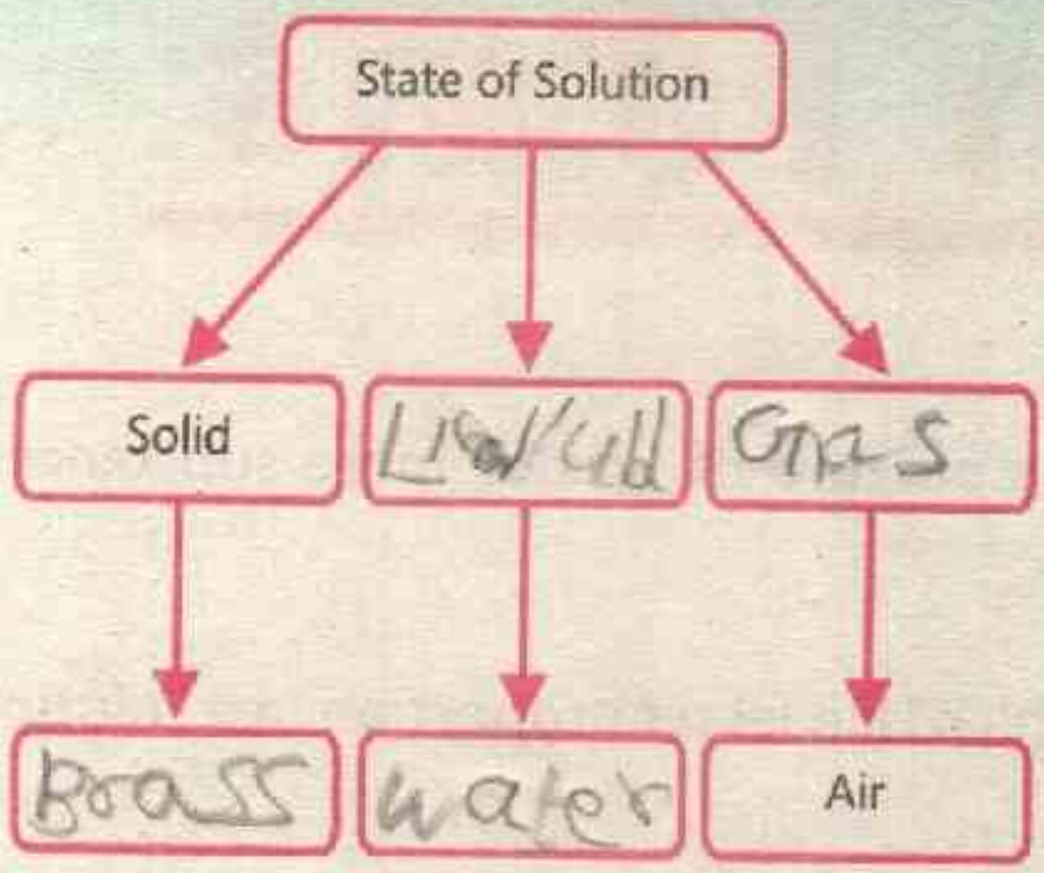
KEY POINTS

- A homogenous mixture of two or more substances is called solution.
- A substance which is in lesser proportion in a solution is called solute.
- A substance which is in greater proportion in a solution is called solvent.

- A heterogenous mixture of undissolved solute in a given solvent is called suspension.
- Saturated solutions are those in which no more solute can be dissolved at a particular temperature.
- **The amount of solute (in gram) which can be dissolved in 100 gram of solvent to get a saturated solution at a particular temperature is known as solubility.**
- Solubility of a solute depends upon temperature.

EXERCISE

A. Fill in the following diagram:



B. Select the best answer from the following.

1. Which of these are completely soluble in water?
   a) sand
   b) cooking oil
   c) wax
   d) table salt (Sodium chloride)
2. A solution is made by dissolving some salt in a beaker of water. The salt is referred as
   a) solute
   b) filtrate
   c) solution
   d) solvent
3. Solubility of which of the following substance increases with increase in temperature?
   a) table salt (NaCl)
   b) carbon dioxide
   c) potassium nitrate (KNO_3)
   d) oxygen
4. Which statement is true for saturated solution?
   a) maximum solute at given temperature
   b) can dissolve more solute
   c) small amount of solute
   d) further added solute will vanish
5. Water insoluble substance is?
   a) salt
   b) sugar
   c) cooking oil
   d) milk

6. Aqueous solution is formed by dissolving a substance (solute) in ____.

a) alcohol b) water

c) cooking oil d) vinegar

7. Which statement is true for suspension?

a) Solute is completely dissolved in solvent

b) Solute is not completely dissolved in solvent

c) Have uniform composition

d) Solute cannot be seen with human eye

C. Answer the following questions.

1. Differentiate between suspension and solution.
2. What will be the disadvantage if water was not a universal solvent?
3. Why sugar will dissolve faster in hot water than ice chilled water?
4. How can we convert an unsaturated solution into saturated solution?
5. Make a list of some common solutions that you use in your home and state from what they are made up of?

PROJECT WORK

Put the given substances in separate glasses containing water.

i.	Flour	ii.	Clay	iii.	Sugar
iv.	Table salt	v.	Cooking oil	vi.	Milk
vii.	Spirit	viii.	Lime	ix.	Starch

a. Shake these substances well for some time.

b. Leave these glasses undisturbed for some time. Classify these substances as solution or suspension.

c. Report your observations in the notebook.

Unit

8

Energy and its Forms

After studying this unit, the students will be able to:

- Explain that energy provides the ability to do work and can exist in different forms.
- Identify different forms of energy with examples.
- Differentiate between kinetic and potential energy.
- Demonstrate how one form of energy is converted into other form of energy?
- Identify that energy is dissipated in atmosphere.
- Explain that energy is conserved during conversion of different forms of energy.
- Explain the importance of energy in improving the quality of life.
- Identify energy converters in their surroundings.
- Illustrate energy conversion to other forms using an energy converter.
- Explain the term renewable.
- Describe the advantages of using renewable energy sources.
- Describes the form of energy stored in the human body.
- Identify energy transfer in an environment.

Introduction

In previous grades, you have learned about the properties and behaviour of light and heat. These are forms of energy. In this unit, you will learn about different forms of energy, how it is converted from one form to another and how it is conserved. Energy is needed for our bodies to grow. We take energy from food and that is how our bodies grow and function.

Energy

Energy is required for all activities and processes. Whenever we move, we need energy. When a car or bus moves, it needs energy. All living things and machines use energy to do work. Scientists define energy as "the ability of a body to do work".

Fig 8.1: Moving car

There are two main categories of energy; potential and kinetic energy.

Potential energy

The energy which is stored in an object due to its position, is called potential energy. Stretched rubber band or a stone raised to a certain height have potential energy.

Fig 8.2: Potential energy

Activity 8.1

When the child drops the stone over the bunch of sticks.

1. What happens to the sticks when the stone hits them?
2. What kind of energy is present in the stone?

Kinetic Energy

Have you ever noticed motion of a car, bicycle or bus? When they move they use energy. Energy in a body due to its motion is called kinetic energy. Moving vehicles, a bullet fired from a gun, a moving ball etc. posses kinetic energy.

Fig 8.3: Moving objects posses kinetic energy

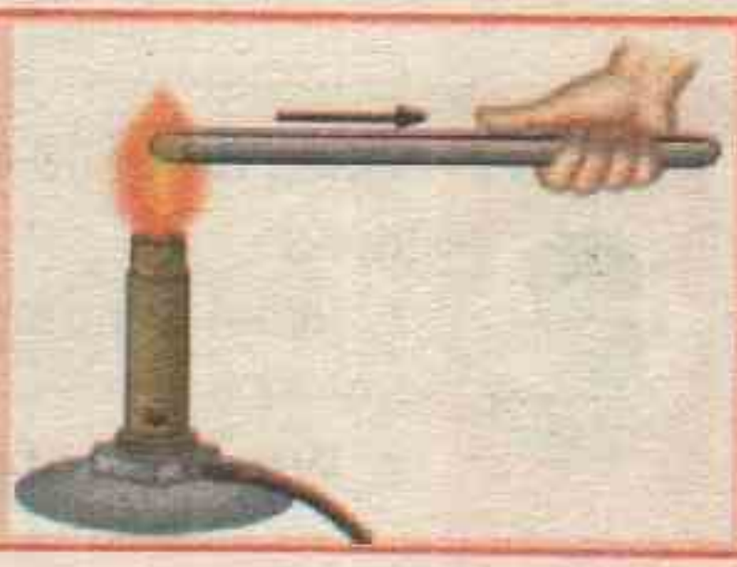
Heat Energy

Heat is a form of kinetic energy. It is the thermal energy that flows from hotter to colder objects. Whenever a hot body touches the cold body, the thermal energy (heat) moves from hotter body to the colder body. For example, when a hot iron rod is placed into a cold water, the thermal energy from hot iron rod transfers into water. The rod becomes cold and the water becomes warm.

Fig 8.4: Thermal energy

Activity 8.2

1. Put one end of an iron rod on the fire.
2. Very soon, you will have to drop the other end of that rod. Why?
3. What type of energy, did you experience?



Light energy

Light is the form of kinetic energy. Sun is the major source of light energy. The sun gives light energy to plants. Plants convert light energy to chemical energy through photosynthesis. Light energy helps us to see things. Our sense of sight can detect light energy.

Fig 8.5: Sunlight energy

Electrical Energy

Electrical energy is due the movement of electrical charges through an electrical conductor. Electrical charges moving through a wire is called electricity. Electrical energy is used for lighting the house and for working of different appliances.

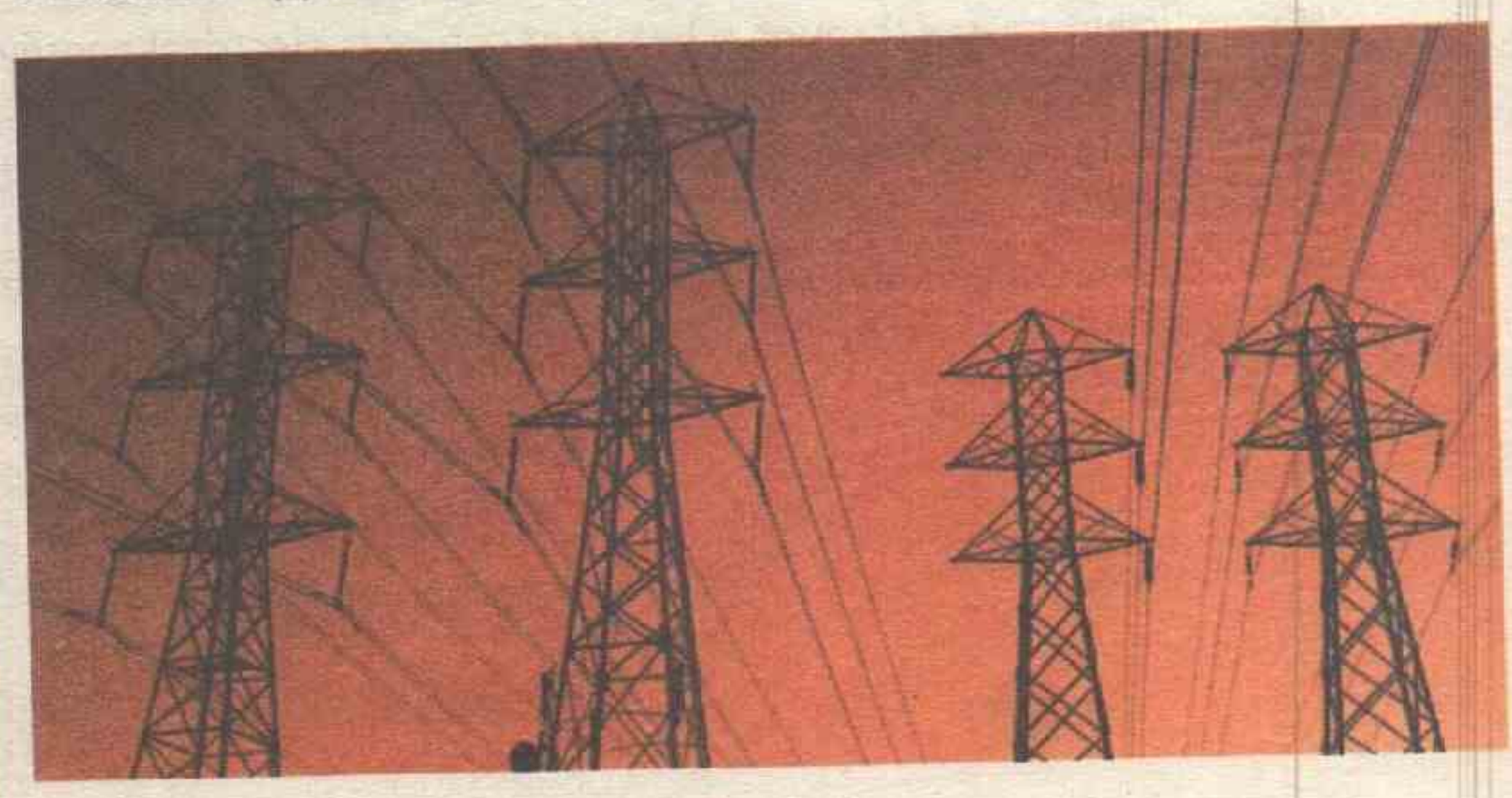


Fig 8.6: Electrical energy

Sound energy

Sound is also a form of energy, associated with the vibration of matter. Sound energy can travel through all states of matter but cannot travel in vacuum. Sound energy helps us to hear things.

Do you Know

Sound energy is so strong that some of the sound frequencies can break glass windows.

Fig 8.7: Sound energy producing instruments

Conversion of Different forms of energy

There are many examples in daily life, which show the conversion of one form of energy to another form. Some of these are given below.

i. When current passes through a heater, it converts electrical energy into heat energy.

ii. When coal is burnt, its chemical energy is converted into heat and light energy.

iii. When current passes through a bulb, it converts electrical energy into light and heat energy.

Fig 8.8: Bulb and heater

iv. When petrol burns in the engine of a car ,it converts chemical energy into heat and then mechanical energy.

v. Loud speaker converts electrical energy into sound energy.

Law of Conservation of Energy

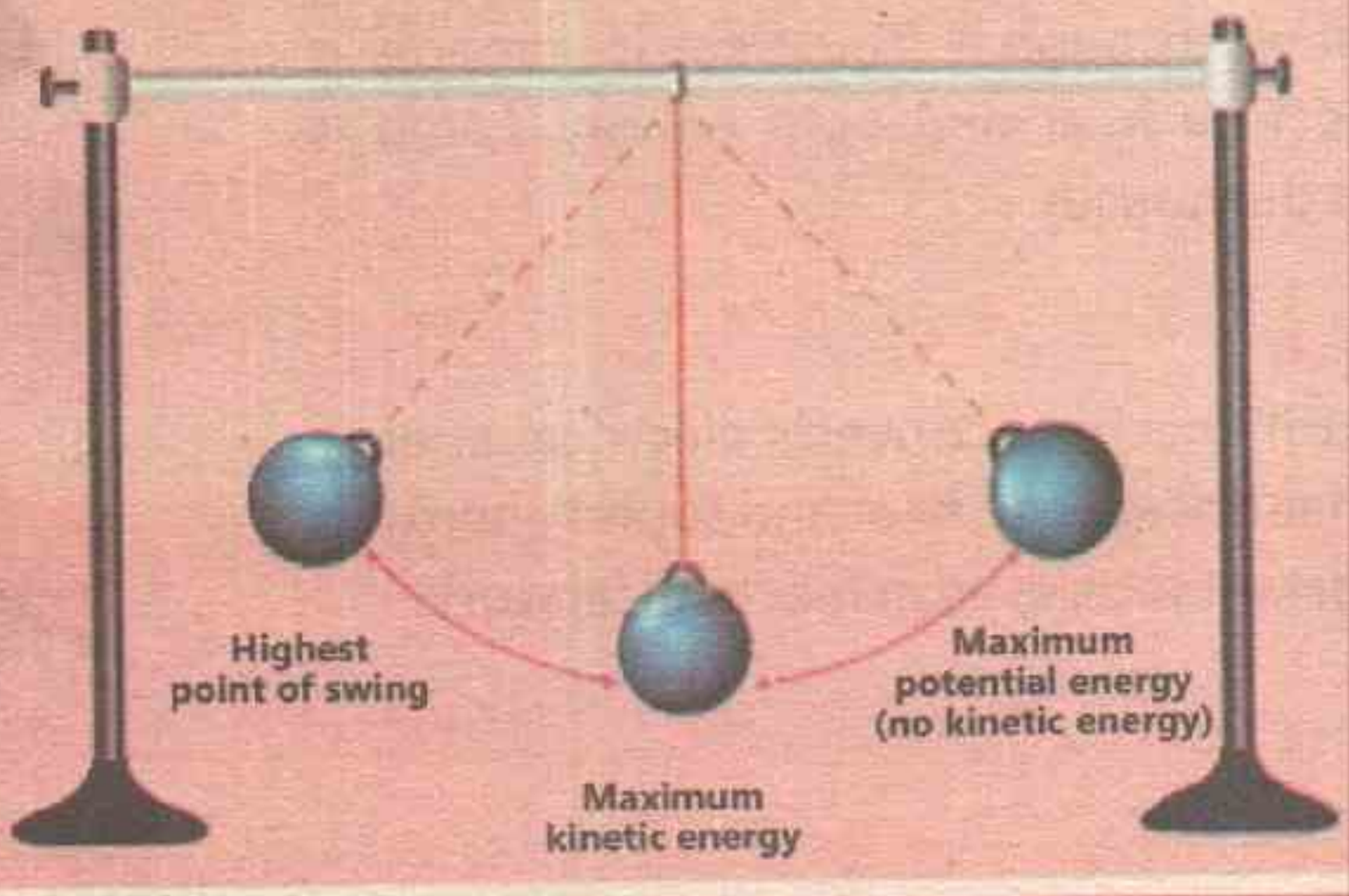
This law states that one form of energy can be converted to another form but the total energy remains constant. To understand the above statement, we have the following activity.

Activity 8.3

Make sure that energy is conserved.

1. Take a pendulum (a hanging ball) and push it to make to and from motion.
2. When the ball is moving, it has kinetic energy.
3. When the ball reaches at the extreme point it has no more kinetic energy.
4. At the highest extreme point the ball has potential energy.
5. When the ball moves again the potential energy converts into kinetic energy.
6. The pendulum keeps swinging and changing the form of energy from kinetic to potential and back to kinetic.
7. What do you know about the total amount of energy?

The total amount of energy remains constant. We say that the energy is conserved. This means that energy cannot be destroyed but can change form.



Energy Converters

Sun is the main source of energy that is used on Earth. This energy is converted into different forms. For example sun light (solar energy) is changed into electrical energy, whenever sunlight falls on the solar cells. Following are few examples of energy converters which convert one form of energy into another form.

1. Radio

Radio use electric energy as the main source of energy. Radio convert electric energy into sound energy. That is how we can hear the different programmes, discussions and songs being played on radio.

Fig 8.9: Radio

2. Television

A television converts electrical energy in to light energy (picture) and sound energy. It is an important source of entertainment and information.

Fig 8.10: Television

3. Lamp

When we connect a bulb to a circuit, current flows through it. This electrical energy is converted into heat and light energy. Lamp is used to lit the houses.

Fig 8.11: Lamp

4. Drill

A drill machine converts electrical energy into mechanical energy, heat and sound energy. It is an important tool, used in mechanical work.

Fig 8.12: Drill machine

5. Washing Machine

An electric motor is used to run the washing machine. The motor converts electric energy into mechanical kinetic energy. It is used for washing clothes.

Fig 8.13: Washing machine

6. Calculator

A calculator is a small electronic device that converts chemical energy into electrical energy. A calculator is used for mathematical calculations.

Fig 8.14: Calculator

Activity 8.4

Make a list of appliances used at your home, which are energy converters. Identify the different forms of energy, which are converted in each appliance?

Renewable Energy Sources

Renewable energy is the energy generated from natural resources like sunlight, wind, rain, tides, and geothermal heat.

The sun is an important source of renewable energy. Solar energy can be converted into electricity with the help of solar cells. Such cells can be used in calculators, solar heating system, space satellites etc.

Fig 8.15 Windmills

Wind is another renewable source of energy. It has been used for a long time to pump water and to grind corn. Nowadays windmills are used to generate electricity by rotating turbines.

Similarly tidal energy, geothermal energy, biomass energy and hydro power energy are renewable energy sources.

Do you know?

With the increase in population, the use of fuel has increased. Scientists estimated that we will use up fossil fuel like coal in the next 1500 years, natural gas in the next 120 years and oil in the next 60 years.

Energy in our lives

Our body needs energy all the time. We need energy for walking, running, playing and studying. Energy is also needed when we are asleep. Energy keeps our body warm. It is necessary for the growth of our body. It is also used to repair the damaged parts of the body. From where does this energy come ?

This energy comes from the food we eat. Food contains chemical energy. Some food items are more nutritious than others. When we eat food, it is digested in the body and energy stored in the food is released during respiration.

Fig 8.16: Energy is used during running.

Science Titbit

An energy resource that is not replaced or is replaced very slowly by natural processes, is called non-renewable energy resource. Primary examples of non-renewable energy resources are the fossil fuels (crude oil, natural gas, coal) and nuclear energy.

