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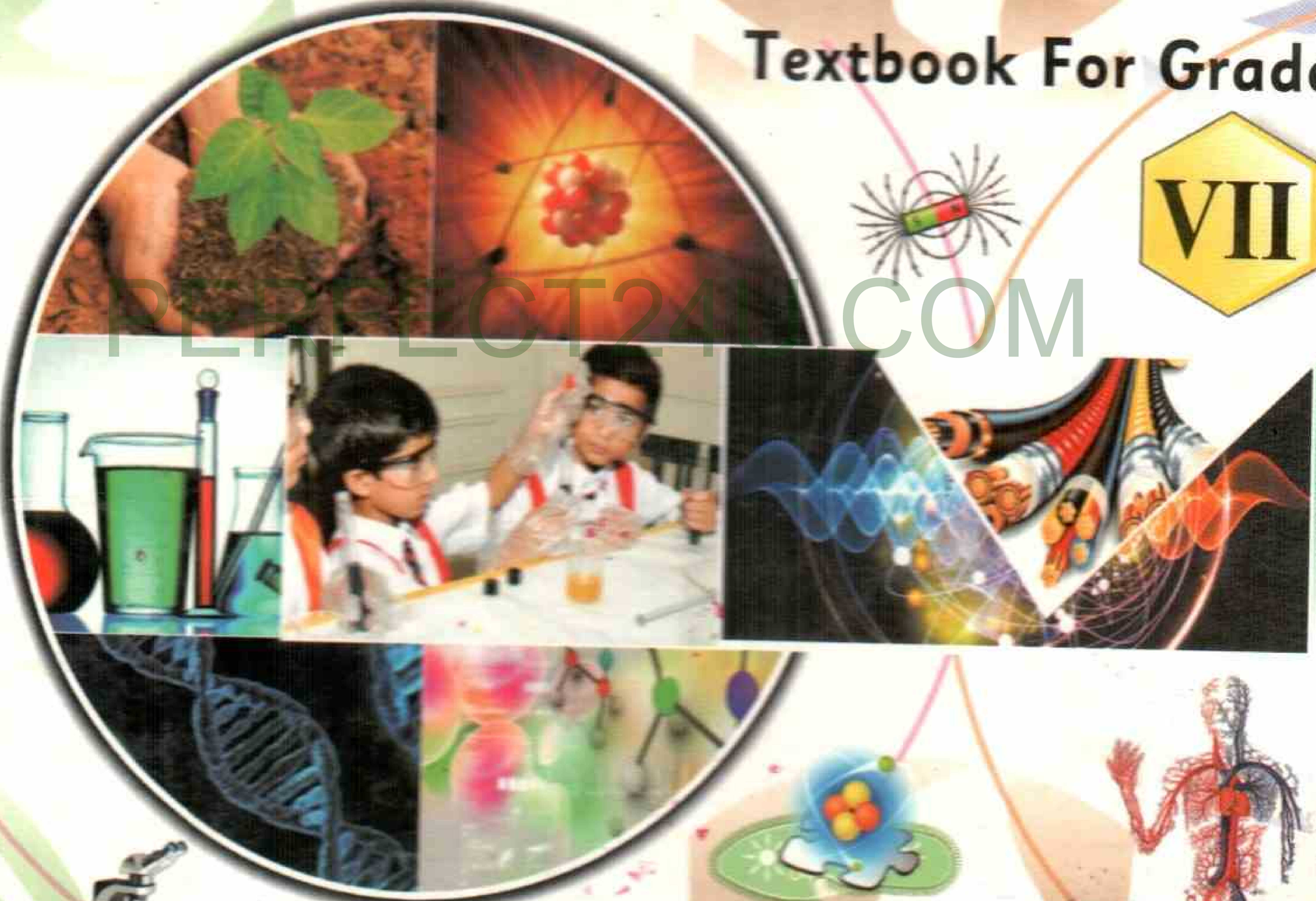
GENERAL
SCIENCE