Do you Know

Age group and daily energy need

1-3 years	1200 K Cal
4-6 years	1600 K Cal
7-10 years	2000 K Cal
11-12 years	2500 K Cal

Energy transfer in an environment

Animals and human beings store chemical energy of food and then change this chemical energy into heat and kinetic energy. In the end, heat and kinetic energy dissipate in to atmosphere.

Energy in the form of radiation transfers to the earth's surface from sun and is absorbed into the environment by the conduction method and is then released into the atmosphere by convection processes.

The above statement shows how energy transfer takes place in the environment. All types of energies pass through different organisms and in the end dissipate in the atmosphere.

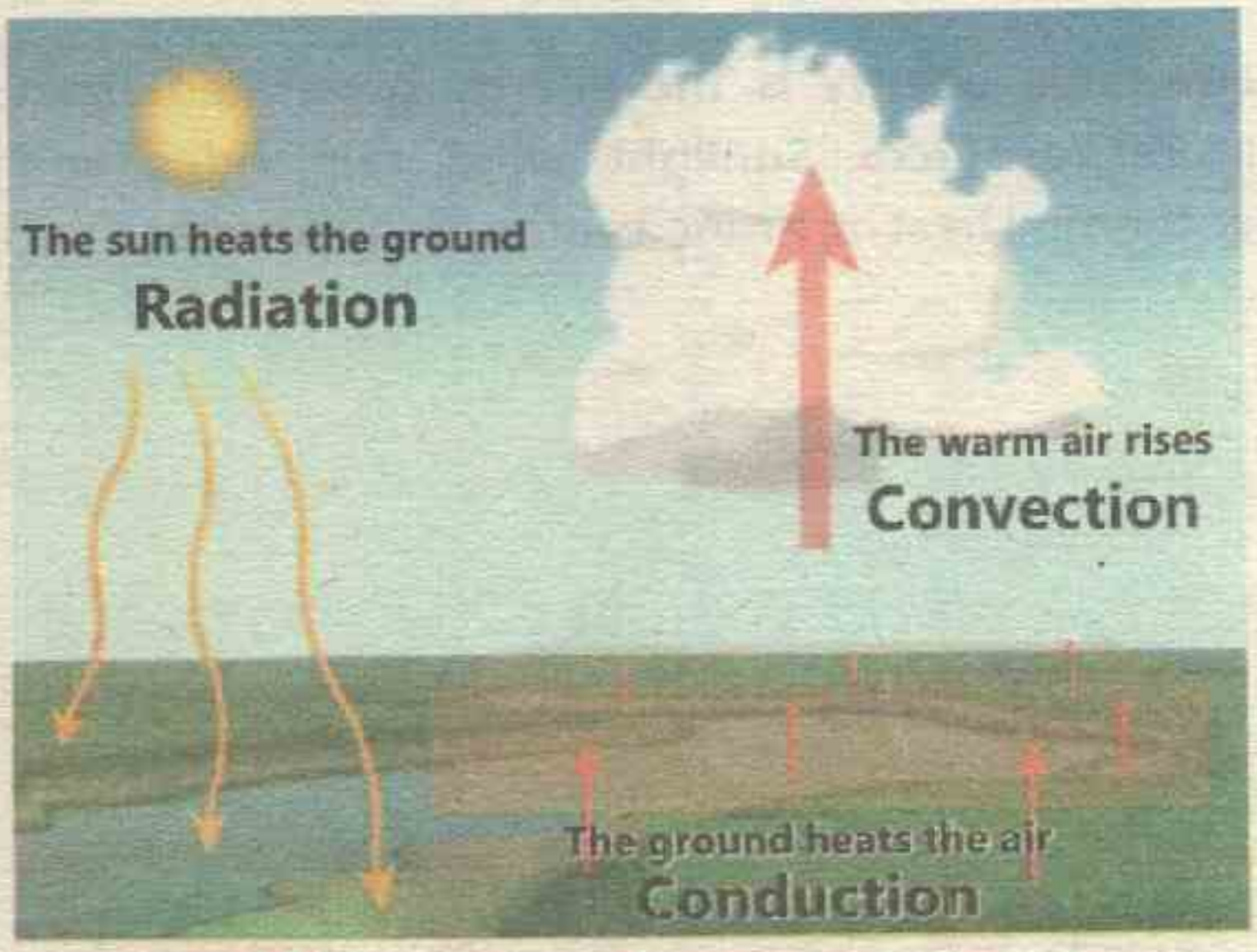


Fig 8.17 : Energy transfer in an environment

KEY POINTS

- Energy is the ability to do work.
- Energy exists in many forms like mechanical, sound, light, electrical, chemical, nuclear, heat, solar etc.
- Energy possessed by a body due to its position is known as potential energy.

- The energy possessed by a body due to its motion is called kinetic energy.
- Renewable energy is the energy generated from natural resources. Sunlight, wind, rain, tides, and geothermal heat are renewable energy sources.

EXERCISE

A. Fill in the blanks.

1) Energy is the ability to do work.
2) Energy possessed by a body due to its position is called kinetic.
3) One form of energy can be converted into another form.
4) Food possesses chemical energy.
5) Sound and light are forms of energy.

B. Select the best answer from the following.

1. The main source of energy is sun
   a) sun ✓ b) water
   c) wind d) magnet
2. A moving car has kinetic energy.
   a) kinetic ✓ b) potential
   c) tidal d) solar
3. Which one is not a form of energy lamp
   a) heat b) light
   c) sound d) lamp ✓
4. In a battery, chemical energy is changed into electrical
   a) heat b) sound
   c) light ✓ d) electrical

C. Answer the following questions.

1. What energy changes takes place when an electric fan is turned on?
2. What is the difference between kinetic energy and potential energy?
3. Conduct a simple experiment to show law of conservation of energy.
4. Why energy is so important in our lives?
5. How energy transfer occur in our environment?

Unit

9 Forces and Machines

After studying this unit, the students will be able to:

- Recognize wheel and axle and identify their uses.
- Describe pulleys and their kinds.
- Identify the uses of pulleys in daily life.
- Describe the functions of pulley systems and gear systems.
- Describe how motion in a system of pulleys of different sizes is transferred to motion in another system of various gears the same structure.
- Investigate with the help of an experiment the effort required by different gear systems to lift the same load.
- Find out how the action of a pulley system is altered by changing the tension of the band connecting two pulleys.
- Design and make a system of pulleys and / or gears for a structure that moves in a prescribed and controlled way and performs a specific function.
- Identify and make modifications to their own pulley and gear systems to improve the way they move a load.
- Describe how a bicycle functions.
- Identify common devices and systems that incorporate pulleys and / or gears.

Introduction

You know that simple machines help in making your work easier. There are seven types of simple machines i.e. lever, inclined plane, wedge, screw, pulley, gear and wheel and axle. You have learnt about the use of lever, inclined plane, wedge and screw in grade -V. In this unit, you will learn about the use of wheel and axle, pulleys and gears.

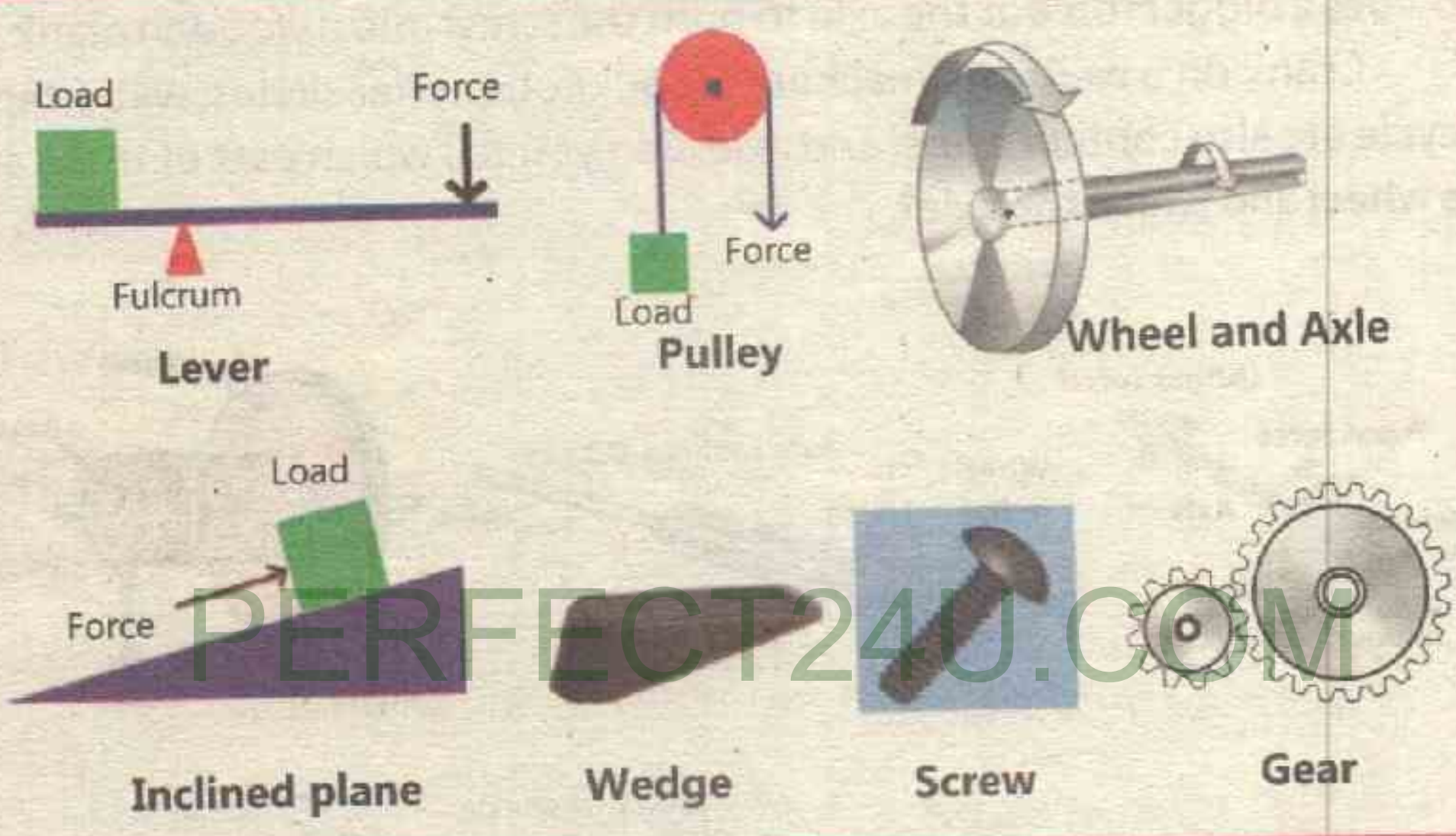


Fig: 9.1: Simple Machines

Wheel and Axle

The wheel and axle is one of the simple machines. The wheel and axle consists of a wheel attached to a smaller axle. These two parts rotate together, in which a force is transferred from one to the other. A hinge or bearing supports the axle, allowing rotation. The wheel has larger diameter than that of axle. It helps to increase force to lift or move objects. A small force applied on the outside of the larger wheel can move a larger load attached to the axle. There are two ways of using wheel and axle.

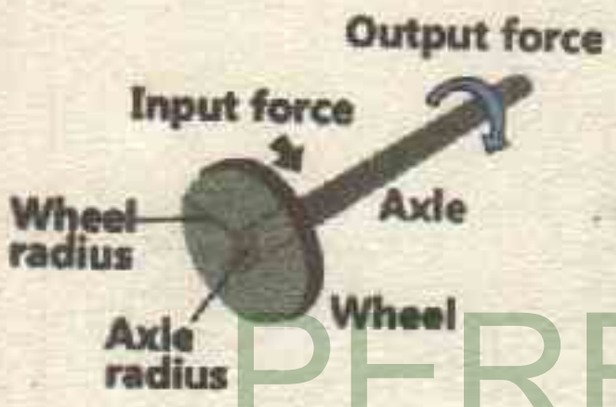
- **To increase the speed:** We apply force on the axle to turn the wheel.
- **To lift a heavy load:** We apply force on the wheel to turn the axle.

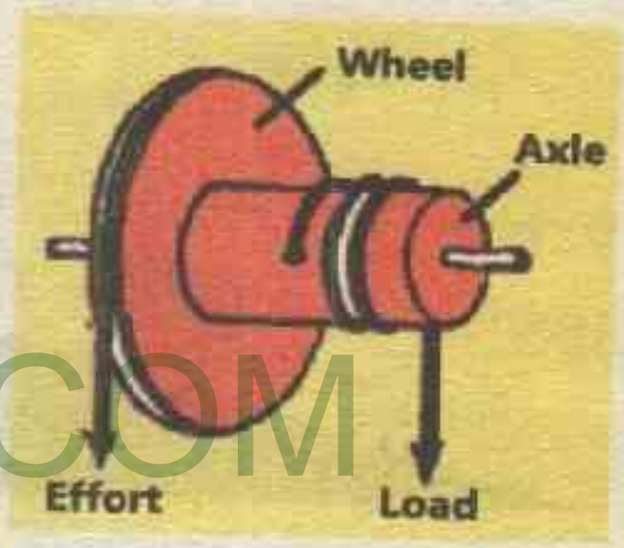
Examples of wheel and axles

The steering wheel is a common example of wheel and axle. A small force on the outer edge of the wheel provides a bigger force at the axle that easily turns the wheel of the vehicle.

Another example of a wheel and axle is a screwdriver. The broader handle of the screwdriver is the wheel while the tip (head) is the axle. To tighten a screw we turn the screwdriver and a small force on the wheel provides a bigger force at the axle to push the screw into a wooden plank.

Crank on a well, drill machine, door knobs, roller skates, water taps, tricycle etc also contain wheel and axle. Can you tell which part of these are the wheel and which the axle?





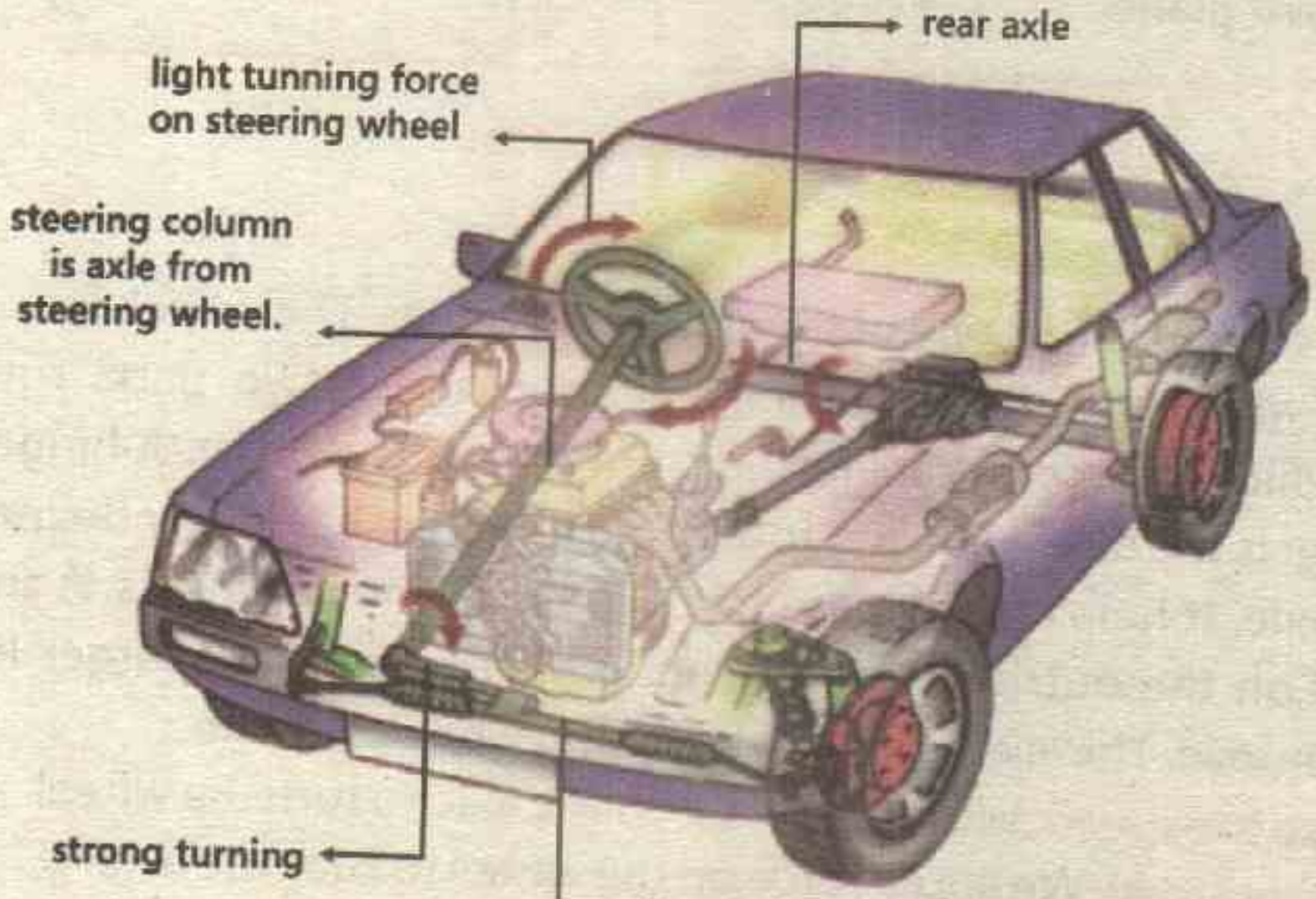


Fig 9.2: Examples of wheel and axle

Activity 9.1

Make a simple (wheel and axle) machine. Now tie the load to the free end of the axle string. Rotate the bigger wheel and lift the load. Can you lift the load easily? Now try to lift the same load without wheel and axle system?

Pulley

A pulley is a simple machine which consists of grooved wheel that can turn about an axle in a frame called the block of pulley. A rope, belt or cable passes the groove of the wheel. Pulleys are used for lifting objects to certain height.

Types of Pulley

According to the ways of their use, following are the types of pulleys.

1. Fixed pulley:

If the block of a pulley is connected to a fixed support and does not change its place then it is called a fixed pulley as shown in the figure 9.3 In a fixed pulley, one end of the rope is attached to the object to be lifted and effort (force) is applied at its free end. For example, when the free end of the rope is pulled downward with an effort equal to the load of the object, it is lifted upward. This

Fig 9.3: A simple pulley

means that a fixed pulley only changes the direction of the applied effort. But it makes easier to lift the load than lifting it without the pulley.

2. Moveable Pulley:

When the block of a pulley is not connected to a fixed support and the pulley is free to move, then it is called a moveable pulley, as shown in figure 9.4.

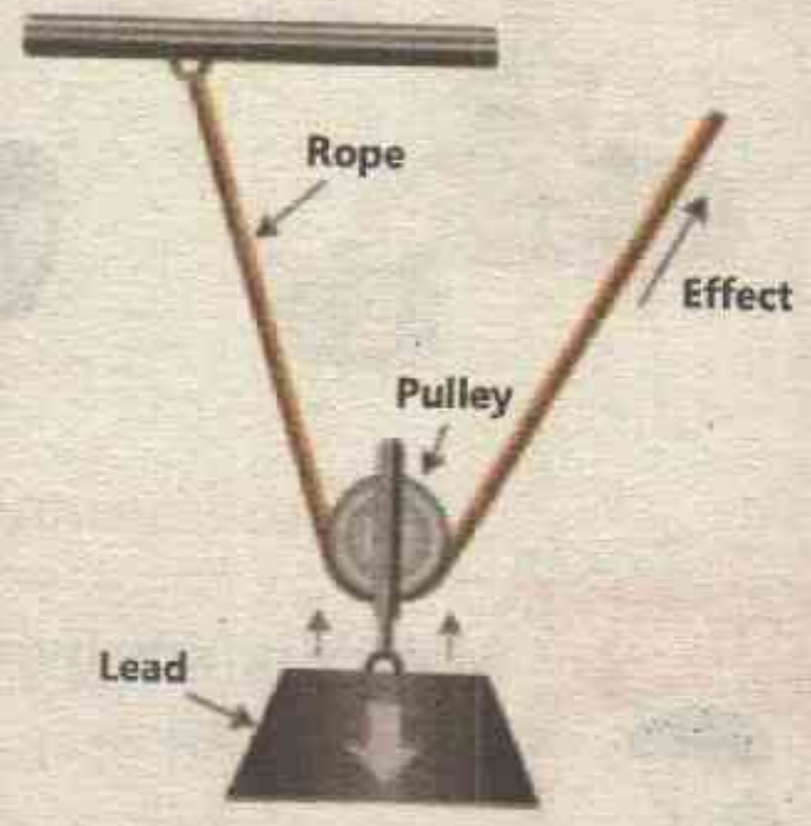


Fig 9.4: A movable pulley

In moving pulley, one end of the rope passing round the pulley is connected with a fixed support and effort is applied at its free end. The object (load) to be lifted is hung from the hook of the block of pulley. Here, two parts of the rope support to lift the load and the load is divided into two. Thus, with the help of a moveable pulley, we can lift greater load by applying less effort as compared to a fixed pulley. A moveable pulley does not change the direction of a force. The applied force and the load move in the same direction.

3. Pulley system

A combination of both fixed and moveable pulleys is called a pulley system as shown in figure 9.5. A pulley system reduces the amount of effort needed to lift a heavy load, which is attached to the moveable pulley. The greater is the number of pulleys in a pulley System, the lesser the effort is needed to lift a load.

In a pulley system, we use additional pulleys to change the direction of effort, so that we can apply effort easily.

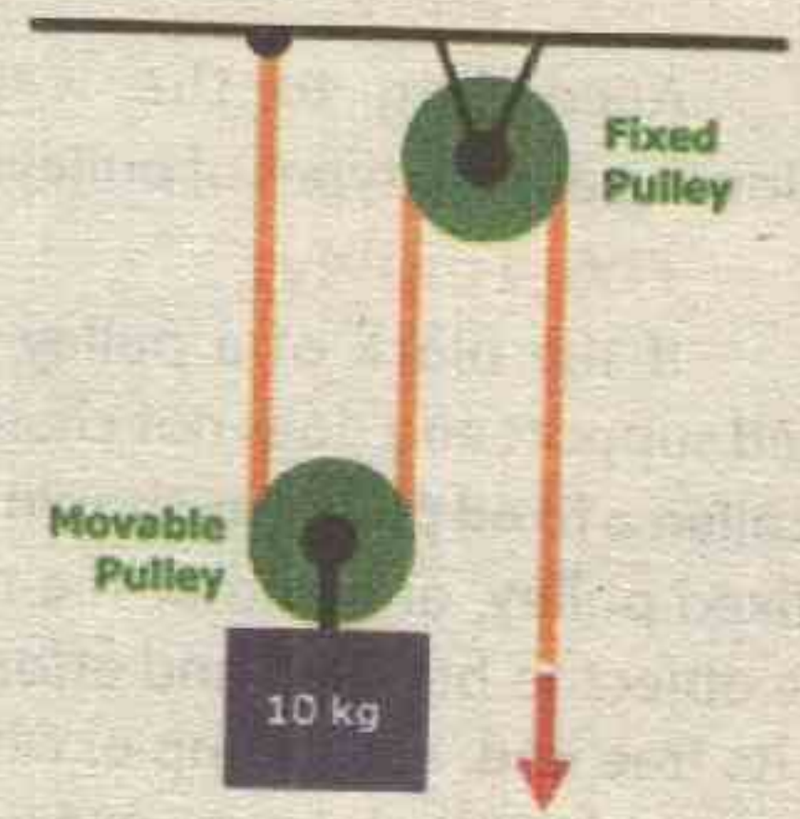


Fig 9.5: A pulley system

Designing a System of Pulleys for lifting heavy loads

If you need to lift a heavy load, you have to apply more force (effort). However, you can design such a pulley system that can reduce the effort. For example, pulley system shown in figure 9.6 (a) has a combination of 3 pulleys in which 3 segments of rope support the weight, so the required effort will be equal to one third of the weight to be lifted. Similarly, pulley system shown in figure 9.6 (b) has a combination of 4 pulleys in which 4 segments of the rope support the weight, so the required effort will be equal to one fourth of the weight to be lifted. You can make any modification in your pulley system to reduce further the required effort for lifting heavy weight as shown in figure 9.6 (c) which is modified form of pulley system shown in figure 9.6 (b)

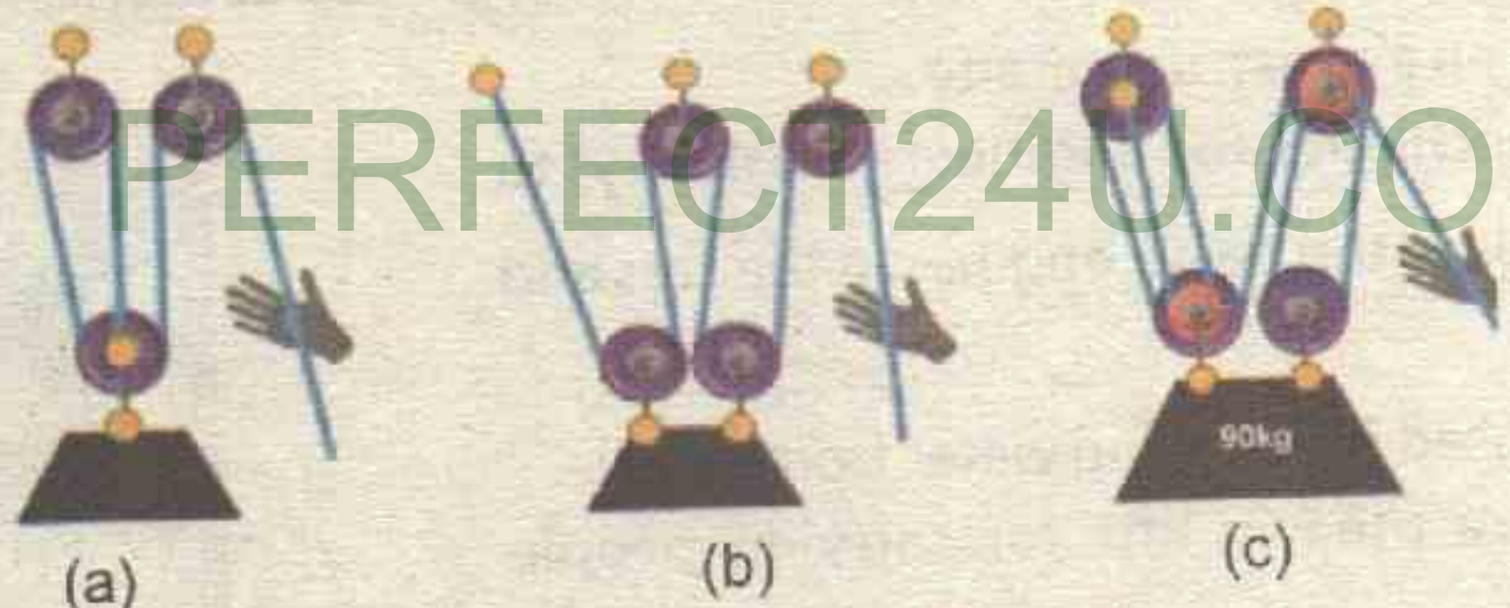


Fig 9.6: Designing pulley system

Do you Know

In a water pump, a small pulley moves and causes the large pulley to move.

Changing the tension in the Band Connecting two Pulleys

The band which connects two pulleys may not be perfectly fit over the pulleys or may stretch a little after use. This cause to reduce tension in the band as a result the function of the pulley is affected. In

Fig 9.7: Tensioning the band connecting two pulleys

order to change the tension of the band connecting two pulleys, usually an idler or tensioning pulley is used in the pulley system, as shown in the figure. By addition of this extra pulley, the tension in the band is changed, as a result the action of the pulley system is changed.

Uses of pulley in daily life

In daily life, pulleys are used for different purposes, some of which are given below.

- A common use of the pulley can be found at the top of a flagpole. Pulling down the rope causes the flag to go up because the pulley changes the direction of the force applied to the flag.
- Pulleys are used to lift construction material to upper stories of a tall building on a construction site.
- Motor mechanics and engineers use pulleys to lift and place the heavy engines in the cars and buses etc.
- Pulley is used for drawing water from a well.
- Pulleys are used in lifts for carrying people and goods.
- Pulleys are also used in mast of sailing boats.

Point to Ponder

What will be the effect of using thick belt or rope.

Fig 9.8 Flag

Activity 9.2

- Go close to the flagpole of your school and observe.
- Can you see a working pulley there! Draw its diagram.
- Design a pulley system to lift heavy loads.
- How a heavy load can easily be lifted by applying small efforts.

Gears and Gear System

A gear is a wheel with teeth that mesh with the teeth of another gear as shown in the figure 9.9. A combination of two or more gears constitute a gear system. Gear system is used to transmit or receive force and motion. When one gear drives another gear, both the gears revolve in the opposite directions. If it is needed to turn both the gears in the same directions, a third gear called "idler gear" is fixed between them, as shown in the figure 9.10.

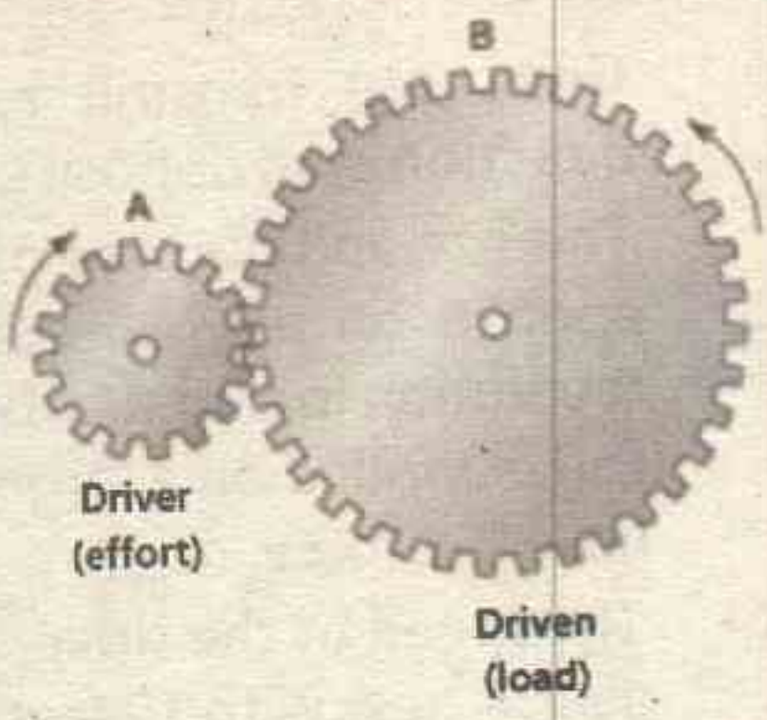


Fig 9.9: Gear system

In daily life, a gear system is used in many objects such as vehicles, bicycle, wind-up clocks, washing machines, clothes driers, saving machines, hand drills, hand food mixer, egg-beater etc.

Fig 9.10: Gear system with idler gear

Do you Know

Driver/ driving gear: Force is applied on it.
Driven gear: It turns due to the movement of the first gear i.e. driving gear.

Characteristics of Gears

- Gears can transmit rotational force to another gear in the same direction or in opposite direction.
- The size and number of teeth on a gear determine its working. A force applied on a small gear will turn the larger gear slowly and fewer revolution in a minute but it will have a great force. On the other hand, a force applied on a larger gear will turn a smaller gear faster but it will have less force.
- The speed of the driven shaft depends on the number of teeth in each gear. A gear with 10 teeth driving, a gear with 20 teeth will revolve twice as fast as compared to the driving gear.

In the following diagrams, gears of different sizes are shown. See how the direction and speed of movement changes when we move one of the two gears.

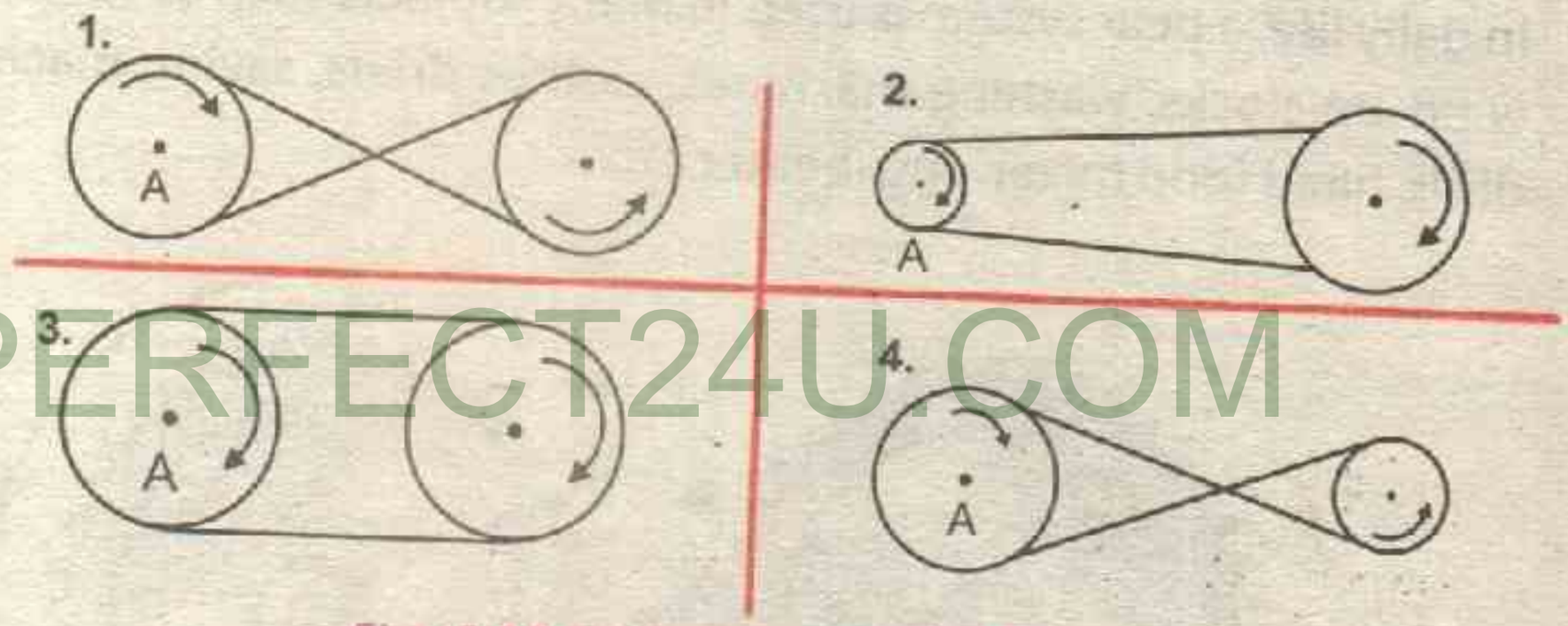


Fig 9.11 Difference sizes of gears

Activity 9.3

Cut card boards to make a system of gears of your own.
Check whether both the gears move with same speed or not when driven gear has 40 teeth and driving gear has 10 teeth.

Point to Ponder

Identify the parts of a bicycle that are wheel, axle and gear.

We can increase the efficiency of the machine (gear system) by changing gears during the lifting of any load.

Activity 9.4

Investigate the effort required by different gears to lift the same load.

You need: A gear bicycle (sports bicycle)

Procedure:

1. Take a gear bicycle.
2. Learn how to change different gears.
3. Ride on the bicycle and start it slowly.
4. Change the gears one by one during the ridding.

Investigate how much effort is required in each gear i.e. in which gear pedalling is felt easier?

Transfer of motion between pulley and gear system

There are certain machines that function on the combine motion of pulley and gear systems. For example, crane, bicycle, hand drill, wind up clock etc.

A. Cranes

Have you ever seen a crane? What does it do? It is a machine for moving heavy objects both horizontally and vertically. A crane has pulleys and gears systems to raise or lower loads and to move them horizontally. A metallic rope passes over pulleys. The rope winds around the axle of "wheel and axle". The gear system provides the required pulling force to rotate the wheel. This pulling force enables the pulleys system to lift the heavy load.

Cranes are commonly used in transport, construction and manufacturing industries.

Fig 9.12: Crane

B. Bicycle

In bicycles, a combination of gear system and wheel and axle are used. The gears are connected with a chain. The rider applies muscular force to rotate the pedals around the crank axle. The pedals in turn are fixed to a chain ring. The chain then transmits the pedaling action to a cog on the hub of the rear wheel, causing the rear wheel to rotate and drive the bicycle forward.

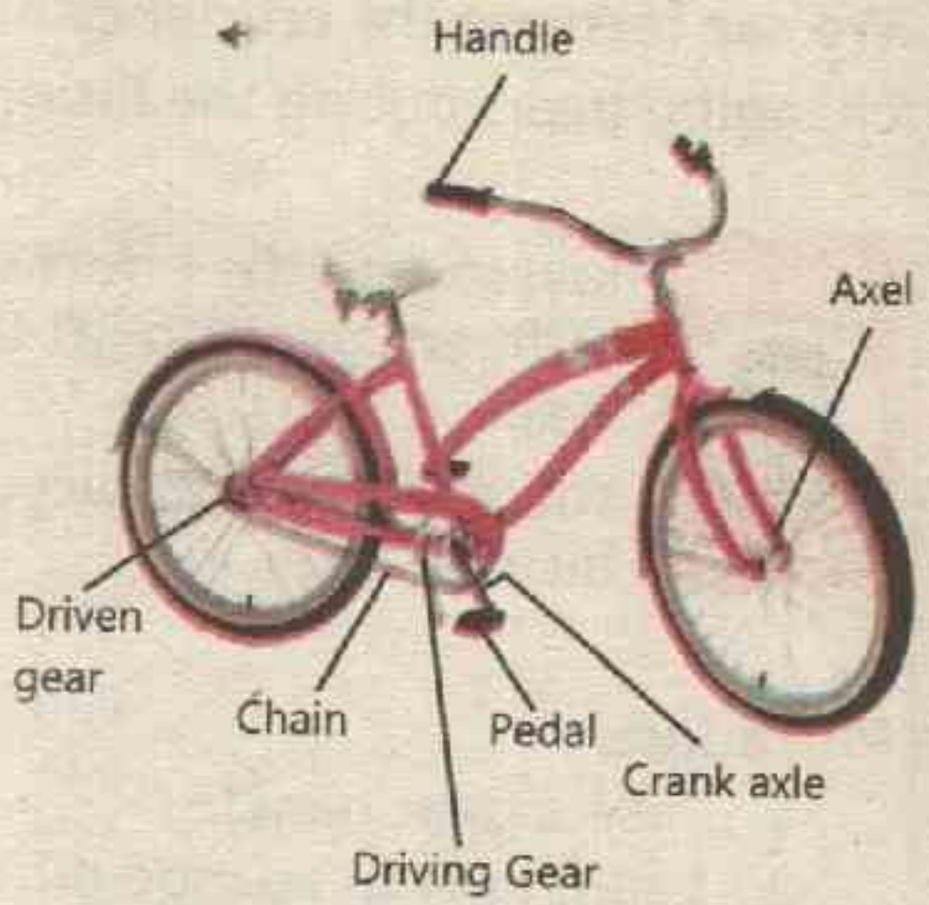


Fig 9.13: Bicycle

C. Hand Drill

A hand drill consist of two mutually perpendicular gears and is used to make holes in the objects made up of wood, plastic, aluminum etc.

Fig 9.14: Hand Drill

D. Wind-up clocks

A gear system is used in wind-up clocks. When the main spring in the clock is wound up and released. It unwinds and drives the gear system that transmits motion to hour, minutes and second needles.

Fig 9.15: Wind up clock

Activity 9.5

- Make a list of 10 common devices and system that have pulleys and/or gear system.
- List some complex machines that are made of simple machines, discuss their uses aiso.

KEY POINTS

- A machine is a device that helps to make work easier.
- There are seven types of simple machines.
- A wheel and axle makes work easier by changing the amount and direction of the force applied to move an object.

- A pulley is a simple machine used to lift the objects.
- There are three types of pulleys, fixed, moveable and compound pulley system .
- A gear is a round wheel which has teeth that mesh with other gear teeth.
- Gears can transmit rotational force to another gear in the same direction or in opposite direction.
- The speed of the driven shaft depends on the number of teeth in each gear.

EXERCISE

A. Fill in the blanks.

1. There are seven types of simple machines.
2. A combination of both fixed and moveable pulleys is called compound
3. The diameter of wheel is less then the diameter of axle.
4. Wheels with teeth around them are called gears
5. Gear can transmit force to another gear.

B. Selects the best answer from the following.

1. _____ gear is used to turn both the gears in the same direction.
   a) ilder gear ✓ b) driving gear
   c) driven gear d) none of them
2. Pulley is a simple machine used to _____ the objects
   a) move b) lift ✓
   c) stop d) rotate
3. A flag pole is an example of _____
   a) fixed pulley ✓ b) moveable pulley
   c) gear d) wheel-axle
4. A moveable pulley can lift greater load by applying ____ effort.
   a) equal b) less ✓
   c) more d) none
5. A hand drill consist of two mutually perpendicular _____
   a) gears ✓ b) pulleys
   c) wheels d) leavers

C. Answer the following questions.

1. Differentiate between fixed pulley and moveable pulley.
2. What are the characteristics of a gear system?
3. Which type of simple machine would be used to lower and lift up the bucket of water in a well?
4. Write some uses of a wheel and axle in our daily life?
5. Differentiate between a pulley system and gear system.

Unit 10

Properties of Light

After studying this unit, the students will be able to:

- Differentiate between transmissions, absorption, and reflection of light.
- Demonstrate the law of reflection.
- Demonstrate the difference between smooth, shiny and rough surfaces.
- Compare the regular and diffused reflection.
- Identify everyday applications which involve regular reflection and diffused reflection.
- Draw ray diagrams for light reflected from a plane mirror at different angles of incidine.
- Describe image formation by a plain mirror.
- Compare characteristics of the images formed by a plane mirror and a pinhole camera.
- Explain the use of reflecting surfaces in different devices.
- Design an experiment to make an optical instrument using mirrors.
- Explain the principle of reflection in a kaleidoscope.
- Describe the relationship of angles between two mirrors and the number of images they can see in a kaleidoscope.
- Explain types of mirror and their uses in our daily life.
- Investigate the image formation by convex and concave mirrors.

Introduction

Light is a form of energy which helps us in seeing objects. It can travel through vacuum and different media such as air, water and glass. Light travels at a very high speed from the light source to our eyes. The speed of light in air is $3x10^8$m/s. You have already learned some properties of light in grade V. In this unit, you will learn about transmission, absorption and reflection of light.

Transmission, absorption and reflection of light

Light shows different behavior, when it falls on different non luminous objects.