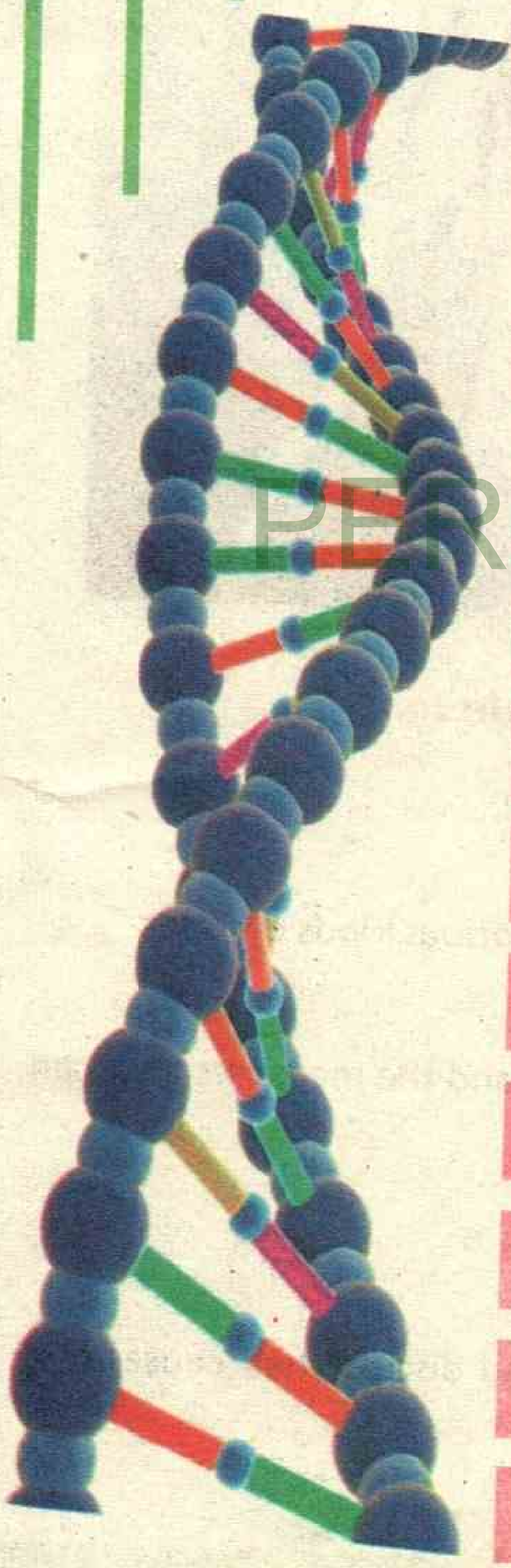
Textbook For Grade

VII



Khyber Pakhtunkhwa Textbook Board

Contents



Introduction

Do you remember what you have learnt about human body? In grade IV, you have learnt about major parts of human body i.e. teeth, bones, muscles, brain, lungs, heart, stomach, skin, eyes etc and common disorders of skin, teeth and stomach. You have also learnt about different cells, tissues and organs of human body in grade VI.

Different organs (parts) of the body when perform a same function, make a system. In this unit, you will learn about the human digestive system, respiratory system and common disorders related to these systems.

1.1 Human Digestive system

The digestive system is involved in the breakdown of food into small molecules. Digestion is the process in which food is broken down into simpler, soluble form for absorption in the blood stream. During digestion, large and complex molecules are broken down into smaller and simple molecules both mechanically and chemically.

1.1.1 Mechanical digestion involves the breaking down of large pieces of food into smaller pieces. It starts in the oral cavity through chewing by teeth. Food is then swallowed and further broken down by the contraction and relaxation of stomach walls.

1.1.2 Chemical digestion takes place through the action of different enzymes, produced by the digestive glands.

These help in the chemical breakdown of proteins in the food and also kills unwanted bacteria that may have been swallowed. When food leaves the stomach, it is transformed into a semi-liquid mass called chyme.

Science tidbit

The oesophagus is 25-30 centimeters long and is located close/parallel to the trachea (breathing tube) and the heart.

iv. Small Intestine

Small intestine is a long (6-8 meters), narrow and coiled tube. The digestive juices from the liver and pancreas enter into the first part of the small intestine. The enzymes in the juices mix with the chyme and complete the digestion of food in the small intestine. Small finger-like projections called Villi, are present on the walls of the last part of the small intestine. Villi slow down the flow of food through the small intestine and help in the absorption of the digested food into blood through capillaries.