Transmission

Light passes through **transparent** objects easily, for example, glass and some plastic sheets. We can see all objects on the other side of the glass window. The passage of light through a transparent object is called the transmission of light. Light cannot pass through **translucent** materials e.g. tracing paper, wood etc.

Absorption

When a ray of light strikes an **opaque** surface, some of it gets absorbed. The energy from the light is transferred to the surface material. This transfer creates a small amount of heat. Such behaviour of light is called absorption of light.

Reflection

When light falls on a smooth shiny object, like a mirror, it bounces back in one particular direction. The bouncing of light is called reflection of light.

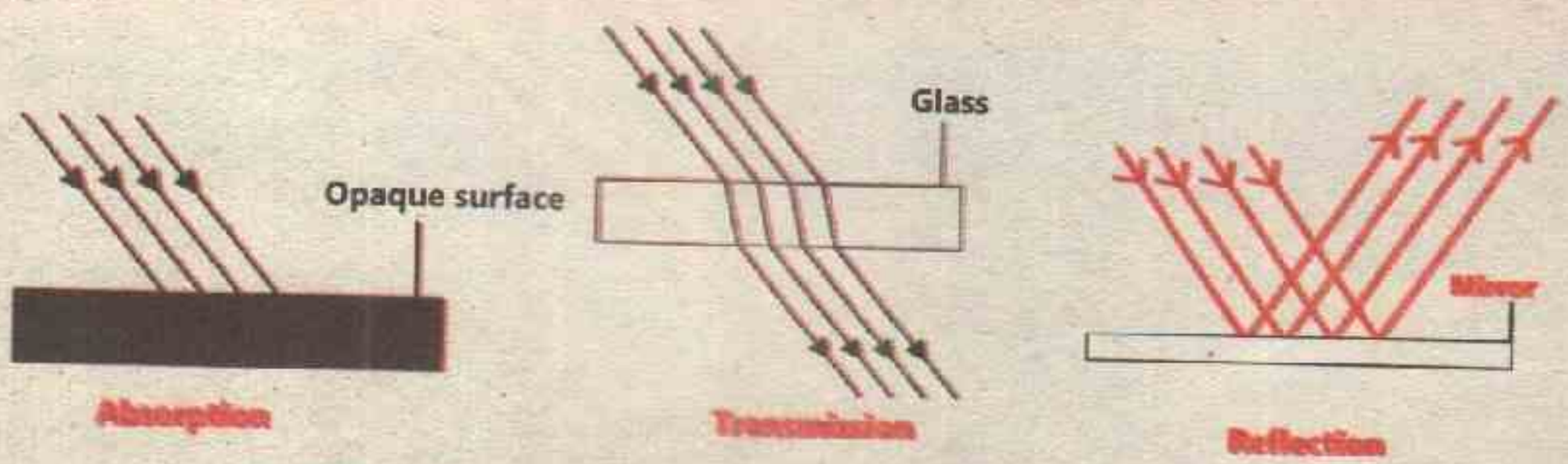


Fig 10.1: Absorption, Transmission and Reflection of light

How reflection occurs?

When a ray of light coming from an object falls on a mirror, it reflects. The ray falling on mirror is called **incident ray** while the bouncing ray is called **reflected ray**. The line perpendicular on the point of incidence is called normal. The incident ray makes an angle with normal and is called **angle of incidence** (i) while the reflected ray makes an angle with the normal called **angle of reflection** (r).

Laws of Reflection

The law of reflection requires that two rays are at identical angles but on opposite sides of the normal, which is an imaginary line at right angles to the surface located, at the point where the rays meet. The law of reflection states that:

1. The incident ray, the reflected ray and the normal to the surface, all lie in the same plane.
2. The angle of incidence is equal to the angle of reflection.

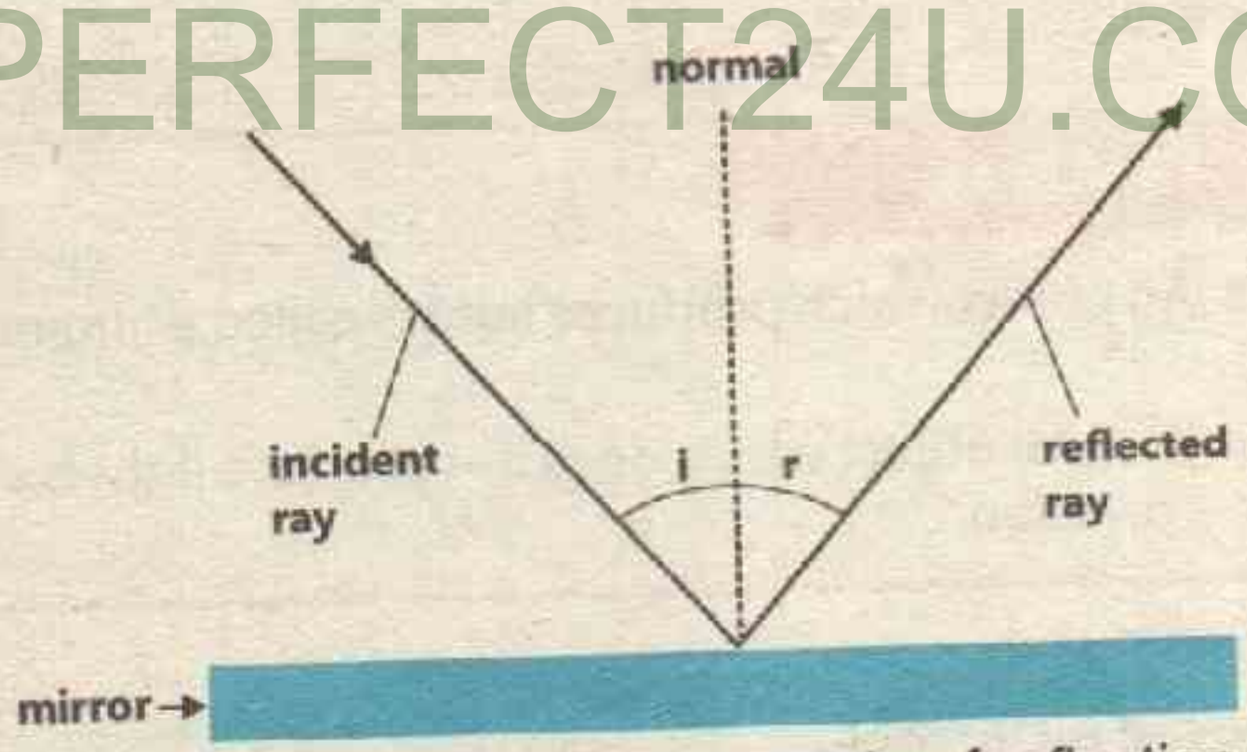


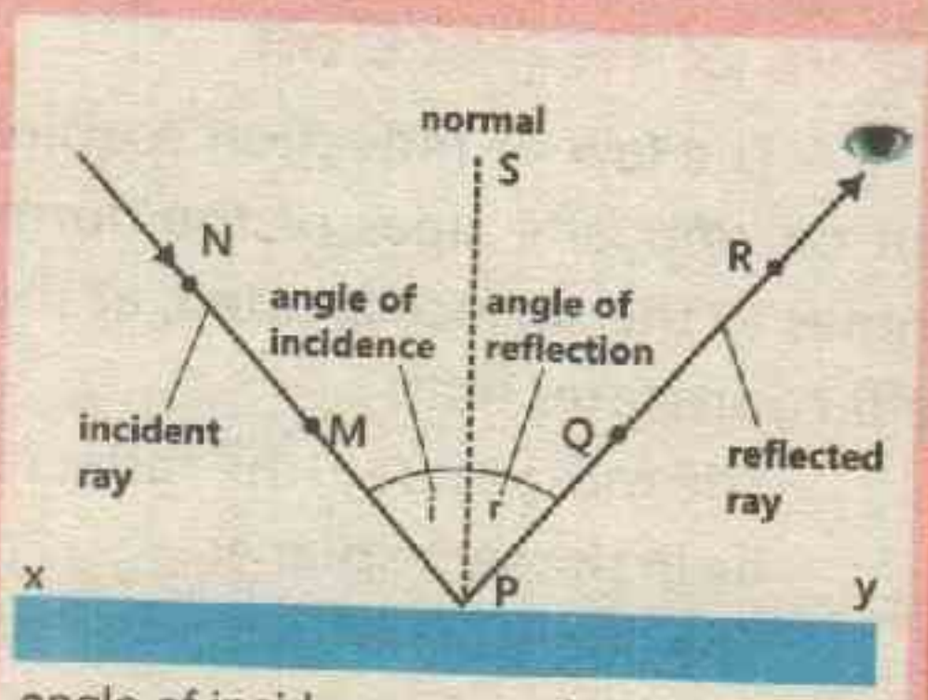
Fig 10.2: Incident ray, reflected ray and the normal

Do you Know

The laws of reflection were first described by Muslim Scientist Ibn-ul-Haithem.

Activity 10.1

- Take a drawing board and fix a white paper with drawing pin.
- Place a mirror slab xy (fixed in standing position) on white paper.
- Fix two common pins N and M obliquely in front of mirror in a straight line.
- Look the image of pins in the mirror and fix two more common pins Q and R in such as way that image of pin N and M and pins Q and R lie on the same straight line.
- Join all points each N, M, Q and R with the xy (mirror) on point P.
- Draw a normal on point P.
- Observe and measure the angle of incidence NPS that incident ray NM forms with the normal and the angle of reflection RPS that reflected ray QR forms with the normal.
- Conclude the result.



angle of incidence = angle of reflection

Science Tidbit

Luminous object: An object which produces light is called a luminous object. e.g. sun, bulb etc.

Non-luminous object: An object which does not produce light is called non-luminous object. e.g. moon.

Types of Reflection

There are two types of reflection.

(1) Regular Reflection

When parallel rays of light strike a smooth and polished surface (for example plane mirror) most of the rays are reflected as parallel rays and the angle of incidence is equal to angle of reflection.

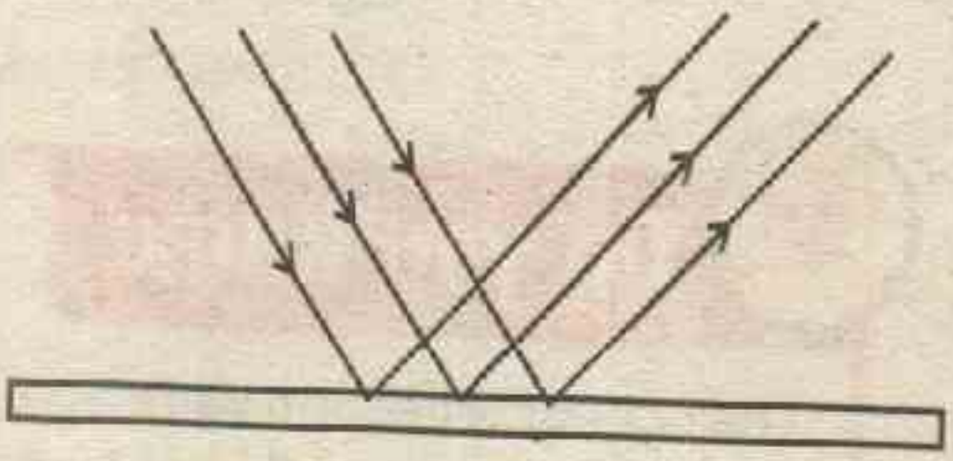


Fig 10.3: Regular Reflection

(2) Diffused Reflection

When parallel rays of light strike rough and irregular surface (for example paper, wall), then the reflected rays are scattered in different directions. This type of reflection is called diffused or irregular reflection.

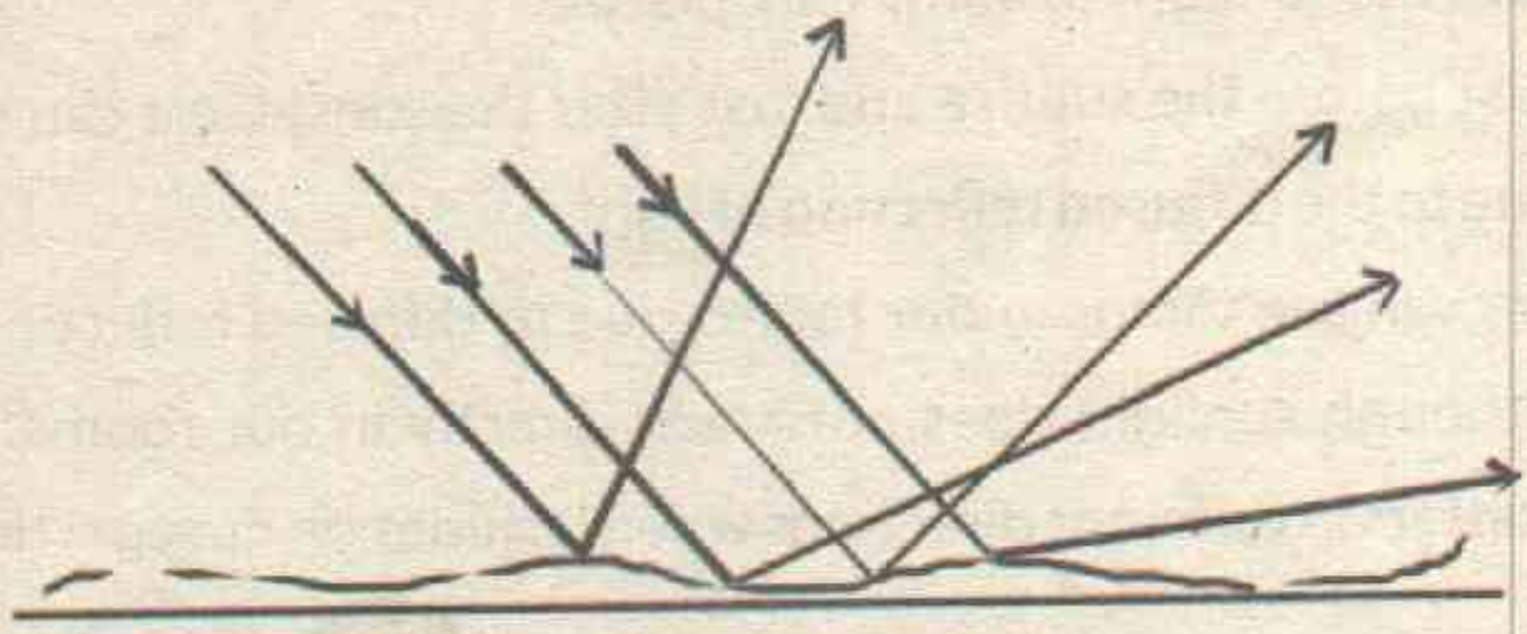


Fig 10.4: Diffused Reflection

Do you Know

(i) Non-luminous objects e.g. moon can be seen due to irregular reflection.

(ii) Due to irregular reflection of sunlight from dust particles in air, we receive light at dawn or after sunset.

Type of Reflecting Surfaces

1. Smooth Surfaces:

The plane surfaces on which regular reflection occurs are known as smooth, polished or regular surfaces. For example, plane mirror, still water etc.

2. Rough Surfaces:

The uneven surfaces which give diffused reflection are known as rough or irregular surfaces. For example paper, wall, cloth, cardboard etc.

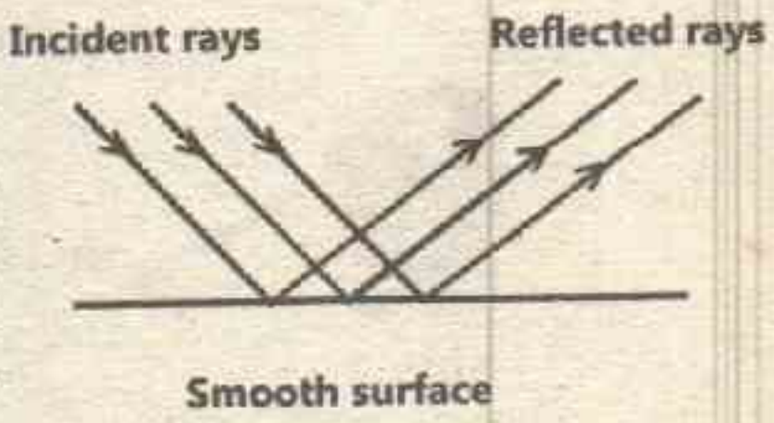


Fig 10.5: Types of reflecting surfaces

Everyday life applications of regular and diffused reflection

- We are able to see our image in the plane mirror due to the regular reflection of light.
- With the help of regular reflection from shining surfaces, we can turn the sunlight towards dark places.
- Just before the sunrise and just after the sunset, we can see things due to the diffused reflection of light.
- We can see things in our rooms due to diffused reflection of light, although sunlight does not reach directly in our rooms. The light scatters in different directions when it shines on dust particles.

Image Formation by a Plane Mirror

A shiny surface is called a mirror. Plane mirror is a mirror which has polished surface, with a coating of silver or aluminum on one side.

Science Tidbit

An image which we can obtain on a screen is called a real image.
An image which we cannot obtain on a screen is called a virtual image.

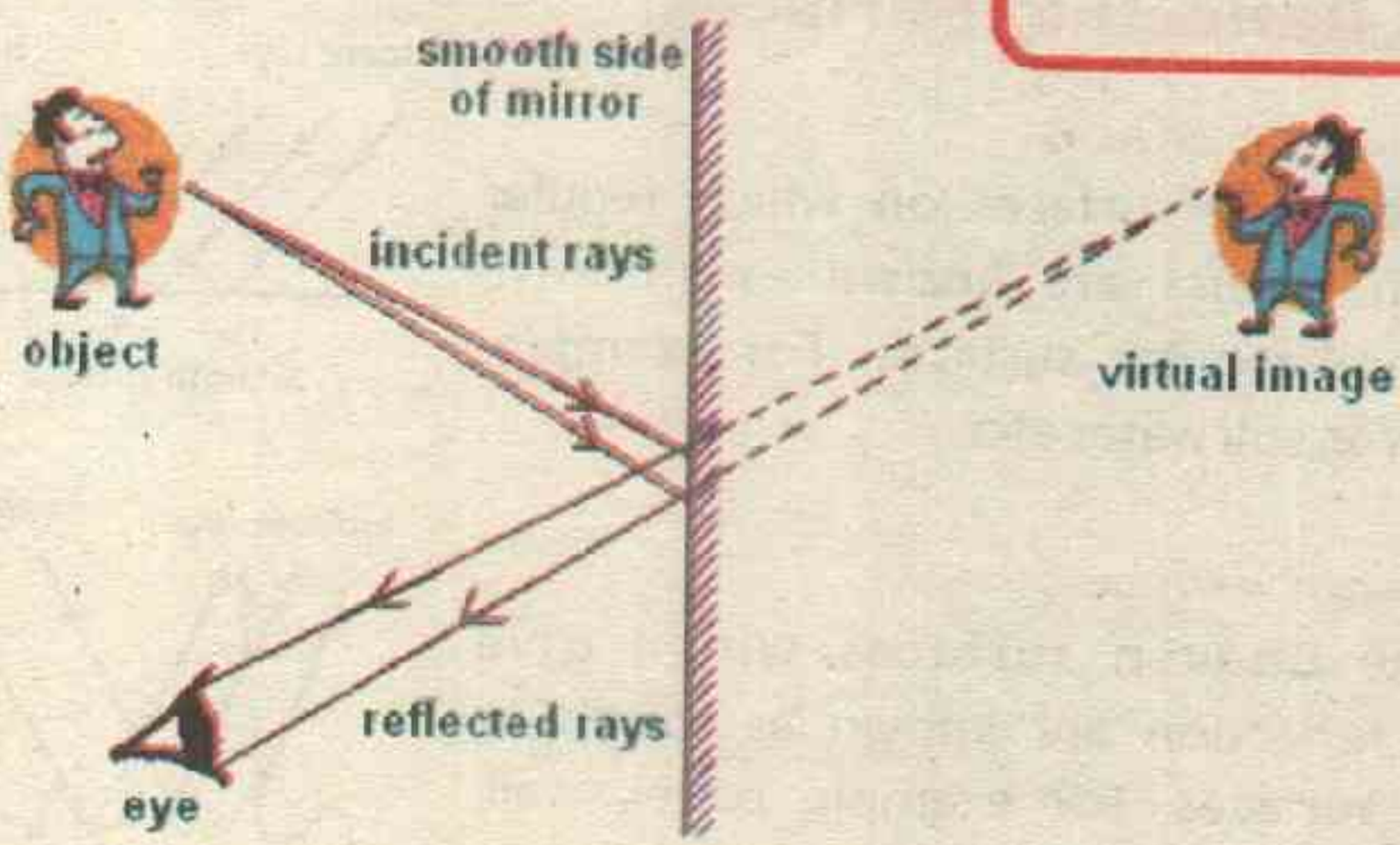


Fig 10.6: Object and its image formation in plane mirror

Features of an Image formed by a plane mirror

We see images in a plane mirror when light reflected by the mirror enters our eyes. Features of an image formed by a plane mirror are following.

- The image seems to be as far behind the mirror as the object is infront of it.
- The image is equal in size to the object.
- The image formed is upright (straight upward).
- The image is virtual. It means the image disappears on removing the object.
- The image is laterally inverted. It means your right becomes left in the image.

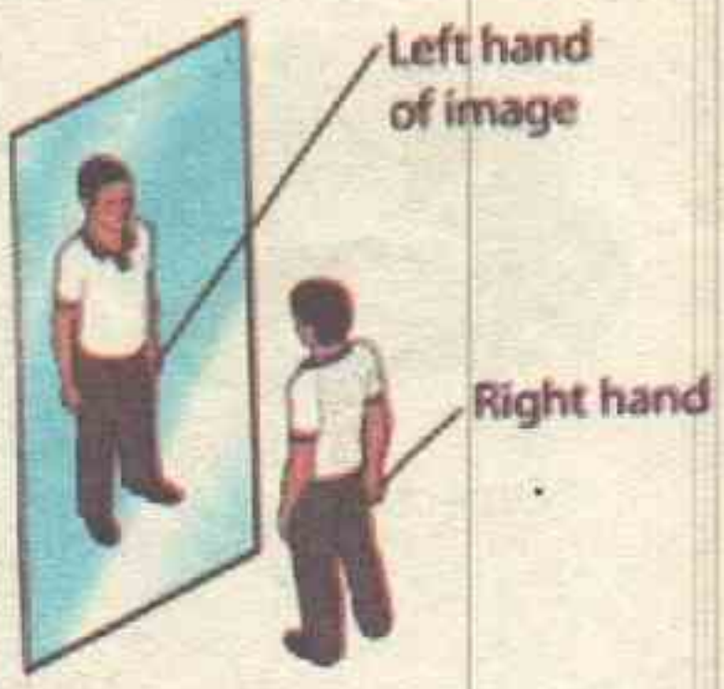


Fig 10.7: Laterally inverted image

Activity 10.2

Try to read laterally inverted words using plane mirror.

Pinhole Camera

A pinhole camera is a device that works on the principle that light travels in straight lines. A muslim scientist Al-Haithem invented the pinhole camera.

Pinhole camera has a simple structure. It consists of a light proof box with a tiny hole in the middle of one side and a translucent (semi reflecting) screen at the opposite end of the box. All inside walls of the box are made black so that light cannot enter the box.

When a brightly lit object is placed in front of the hole, an image of the object can be seen on the screen.

When the rays coming from an object strikes the translucent screen, it reflects the rays. The reflected rays reach to our eyes and image is formed. We can obtain good pictures

Do you Know

A small pinhole will give a sharp image while a large pinhole will give a blurred image.

with pinhole camera by pasting some photographic film instead of a translucent screen.

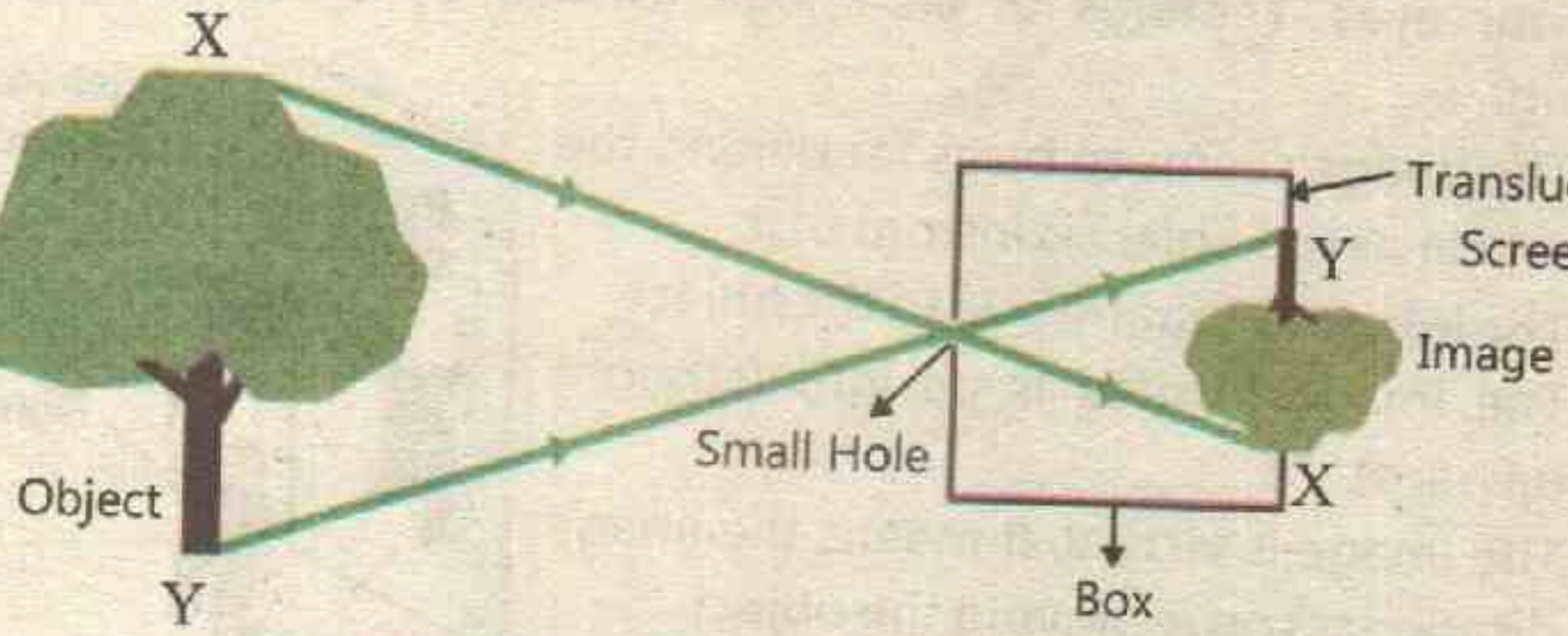


Fig 10.8: Image formation by Pinhole Camera

Features of an Image formed by pinhole camera

1. Image is found to be a real one.
2. Image is inverted. It is upside-down.
3. Image has the same colour as that of the object.
4. Size of the image depends on the position of the object, where it is placed.

Do you Know

Why the word "Ambulance" is written invertedly on an ambulance van?

Table 10.1 Comparison of images formed by a plane mirror and pinhole camera

Plane mirror	Pinhole camera
Forms virtual image.	Forms real image.
Forms the image of equal size as of the object.	Mostly forms smaller or diminished images.
Forms an upright image.	Forms an inverted image.

Uses of reflecting surfaces

Reflecting surfaces are used in a number of devices. A few of them are discussed here.

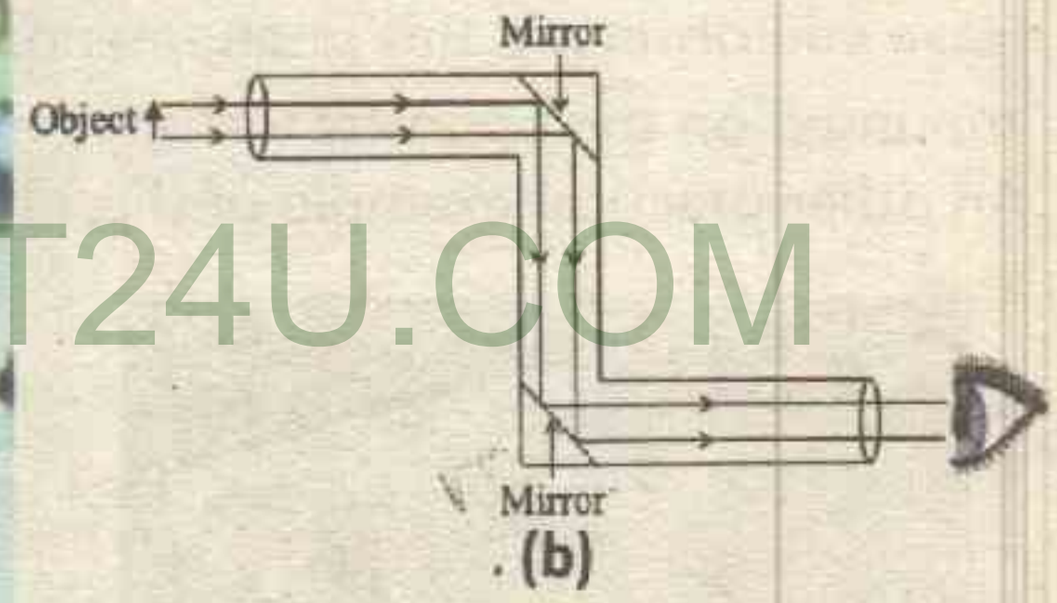
i. Periscope

A periscope is an instrument with the help of which we can see the objects higher than the level of our eyes.

A simple periscope can be constructed by using two plane mirrors at 45° in a tube as shown in figure 10.9.(b)

The light rays coming from an object hit the surface of the first mirror and reflect making a bend of 90°. These reflected rays are once again reflected by second mirror and a virtual upright image is seen to our eyes. Periscopes are used in submarines, battle tanks etc. **Fig 10.9 (a)**

(a)



(b)

Fig 10.9: Periscope

Activity

Design an experiment to make periscope using two plane mirrors.

ii. Telescope

A telescope is an instrument, with the help of which you can see distant objects like the moon, stars and planets clearly. In reflecting telescope a concave mirror and plane mirror are used.

Fig 10.10 Telescope

iii. Microscope

A microscope is an instrument used to produce a large image of a small object like bacteria etc. A reflecting mirror is used at the base of microscope, which illuminates the object, by reflecting the rays coming from the surrounding.

Fig 10.11 Microscope

Multiple Reflections

A phenomenon of reflection in which a number of images of an object are formed by placing two plane mirrors inclined to each other, is called multiple reflection, as shown in Figure 10.12.

Have you observed this phenomenon in a barber shop, where mirrors are mounted on the opposite walls?

An other practical example of this phenomenon is Kaleidoscope.

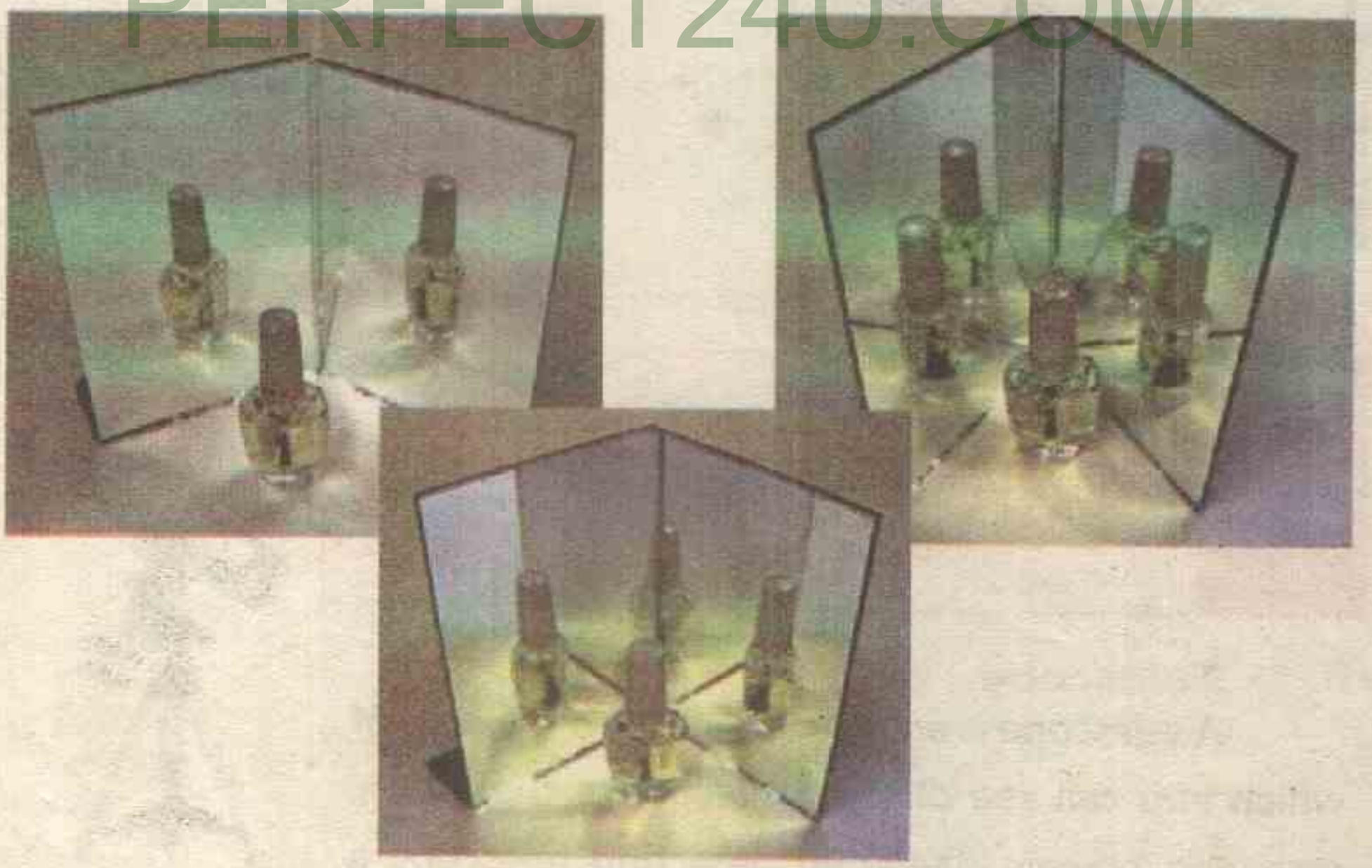


Fig 10.12: Multiple reflection

Activity

10.4

- Take two plane mirror.
- Hold them at some angel to one another in such a way the reflecting surfaces are facing each other.
- Place an object between them.
- What do you observe?
- Multiple images are formed.
- Now change the angle in between and count the number of images formed every time.
- Depending upon the angle between the two mirrors, the number of images formed will differ.

Kaleidoscope

It is an optical toy instrument which is based on the principle of multiple reflection. A Kaleidoscope consists of a hollow tube containing two or more rectangular plane mirrors inclined to each other at certain angles. At one end it is closed off with a transparent glass or plastic. Inside this end, small coloured objects (beads, pebbles etc.) which are to be reflected, are placed. The other end of the Kaleidoscope has a small hole through which the multiple images are seen. The number of images depends upon the angle between the two mirrors as shown in the figure 10.13. If the angle

Do you Know

The first kaleidoscope came into being in 1851, by Sir David Brewster who belonged to Scotland.

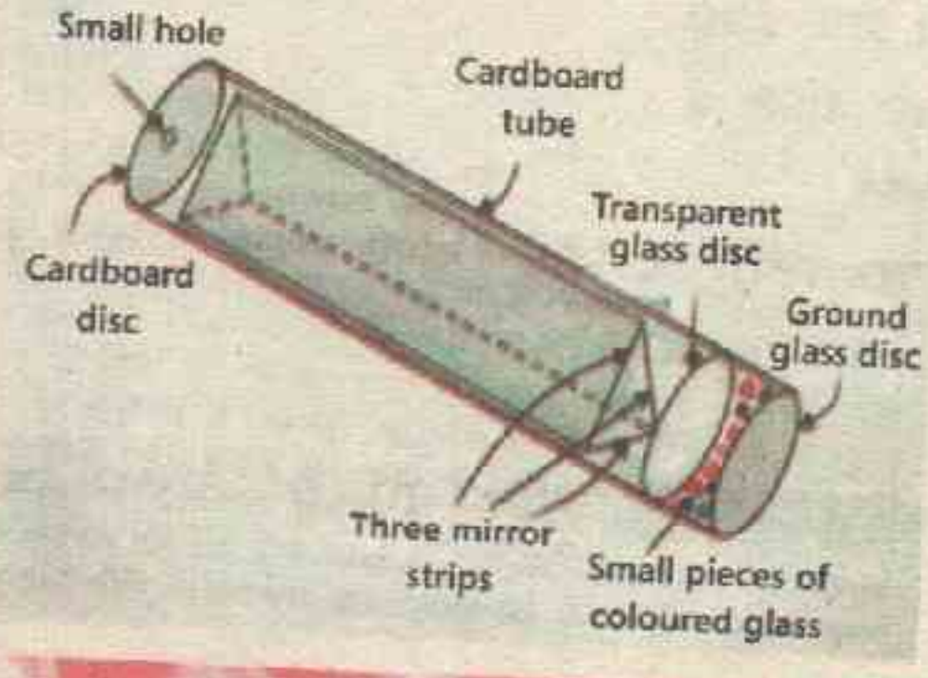


Fig 10.13: Kaleidoscope

between the mirrors is 120°, two images of the object are formed, if the angle is 90° then three images are formed and if the angle is 60° then four images of the object are formed.

Activity 10.5

Try to make a kaleidoscope using three mirrors and coloured piece of paper and describe the relation between angles of mirrors and the "number" of images.

Types of Mirrors

A mirror is an object that reflects light. It has a polished, smooth and regular surface. A mirror is normally made from glass with a thin layer of silver or aluminum on one side. All the reflecting surfaces are not flat like the plane mirror. Some are curved in shape.

Following are the types of mirror.

a) Plane Mirror
b) Curved Mirror

a) Plane Mirror

It is a mirror which is flat in shape and reflects the light with the same angle as that of the angle of incidence.

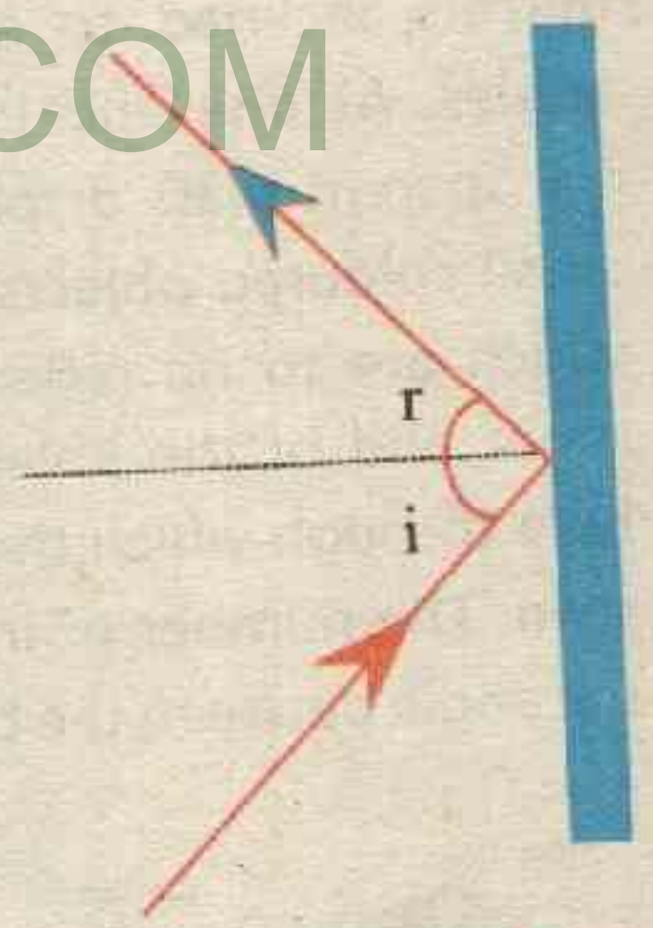


Fig 10.14: Plane Mirror

Uses:

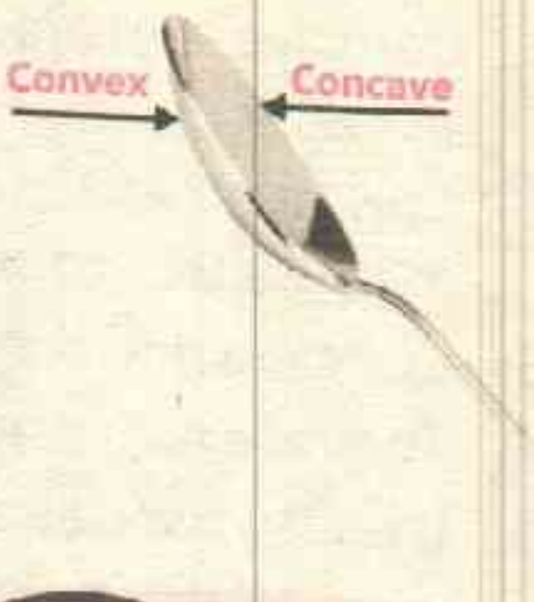
1. Plane mirrors are used to see the images of objects i.e. we use a plane mirror to see ourselves.
2. Plane mirrors are used to reflect the light and used in periscopes, telescopes and microscopes.

b) Curved Mirror

Curved mirror is a part of a hollow sphere. Curved mirrors are of two types i.e. concave mirror and convex mirror.

(i) Concave Mirror

A curved mirror whose shining surface curves inward like the bowl of a spoon and is reflecting. This type of mirror has the capability to converge a parallel beam of light at a point after reflection from it, and then spreads, as shown in the figure 10.15. The point at which the light rays converge after reflection from concave mirror is called principal focus and is denoted by F.