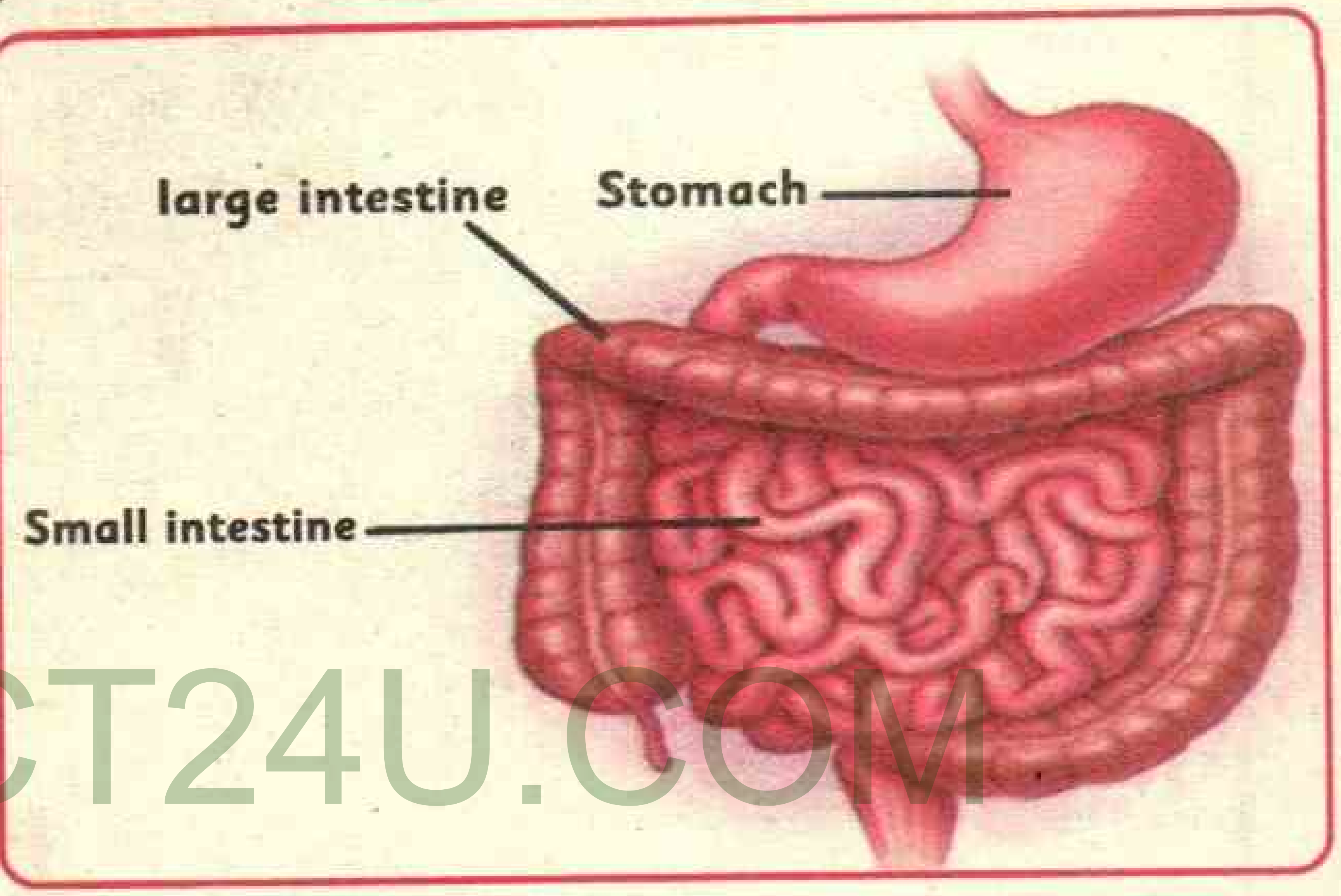


Fig. 1.2 Stomach, small and large intestines

Digestion time of different foods	
Fruit Juices:	15-20 minutes
Fruits and vegetables:	30-45 minutes
Seeds and Nuts:	up to 2 hours
Chicken:	2-2 ½ hours

v. Large Intestine

This is the last part of the digestive system. Water and minerals are reabsorbed in this part. The undigested food is stored in rectum before it is excreted through the anus.

Table 1.1 List of secretions, their origin and functions

Source	Secretion	Functions
Salivary Gland	Saliva	Breakdown of sugars and killing of germs.
Stomach wall	Gastric Juice	Breakdown of Proteins and killing of germs.
Liver	Bile	Breaking of Fats into small molecules.
Pancreas	Pancreatic Juice	Breakdown of proteins and sugars.

1.1.4 Importance of Digestion

Food is the source of energy. The digested food is absorbed from the small intestine into the blood. Blood transports this digested food to each and every cell of the body where by the oxidation of the food, energy is released to carry on life activities.

1.2 Disorders of the Digestive System

Food is sometime not digested properly and may result in some health problems. There may be many causes of digestive disorders, such as, infected food, not washing hands before meals, eating in unclean utensils etc. Any of these factors may lead to digestive disorders like food poisoning, diarrhea and constipation etc.

1.2.1 Diarrhea

Diarrhea is the frequent discharge of loose, watery fluid from the body. It is caused by eating food infected by bacteria, viruses or other parasites or by drinking water contaminated by these germs. Diarrhea is a serious illness especially for babies as large amount of water and minerals are lost from the body.