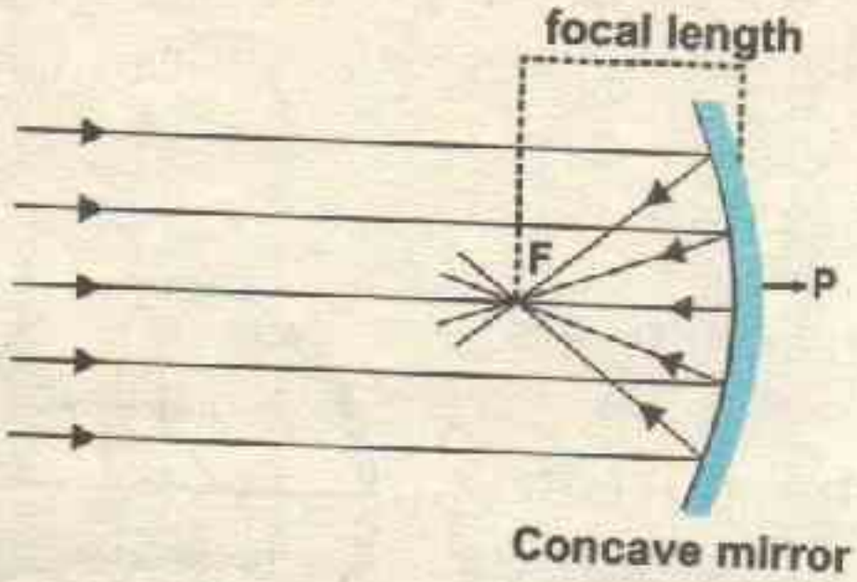


Fig 10.15: Concave Mirror

Image formation in Concave Mirror

The type of image formed by concave mirror depends upon the position of object in front of the mirror. If the distance of an object from a concave mirror is changed then nature, size and location of the image is also changed.

(i) If an object lies in front of a concave mirror beyond or at the principal focus F, a real and inverted image of the object is formed in front of the mirror, as shown in figure 10.16.

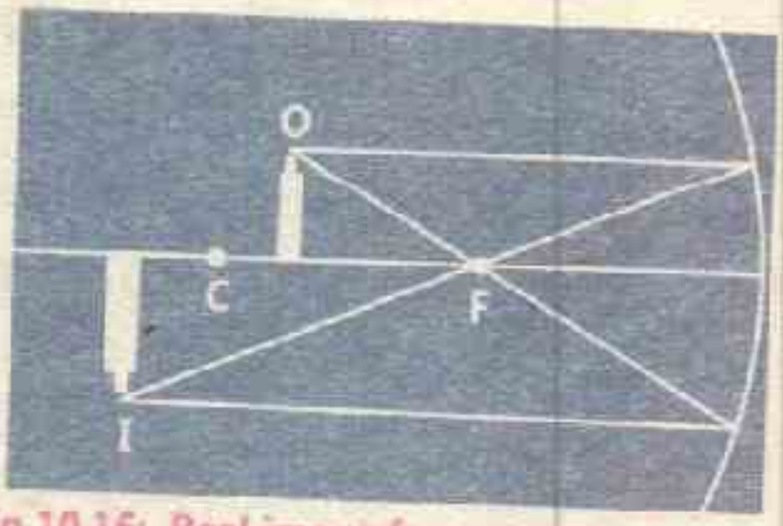


Fig 10.16: Real image from concave mirror

(ii) If an object lies in front of a concave mirror between the principal focus and the mirror, a virtual, upright and magnified image of the object is formed behind the mirror, as shown in the figure 10.17.

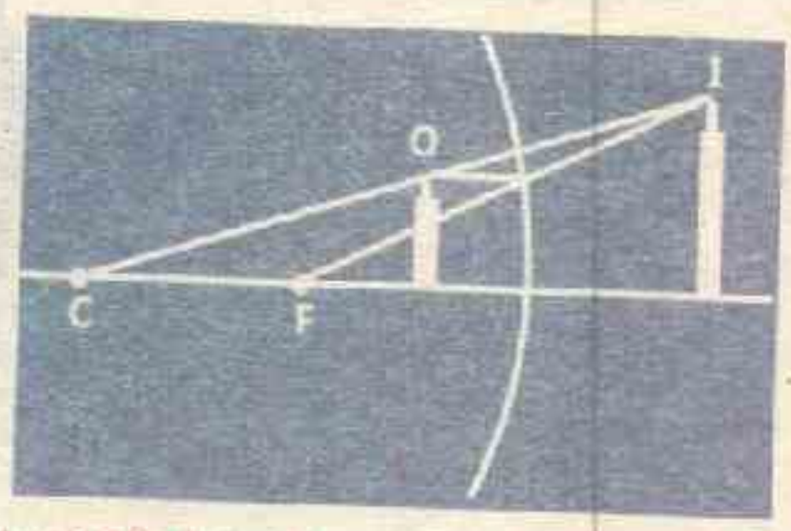


Fig 10.17: Virtual image from concave mirror

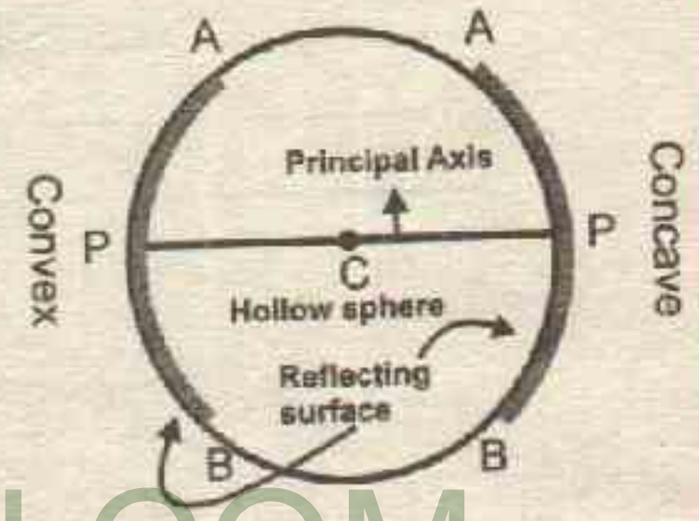
Uses:

1. Concave mirrors are used by doctors to examine ears, nose, throat and eyes.
2. Concave mirrors are used in car head-lights, search light and spot light in operation room in the hospital.
3. Concave mirrors are used to throw light on the slides of a microscope.
4. They are also used in telescopes.
5. It is also used as a cosmetic mirror.

Science Tidbit

Terms related to curved mirrors.

- Centre of curvature which is the centre of the curve, denoted by "C".
- Pole is the centre of the mirror represented by "P".
- The line joining "C" and "P" that passes through the centre of curvature is called the principal axis.



(ii) Convex Mirror

The spherical mirror is one whose shining surface curves outward. It is like the out side of the bowl of spoon. When rays of light parallel to the principal axis fall on a convex mirror, they diverge / spread after reflection. It is also called diverging mirror.

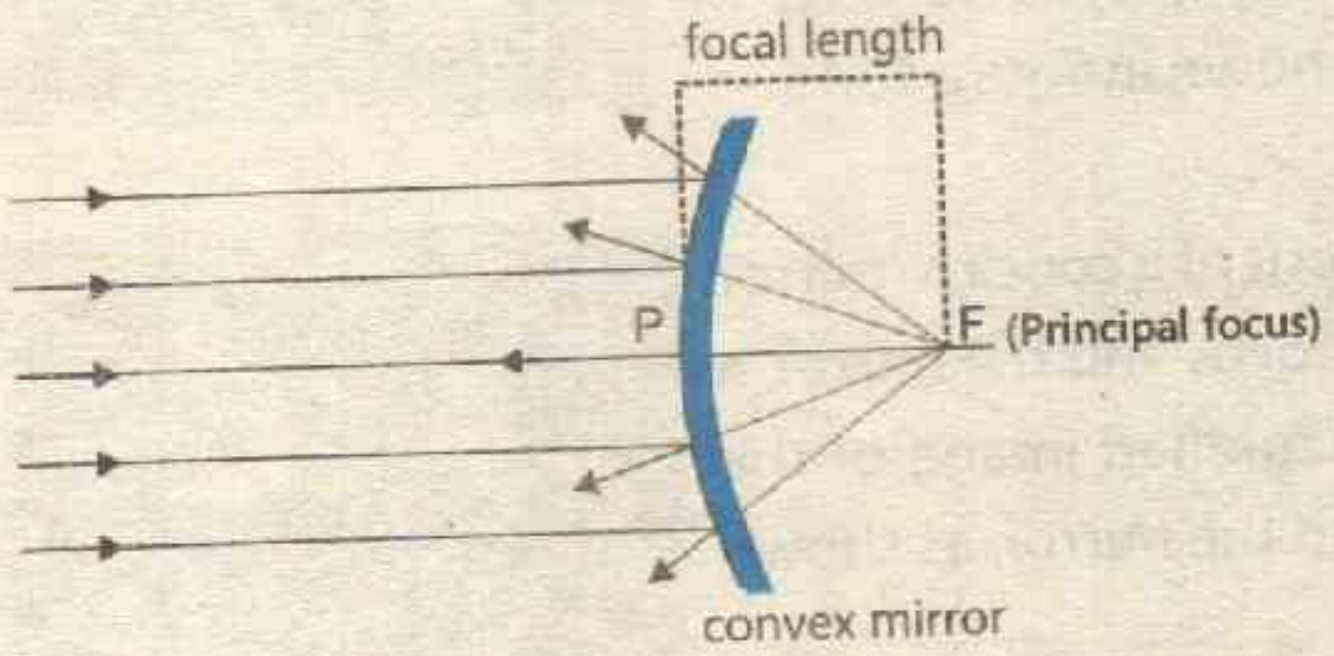


Fig 10.18: Convex Mirror

Image Formation in Convex Mirror

When rays of light, parallel to the principal axis, fall on the convex mirror, they spread after reflection from the mirror, in such a way that they appear to come from a point on the principal axis behind the mirror. This point is called principal focus "F" of the convex mirror. As the reflected rays do not actually pass through the principal focus "F", therefore, a convex mirror always forms an upright, virtual and a smaller image, as shown in the Fig. 10.19.

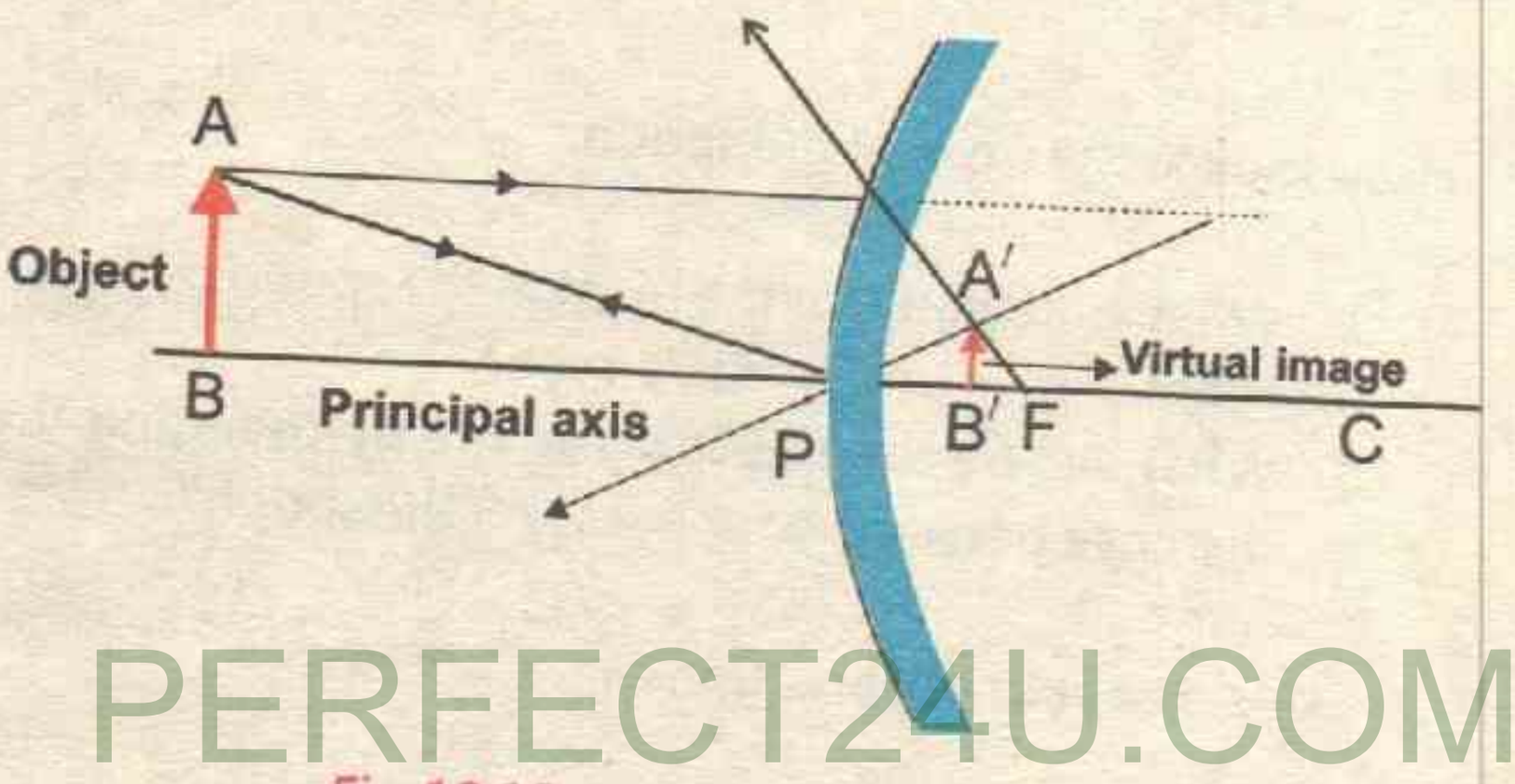


Fig 10.19: Image formation in Convex Mirror

Uses:

There are several important applications of convex mirrors. A few of them are given below.

1. Convex mirrors are used in vehicles to observe the rear view of objects.
2. Convex mirrors are also used as blind corner mirrors on roads especially in mountains.
3. Convex mirrors are used as security mirrors in shops.

Fig 10.20
Rear view Convex Mirror in vehicle

Activity 10.5

Look at the back of a shiny spoon.

- What kind of mirror does the back of the spoon represent?
- What kind of image do you see?
- What will be the effect on image by changing the distance between your eyes and the spoon?

Image from the outer side of a spoon

Image from the inner side of a spoon

Now look at the front of the spoon.

1. What kind of mirror the front of the spoon is ?
2. What kind of image do you see?
3. What will be the effect on image by changing the distance between your eyes and the spoon?

Conclude your observations.

KEY POINTS

- Light travels along paths, which are called rays.
- Light travels at a speed of 3×10^8 m/s.
- When rays of light travelling in one medium are incident on the boundary of another medium, they bounce back, this bouncing of light is called reflection of light.
- The two laws of reflection are:
  - o The incident ray, the reflected rays and the normal to the surface all lie in the same plane.
  - o The angle of incidence is equal to the angle of reflection.
- The surfaces which give regular reflection are known as smooth surface and the surfaces which give diffused reflection are known as rough surfaces.
- Plane mirror has smooth, polished and regular surface.
- Image formed by plane mirror is laterally inverted, virtual and of same size.
- Image formed by pinhole camera is upside-down.
- Periscope is a device which contain two plane mirrors placed in a tube at 45°.
- A reflecting telescope has a concave mirror and a plane mirror.
- In microscope, a mirror is used to reflect light on to the specimen above.
- Kaleidoscope is an instrument or toy containing mirrors which make multiple reflections.
- Concave mirror is a mirror whose inner surface is shining.
- Convex mirror is a mirror whose outer surface is shining.

EXERCISE

A. Fill in the blanks.

1. An instrument used to see distant objects is called _____.
2. Speed of light is _____.
3. Image formed in concave mirror is always _____.
4. Image formed by plane mirror is _____ inverted.
5. The angle of incidence is always _____ to the angel of reflection.

B. Select the best answer from the following.

1. Image formed by convex mirror is always _____.
   (a) virtual (b) erect and large
   (c) real (d) inverted
2. Concave mirror has the capability to _____ a parallel beam of light.
   (a) converge (b) diverge
   (c) dispense (d) no change
3. A microscope is an instrument used to produce a _____ image:
   (a) large (b) small
   (c) short (d) far
4. Which one is not a rough surface:
   (a) paper (b) wall
   (c) cloth (d) mirror
5. Mirrors used in car head lights and search lights are _____.
   (a) convex (b) concave
   (c) plane (d) all of them

C. Match column A with column B.

Column A	Column B
Multiple reflection	Two plane mirror
Periscope	Kaleidoscope
Microscope	virtual image
Pinhole camera	real image
convex mirror	large image

D. Answer the following questions.

1. Compare the images formed by a plane mirror and pinhole camera.
2. Mostly people wear white clothes in summer and dark clothes in winter season. Give reason.
3. Differentiate between the transmission, absorption and reflection of light.
4. Prove the law of reflection through an activity.

Unit

11

Investigating Sound

After studying this unit, the students will be able to:

- Describe sound as a form of energy.
- Compare the speed of sound in solids, liquids and gaseous mediums.
- Identify a variety of materials through which sound can travel.
- Explain that how does a human ear receive sound waves.

Introduction

In grade IV, you have learnt that sound is produced when objects vibrate. You know about the intensity of sound and can differentiate between low and high sounds. You have also learnt that sound can travel through solids, liquids and gases but cannot travel through vacuum. In this unit, you will learn about the production and propagation of sound in different material mediums as well as how human ear receives sound.

Birds Chirping

Music

Fig 11.1 : Different sounds

Sound

Sound is a form of energy that stimulates the sense of hearing. Sound is produced by a vibrating body. Sound travels as longitudinal waves.

Three things are necessary for hearing sound:

1. Production of sound - vibration
2. Medium for travelling of sound
3. Receiving device

Do you Know

Hearing takes place whenever vibrations of frequencies ranging from 20 Hertz to 20,000 Hertz reaches the inner ear. Human ear receives the vibrations and sends them to the brain to make meaning out of them.

1. Production of Sound

Sound is the energy produced by vibrating things. Vibrations mean back and forth movement of an object. For example when you strike a metallic object with a spoon, a sound is produced. You can feel the vibrations by touching the metallic object with your hand.

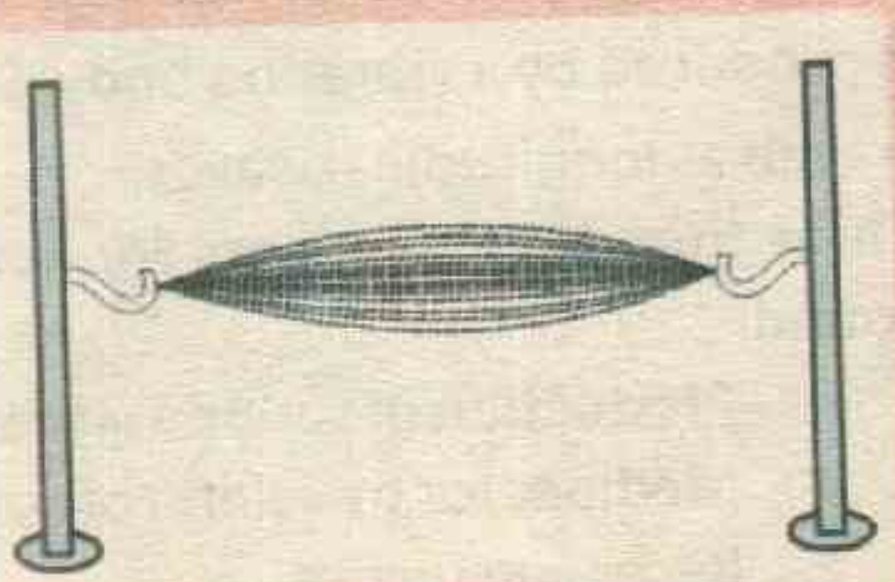
Observe the loudspeaker of a cassette player. When the volume is high, the sheet of the loud speaker vibrates very fast but when the volume is low, its vibration is also reduced. Similarly, if we touch our throat while we are talking, we can feel the vibrations in our voice box. Thus we can conclude that sound is produced when an object vibrates.

Fig 11.2: Sound producing instruments

Activity

11.1

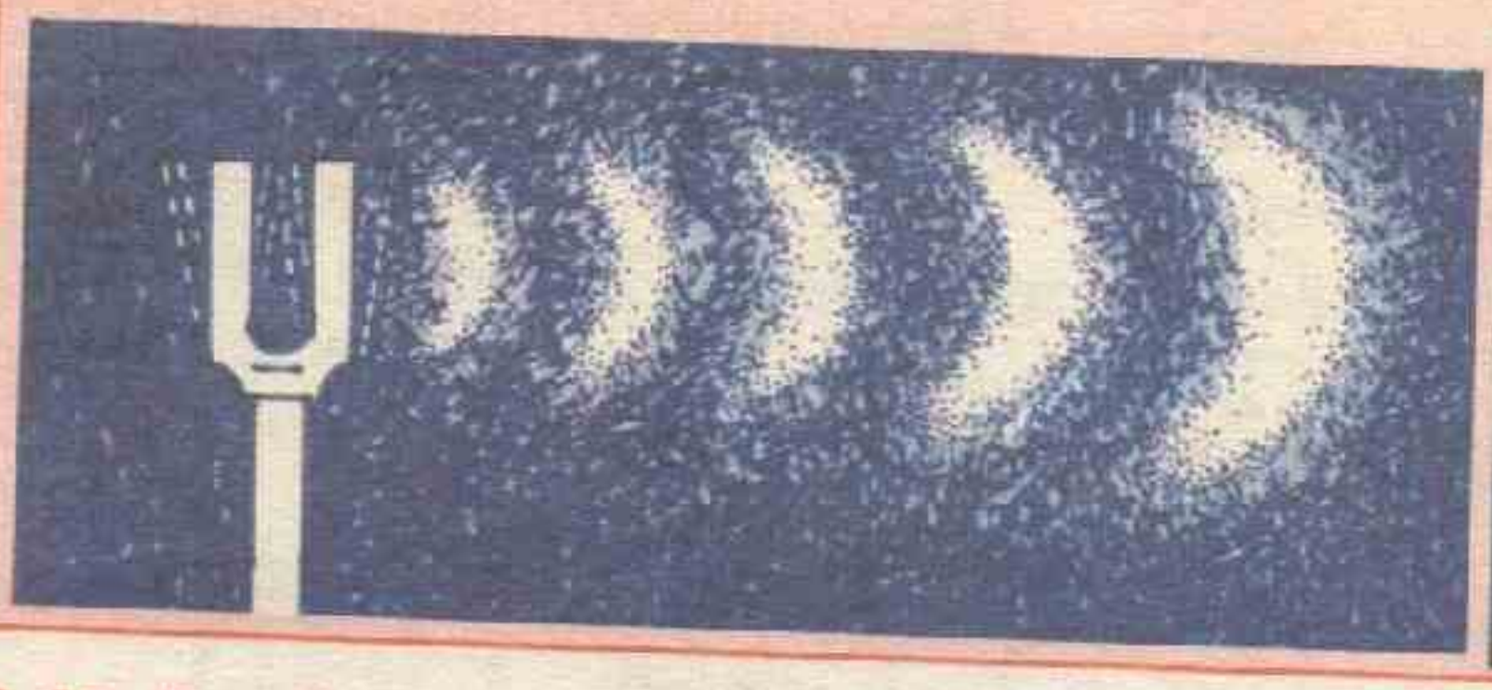
Fix a rubber chord between two hooks. Pluck it and place your finger next to the chord. You can feel the chord moving back and forth. The chord vibrates and produces sound. Bring your ear near it. Can you hear something? The vibrations of the chord produce sound.



Activity

11.2

Strike a tuning fork on a rubber pad. Touch one of its prongs with a pith-ball. The resulting movement of the pith ball shows that the prongs are vibrating. The vibrating tuning fork also produces sound. Can you hear the sound?



2. Medium for travelling of sound

We know that when something moves, work is done. Thus sound is the form of energy that moves and is associated with the vibrations or disturbances of matter. Sound waves need a medium such as a solid, liquid or gas to travel. The sound waves move through each of these mediums by vibrating the molecules in the matter. Normally sound (in air) is made when air molecules vibrate and move (away from the vibrating source) in a pattern called sound waves. Sound, however cannot travel through a vacuum, it always needs a medium to travel.

Example: A guitar has sound energy because when you strike the string of a guitar, the string moves back and forth and produces sound. The vibrations of the guitar string vibrate the air all around it as well. As the air moves, it carries energy out from the guitar in all directions. Eventually, even the air inside your ears starts vibrating and that is when you begin to hear the sound of the guitar.

Fig 11.3: Child listening radio

Activity

11.3

Sound travels through different materials

- Take a balloon or plastic bag (sealable), pencil eraser, water, wooden block and iron block.
- Hold the bag (filled with air) to your ear and cover the other ear with your hand.
- When your partner taps the bag lightly with the pencil eraser, listen to the sounds.
- Are they loud or low?
- Now fill the balloon or bag with water and repeat the same activity. Listen again the sounds and record whether the sounds are louder or quieter than before.
- Hold the wooden block and iron block, one by one, next to your ear and cover the other ear. Repeat the tapping of pencil eraser activity and listen to the sounds.
- Note down your observations.

Interesting information

Loons are very interesting birds due to the sound they produce. When they produce sound, it sounds like they are laughing.

The speed of sound in solid, liquid and gaseous mediums

The speed of sound in a given medium is defined by the distance covered by sound in unit time (one second).

The speed of sound is different through different materials. For example the speed of sound in dry, sea level air at a temperature of 0°C is 332m/s. The speed of sound in air varies under different conditions. If the

temperature is increased, the speed of sound increases. It is because the molecules move faster at higher temperature. So the speed of sound at 20°C is 340 m/s.

Sound generally moves much faster in liquids and solids than in gases. The speed of sound in water is approximately 1525 m/s. It is almost five times as fast as in the air. The speed of sound in Iron (solid) is 5130 m/s which is much faster than water (liquid) and air (gas).

Point to Ponder

Can you observe the speed of sound and tell through which material (solid, liquid, gas) can sound travel most easily?

3. Receiving device (Ear)

The process of hearing begins when sound waves strike upon an ear. We studied in unit 2, that the human ear has three distinct parts: the outer ear; the middle ear and the inner ear. The outer ear collects the sound waves and directs them along the ear canal to the eardrum, which is caused to vibrate. The message of these vibrations is sent to the brain. The brain interprets this message as the sensation of the sound.

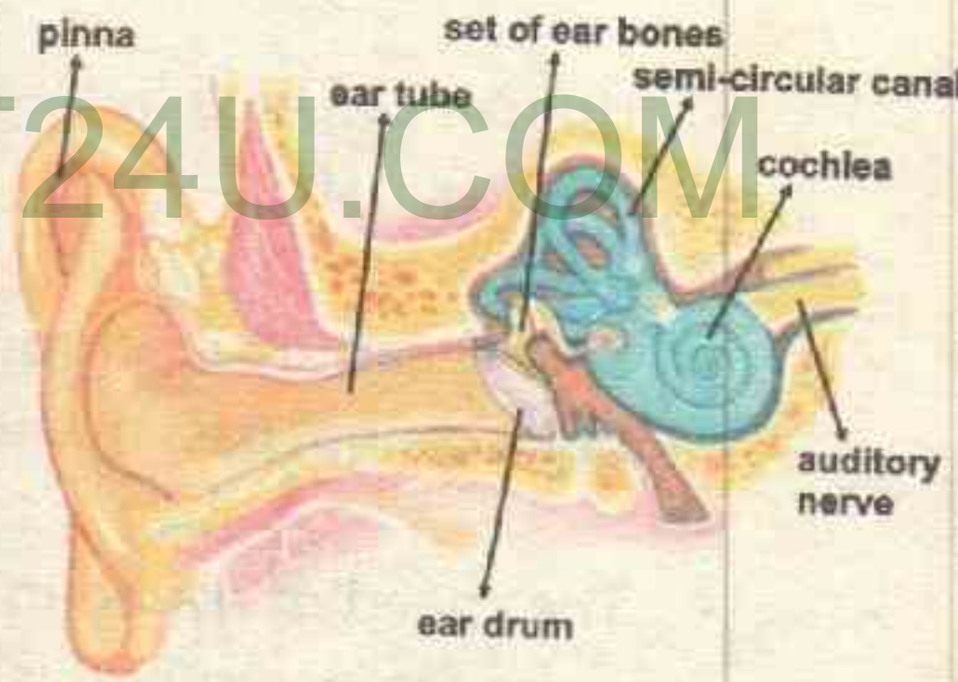


Fig 11.4: Cross section of human ear

Safety measures

All the activities related to sound production should be done carefully because the eardrum of your ear is very sensitive. It can be easily damaged. So do not enter any object into the ear. It may be dangerous and do not try to listen to the sound which has high frequency.

KEY POINTS

- Sound is a form of energy which travels as longitudinal waves.
- Sound is produced by vibrating body.
- Human can hear in frequency range between 20 Hz to 20, 000 Hz.
- Sound can travel through solids, liquids and gases but it cannot pass through vacuum.
- The speed of sound in air at O°C is 332 m/s. At the same temperature it is 1525 m/s in water and 5130 m/s in iron.

EXERCISE

A. Fill in the blanks.

1. Sound waves cannot pass through vacuum.
2. Sound is also a form of energy
3. Human ear can detect frequency from 20 hertz to 20000 hertz.
4. Back and forth movement of an object is called vibration.
5. Speed of sound in air greatly varies with temperature

B. Selects the best answer from the following.

1. Sound cannot travel through vacuum.
   a) iron
   b) wood
   c) water
   d) vacuum

2. Human ear has three distinct parts.
   a) four
   b) two
   c) one
   d) three

3. Speed of sound increases in air with increase in temperature.
   a) increases
   b) decreases
   c) remain same
   d) both (b) and (c)

4. Speed of sound in Iron is
   a) 5130 m/s
   b) 1530 m/s
   c) 3150 m/s
   d) 1503 m/s

5. The sound is a form of energy which travel through any medium as
   a) longitudinal waves
   b) transverse waves
   c) only rarefaction
   d) only compression

C. Match the column.

Sound	20 Hz - 20,000 Hz
Eardrum	No sound
Energy	Sound
Vacuum	Human ear
Human being	Longitudinal waves

D. Answer the following questions.

1. Prove that sound is a form of energy.
2. How sound is produced. Explain with examples.
3. Compare the speed of sound in solids, liquids and gaseous media.
4. Explain how does human ear receive sound waves.
5. Write down any two safety measures, which will protect your ear drum from the damage.

Unit

12 Space and Satellites

After studying this unit, the students will be able to:

- Define the term satellite.
- Compare the physical characteristics of comets, asteroids and meteors.
- Describe different kinds of meteors.
- Inquire into the sighting of Halley's comet; describe what would they feel if they saw it.
- Define the terms artificial satellites and geostationary.
- Explain the key milestones in space technology.
- Describe the uses of various satellites in space.
- Investigate how artificial satellites have improved our knowledge about space and are used for space research.
- Explain that how do satellites tell us where we are.

Introduction

The Solar System is full of planets, moons, asteroids, comets, minor planets and many other objects. The solar system includes the Sun and all the objects that orbit around it due to its gravity. There are eight planets in the Solar System. The four inner planets are Mercury, Venus, Earth and Mars while the four outer planets are Jupiter, Saturn, Uranus and Neptune. We already studied some facts about the solar system and the eight planets in earlier grades. In this unit, we will learn about one of the other members of solar system called satellites.

Do you Know

Objects in space, such as planets, moons, asteroids and stars are called celestial bodies or heavenly bodies. The heavenly bodies are moving in an unimaginable vast space i.e. universe.

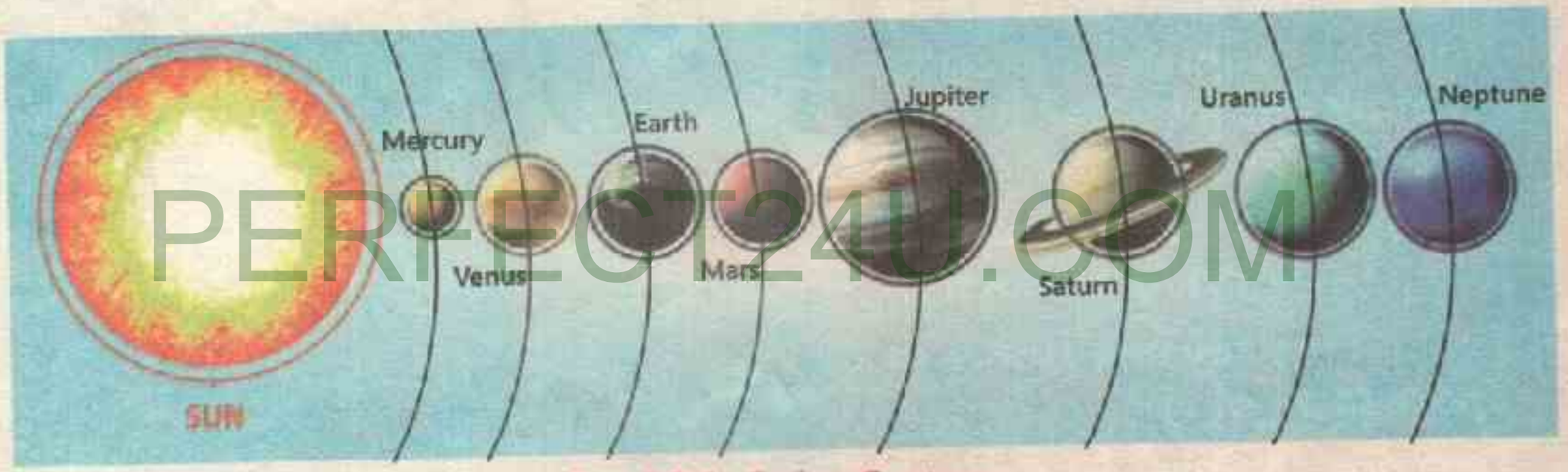


Fig 12.1: Solar System

Satellites

We know that sun is at the center of the solar system and the eight planets including the earth revolve around it. We also see the moon at night. The moon revolves around the earth and gets its light from the sun. Any heavenly body that revolves around the planets are known as satellites.

Satellites are classified into two major types:

1. Natural satellites
2. Artificial satellites

Fig 12.2: Satellite

1. Natural satellites

In astronomy, a celestial body that revolves around a planet is known as natural satellite. The best known natural satellite is the Earth's moon. Other planets also have moons. Beside moons of planets, some other bodies (natural satellites) are asteroids, comets and meteoroids, which are moving around the sun.

2. Artificial Satellites

An object launched into orbit by human beings is called an artificial satellite. It revolves around the Earth or other planets.

The first artificial satellite was launched in 1957. Artificial satellites are used for different purposes. Today, these satellites play key role in communications, industry, military intelligence and in the scientific study of the Earth and outer space.

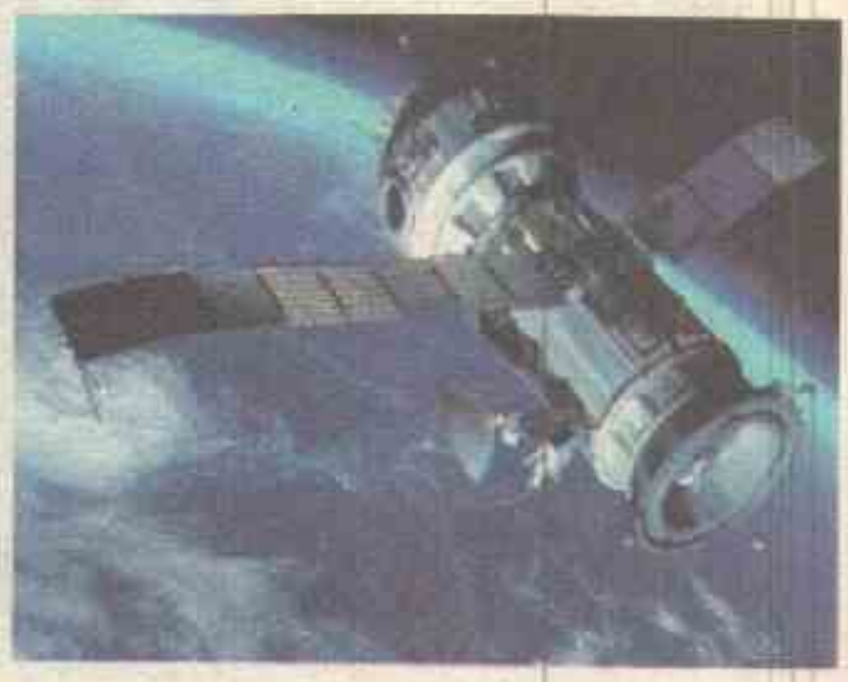
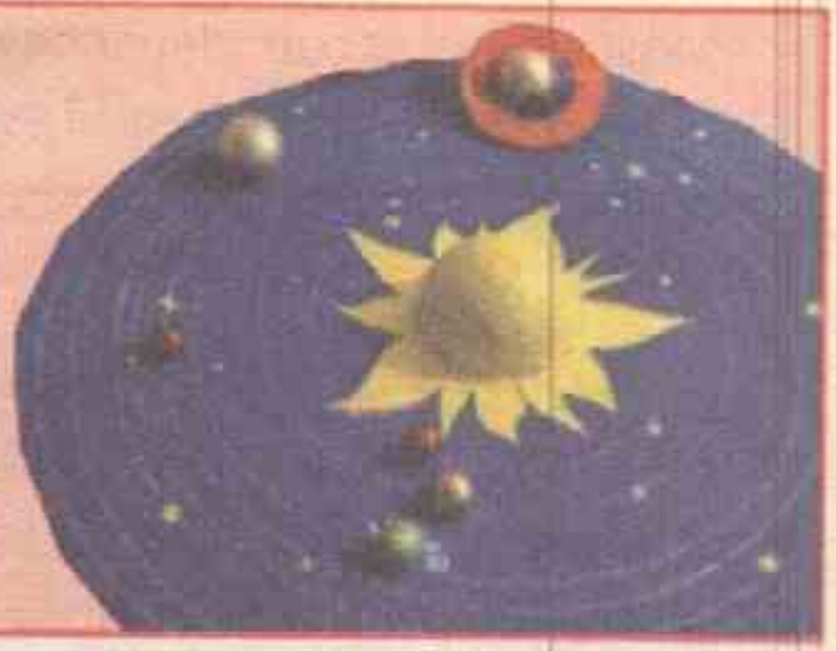


Fig 12.3: Artificial Satellite

Activity 12.1

- See the diagram and make a solar system. How can you identify the planets.
- Collect pictures of satellites from different books, magazines and other resources.



Other bodies in solar system

Along with the sun, planets and natural satellites, our solar system also contains minor planets known as asteroids, comets and meteors.

Asteroids

Asteroids are rocky bodies of different sizes that are members of the solar system. They move in elliptical orbits between Mars and Jupiter.

There are about 100, 000 asteroids. Some asteroids have diameter upto 1,000 kilometers but some are very small in diameter. Majority of them are too small to be seen from the Earth. Only two named ceres and vesta can be seen from the earth without a telescope.

Fig 12.4: Asteroids

Do you Know

Most asteroids complete one orbit around the sun in about five earth years. Ceres is the largest asteroid ever discovered. Its diameter is about 933km.

Comets

Comets are relatively small, icy celestial bodies revolving around the Sun. When a comet approaches near the Sun, some of the ice in the comet turns into a gas.

This gas and other loose particles freed from the ice create a long, luminous tail. In space they look like a bright

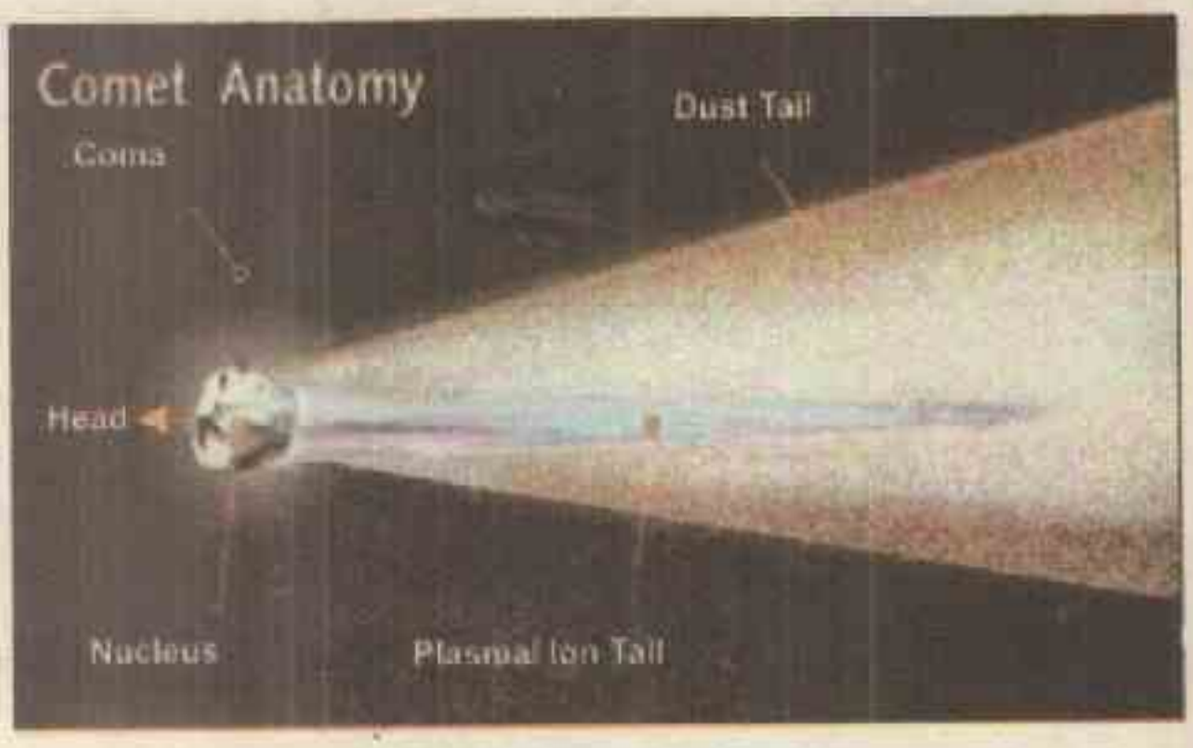


Fig 12.5: Comets

ball with a long shiny tail. A comet has three parts; a head, coma and a tail. The head is formed of ice, particles of rocks and gases. When comet become closer to sun and heats up. The gases released from the head form a large circular cloud around the head, called the coma. While orbiting near the sun, a long tail of gases and dust particles is formed. Comets bear no tail, when they are far away from the sun.

Halley's comet is a ball of ice and dust revolving around the Sun. It has appeared in the sky many times. It can be seen from the Earth once about every 76 years. Last appeared in 1986. Its next appearance is scheduled to be in 2062.

Science Tidbit

Sighting the comet Halley in past

- Some people sighted it as a long haired star.
- Some sighted it as having a tail like a broom.
- Some sighted it as having a tail like the blade of sword.
- To some people, it looked like a dragon with multiple tails and afraid of it.

What would you feel if you see the Halley's comet?

Meteors

Meteor is a small solid body made up of rocks and iron. When it enters in Earth's atmosphere it burns with light making a visible track due to the friction produced by its rapid motion. Most meteors entering our atmosphere burn up 50 to 100 kilometers above the surface of the earth. It adds tons of dust into our atmosphere everyday.

Fig 12.6: Meteor

Kinds of Meteors

Different kinds of meteors are given below.

- Brilliant meteors are known as fireballs occur singly and consist of a luminous head, followed by a tail of light.
- Bolides are kind of meteors that have been seen to explode with a sound like thunder.
- Fainter meteors are called shooting or falling stars. We usually can see several of them on a clear starry night. Sometimes hundreds of such meteors occur simultaneously and appear from a fixed point. These cluster of meteors is called meteor showers.

Brilliant meteors | Bolides meteors | Fainter meteors

Fig: 12. 7: Meteors

Science tidbit

A few meteors, very large ones, sometimes strike on the surface of the earth are called meteorites.

A gigantic meteorite crashed onto the earth in Arizona in the United States, somewhere between 5,000 and 50,000 years ago. It has left a huge crater 1200 meters wide and 180 meters deep. A much larger body, about 10 kilometers wide, is believed to have crashed on the earth about 60 million years ago. Some scientists think that it has changed the climate and vegetation of the earth and caused the dinosaurs to die.

Crater in Arizona

Table 12.1 Comparison of properties of asteroids, comets and meteors

Characteristics	Asteroids	Comets	Meteors
Size	Upto 1000 km in diameter	Upto 20km in diameter	From few centimeter to few meters in diameter
Shape	Irregular	Irregular	Irregular
Composition	Carbon, iron and other metals	Iron, rock, ammonia and other gases	Iron, rock, etc
Location	Between Mars and Jupiter	They move in elliptical orbit around the sun	These are the wondering bodies in the solar system

Space Travel

For centuries, humans have dreamed of traveling in space. In mid of 20th century, there started a "Space Race" between the United States of America and the former Union of Soviet Socialist Republic (USSR) to create a rocket that could reach space.

Soviet scientists scored the first victory on October 4, 1957, when they launched the first artificial satellite, Sputnik-1 into orbit around the Earth.

Science Tidbit

A rocket or space craft has to overcome the earth's gravity to go into the space. The speed at which a space craft escapes the earth's gravity completely is called the escape velocity (40,000km per hour).

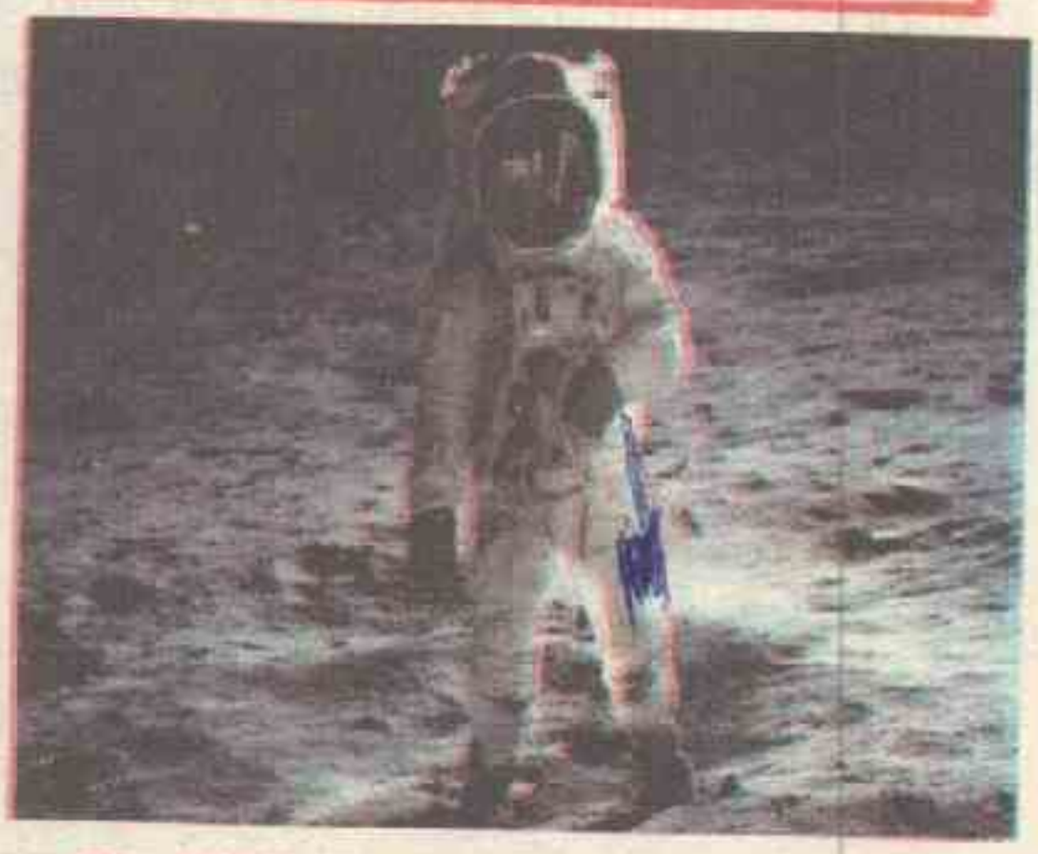


Fig 12.8: Astronaut in the space

Artificial Satellites

There are many man made satellites orbiting around the earth. These satellites help scientists to learn about weather and many other things on the earth.

Following are the kinds of artificial satellites.

(i) Sputnik

It is the name of several artificial satellites launched by the Soviet Union from 1957 to 1961. The goals of the sputnik program included studying the Earth's upper atmosphere and testing rocket technology. Sputnik-I was an unmanned launch, while sputnik-II carried a dog.

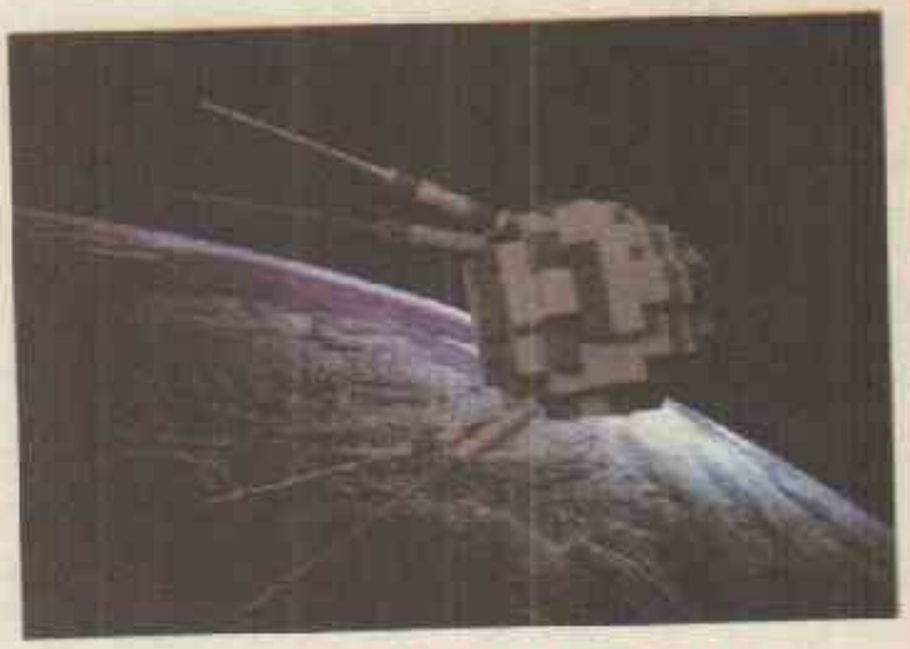


Fig 12.9: Sputnik I

(ii) Geostationary Satellites

Geostationary satellites are communication satellites using geostationary orbit. Their speed is equal to the revolving speed of the Earth i.e. 24 hours. So these satellites appear stationary from the earth i.e. remain over the same spot above Earth's equator. Pakistan has launched its first geostationary satellite, Paksat-IR in 2011.

Fig 12.10: Geostationary Satellite

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Artificial satellites move around the earth in different orbits, e.g. geostationary orbit, polar orbit, eccentric orbit, low earth orbit etc.

(iii) Landsat satellite

The Landsat satellites is a series of satellite missions. These have collected information about earth from space. Landsat satellites have taken photographs of earth's continents and surrounding coastal regions. Landsat data is used for applications such as mapping land, managing forested land, estimating crop production and protecting wild life.

Fig 12.11 Landsat Satellite

(iv) Communication satellite

A communication satellite (some times abbreviated to comsat) is an artificial satellite stationed in space for the purpose of telecommunications. They link remote areas of earth with telephone and television.

Fig 12.12: Communication Satellite

(v) Polar satellite

Satellites revolving around the Earth over both the north and the south poles are called polar satellites. They provide weather information and also map ozone levels. Polar satellites will help scientists to protect future satellites from atmospheric dangers.

Fig 12.13 Polar Satellite

(vi) Global Positioning System (GPS) / Navigation Satellite

The Global Positioning System is a group of 24 satellites that transmit signals to and from all parts of the world. The system enables a GPS receiving person to determine his location, speed, direction and time anywhere.

Fig. 12.14: Navigation Satellite

Uses of Satellites

Scientists have developed many kinds of satellites; each designed to serve a specific purpose or mission.

- Telecommunications satellites help in carrying radio, T.V. and telephone signals over long distances.
- Navigational satellites pinpoint the location of objects on Earth.
- Weather satellites help in weather forecast.
- Surveillance satellites are used to monitor military activities.
- Scientific satellites give a space based platform for observation of Earth, the other planets, the Sun, the comets, the galaxies and the outer space.

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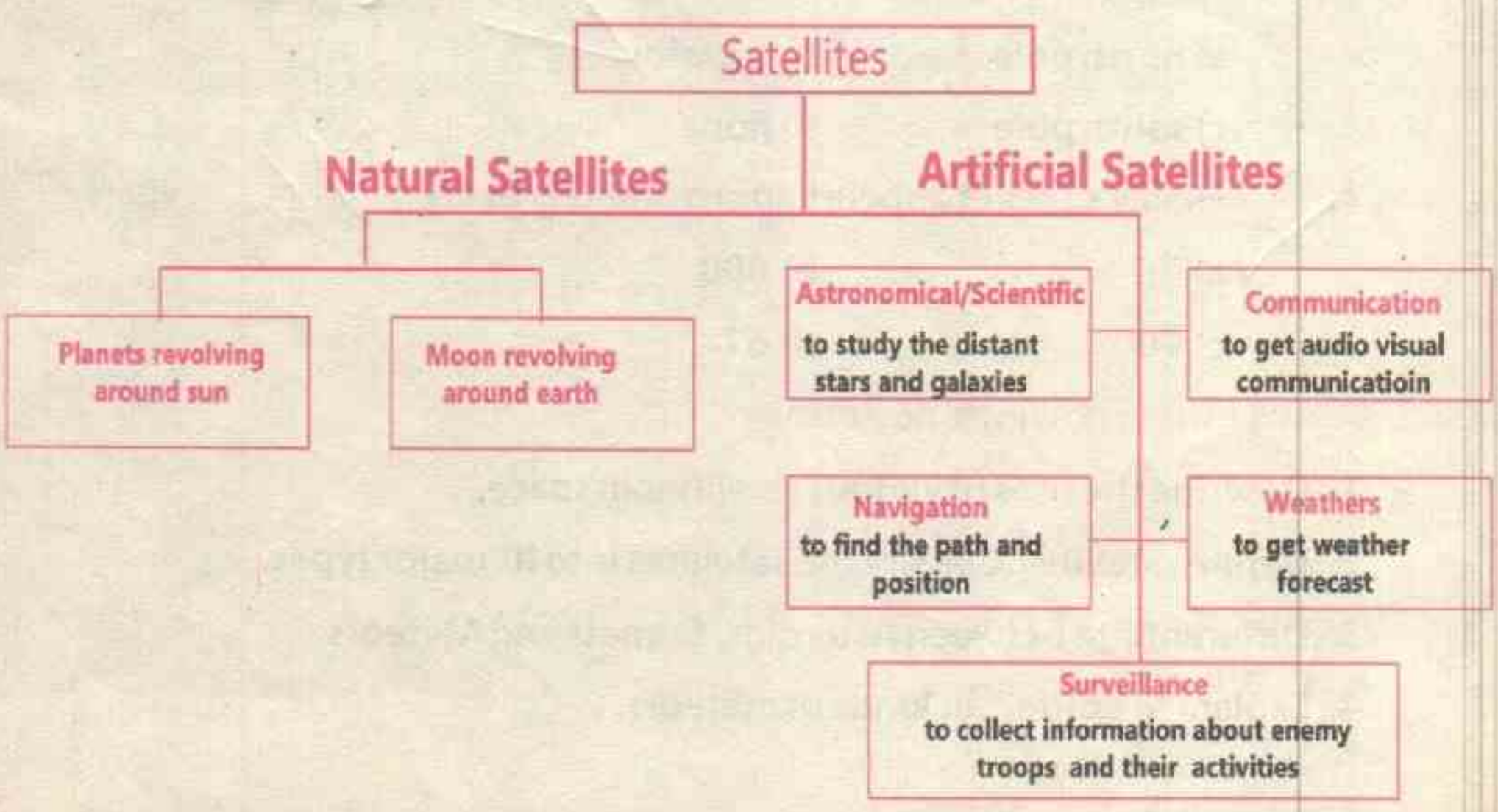
Do you Know

- Yuri Gagarin was the first man to enter the space and return safely.
- Valentina Tereshkova was the first woman to travel to space.
- Neil Armstrong and Edwin Aldrin were the first Americans to step on the moon in 1969.
- Pakistan sent the first Satellite Badr-I in 1990s.

KEY POINTS

- Satellite is an object that revolves around the planet.
- There are two main types of satellites i.e. Natural satellites and Artificial satellites.
- Artificial satellites are the objects which are purposely placed into orbit around the Earth.
- Natural satellites revolves around the planets e.g. earth's moons.
- Asteroids are small rocky bodies that are members of solar system. They are mostly moving between Mars and Jupiter.
- Comet is relatively small, icy celestial body revolving around the Sun. It has luminous tail.
- Meteors are small solid bodies that enter a planet's atmosphere.
- There are different artificial satellites used for specific purpose. e.g. Telecommunication, Navigation, weather information, military information etc.



EXERCISE

A. Fill in the blanks.

1. A celestial body revolving around a planet is known as comets.
2. Polar satellites provide weather information and map of ozone levels.
3. The speed of artificial satellite equal to the revolving speed of the Earth.
4. Navigational satellites pinpoint the location of the object on Earth.
5. Spy/ military satellites is used to monitor the military activities.

B. Selects the best answer from the following.

1. Over 300 communication satellites have been launched since 1957.

   a) 100 b) 200

   c) 300 d) 600

2. Landsat satellite is used for mapping land.

   a) Sputnik b) Explorer

   c) Landsat d) Polar

3. Geostationary orbit is exactly above the equator

   a) north pole b) equator

   c) south pole d) none

4. Halley's comet appears approximately every 76 years.

   a) 76 b) 600

   c) 700 d) 67

C. Answer the following questions.

1. Describe the uses of various satellites in space.
2. Define satellites. Classify the satellites into its major types.
3. Differentiate between Asteroids, Comets and Meteors.
4. Explain the different kinds of meteors.

GLOSSARY

Absorption of light	The reduction in the amount of energy available after the reflection of light from opaque surface.
Air	Air is a mixture of different gases, mainly consists of nitrogen, Oxygen, carbon dioxide, inert gases, dust particles and water vapours.
Asteroids	A space object that orbits the sun between Mars and Jupiter.
Atmosphere	A thick layer of air around the earth.
Atom	The smallest particle of an element, which can take part in a chemical reaction.
Carbon dioxide	Carbon dioxide is a gas, present in air in a volume of 0.03%.
Cell	The cell is the structural and functional unit of all all living organisms.
Cell wall	A cell wall is a tough, flexible and sometimes fairly rigid layer that surrounds plant cell. It is located outside the cell membrane and provides protection and support to the cell.
Central nervous system (CNS)	CNS is the part of the nervous system that functions to Coordinate the activity of all parts of the bodies of multicultural organisms. It consists of brain and spinal cord.
Centrioles	Centrioles are tube-like structures that help in cell division.
Chromatography	It is a modern technique used for the separation of mixtures. Basically it is used for the separation of colors.
Comets	These are small icy and rocky bodies revolving around the sun.
Compound	Compound is a substance, which is formed by the chemical combination of two or more than two different elements in a fixed ratio.
Concave mirror	A mirror with a surface that curves inward.
Concentrated solution	The solution, which contain large amount of dissolved solute in the solution.
Convex mirror	A mirror with a surface that curves outward.
Crane	A machine that is used for lifting heavy loads.
Cytoplasm	It is a jelly-like material present between the cell membrane and nuclear membrane. It contains about 80% water.
Dilute solution	The solution, which contain small amount of dissolved solute in the solution.

Ecosystem	An ecosystem is a natural unit consisting of all plants, animals and micro -organisms (biotic factors) in an area functioning together with all of the physical (abiotic) factors of the environment.
Element	A substance, which cannot be broken down into anything simpler by either chemical or physical methods. An Element is composed of only one kind of atom.
Energy	Ability of a body to do work.
Environment	The sum of the elements, factors and conditions in the surroundings which may have an impact on the development, action or survival of an organism or group of organisms.
Filtration	This method is used to separate insoluble particles from liquids, passing through a filter.
Fixed pulley	A kind of pulley whose axle is fixed.
Gear	A wheel with teeth around it.
Geothermal energy	Energy obtained from the hot molten areas inside earth crust.
Halley's comet	A ball of ice and dust orbiting the sun.
Heterogeneous mixture	Mixture, which do not has uniform composition, is called heterogeneous mixture
Homogeneous mixture	Mixture, which has uniform composition, is called homogenous mixture.
Incident ray	Ray striking the surface of an object.
Kaleidoscope	A device where constantly changing pattern of simple designs can be viewed.
Kinetic energy	Energy of moving body.
Law of conservation of energy	A law, which states that energy cannot be created or destroyed.
Law of reflection	The angle of incident = the angle of reflection
Matter	Anything which occupies space and has mass is called matter.
Metal	Metal is a substance that is typically hard (except Mercury), opaque and shiny. They can pass electricity and heat.
Meteor	A stray piece of metal or rock from space that enters earth's atmosphere and glows.
Microscope	An instrument used to see small objects not visible by naked eyes.

Mitochondria	Rod shaped organelles that can be considered the power generators of the cells.
Mixture	A mixture is formed when two or more than two substances are physically combined with each other in any proportion.
Molecule	The smallest unit of substance, which can exist independently and shows all the properties of that particular substance, is called a molecule.
Multicellular	Multicellular organisms are organisms consisting of more than one cell.
Mutualism	A relationship between two organisms that benefits both of them.
Nitrogen	Nitrogen is a gas, present in air in a volume of 78%.
Nonmetal	Nonmetals are substances that mostly lack metallic features (hardness, luster, conductivity) . When non-metals are heated, they are easily converted into gases.
Nuclear energy	The energy present in the nucleus of an atom.
Nucleus	The central part of atom.
Nucleus	The nucleus is a membrane bound structure that contains the cell's hereditary information and controls the cell's growth and reproduction.
Organism	An individual, animal, plant or single cell life form.
Oxygen	Oxygen is a gas, present in air in a volume of 21%.
Parasitism	The relation between two different kinds of organisms in which one receives benefits from the other by causing damage to it.
Photosynthesis	The process in green plants and certain other organisms by which carbohydrates are synthesized from carbon dioxide and water using chlorophyll and light. Most forms of photosynthesis release oxygen as a byproduct.
Pitch	The difference between low and high sound.
Plane mirror	Flat mirror that produce same and upright image of object.
Predation	Predation describes a biological interaction where a predator (an organism that is hunting) feeds on its prey (the organism that is attacked and killed).
Pulley	A simple machine made of wheel and axle.
Rare gases	These gases are also known as inert gases. Sometime they are referred as noble gases. These are Helium, Neon, Argon, Krypton and Xenon.

Real Image	An image which can be obtained on a screen.
Reflection of light	The bouncing back of light ray.
Respiration	The act of inhaling and exhaling air in order to exchange oxygen and carbon dioxide.
Saturated Solutions	A solution, which cannot dissolve more solute at a given temperature, is called saturated solution.
Sieving	This method is used to separate solid particles of different sizes, passing through a sieve.
Solubility	The amount of solute dissolved in 100 grmas of a solvent to prepare a saturated solution at a particular temperature.
Solute	The component of solution, which is present in smaller quantity, is called solute.
Solution	A homogenous mixture of two or more than two substances is called solution.
Solvent	The component of solution, which is present in larger quantity, is called solvent.
Sublimation	The process in which some solid substances, when heated, change directly to the gaseous state without passing through the liquid state. On cooling they become a solid again.
Substance	Matter in its pure form is called substance.
Suspension	A heterogeneous mixture (which does not have a uniform composition) of un-dissolved solute in a given solvent.
Symbol	Symbol is a short name of an element.
Unicellular	Organisms that have only one cell.
Universal solvent	The solvent, which can dissolve most substances. e.g. water.
Unsaturated Solutions	A solution, which can dissolve more solute at a given temperature, is called an unsaturated solution.
Vibration	Back and forth movement
Virtual image	Image which cannot be obtained on the screen.
Volume	Loudness of sound

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