During the breathing process the air passes through the nose, larynx, trachea, bronchi, alveoli and enters into the lungs.

Following are the major organs of breathing system.

i. Nose: The nose consists of two cavities called nostrils. The nostrils remain moist due to the presence of mucus. As air enters the nostrils it becomes moist and warm. The hairs in the nostrils capture dust particles from the air inhaled and clean it.

ii. Larynx: The larynx or sound box is located in the neck. It contains vocal cords which are sound producing organs. Air from the nose passes through the pharynx into the larynx before it enters the trachea.

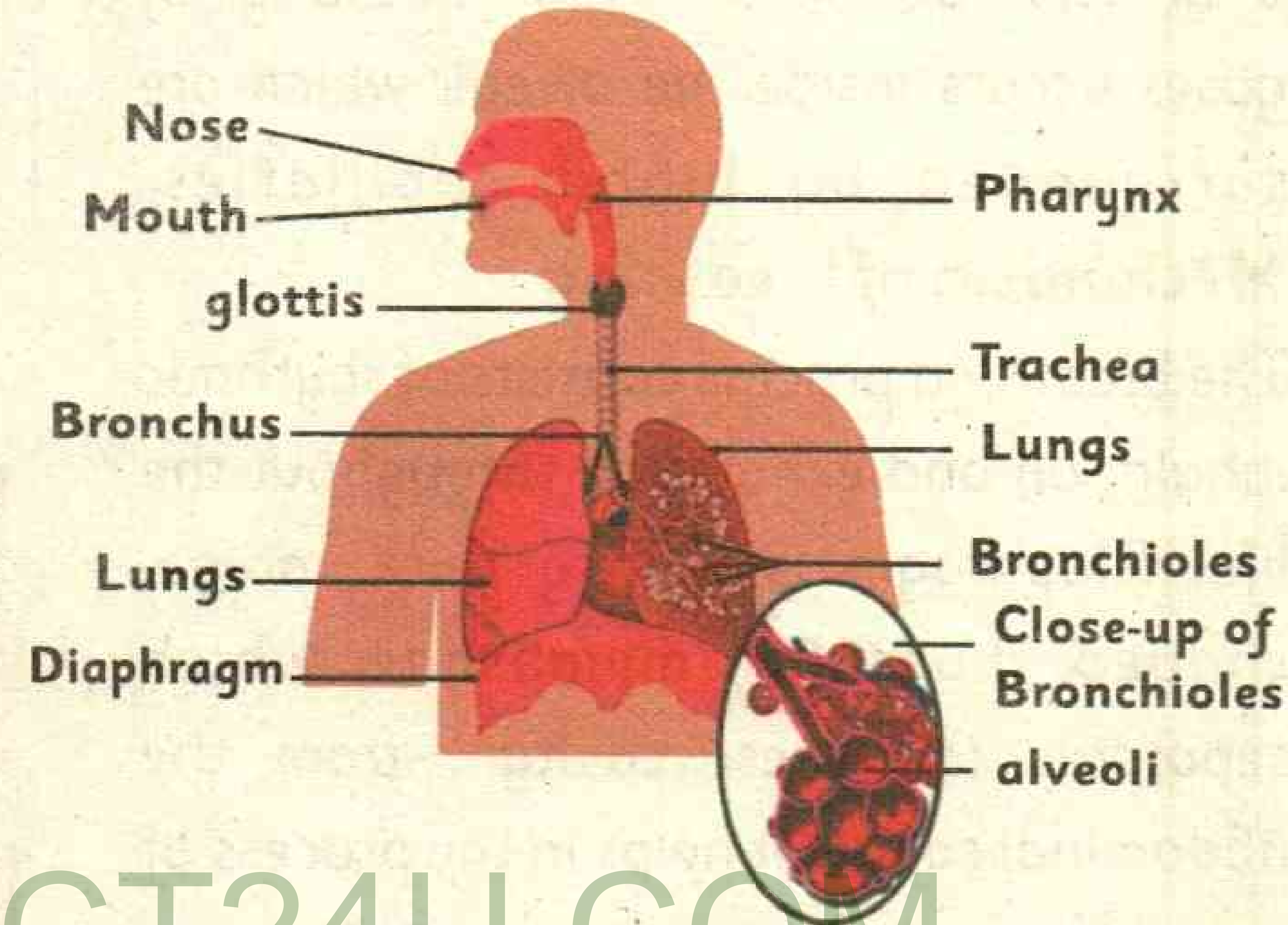


Fig.1.4 The human respiratory system

iii. Trachea: Trachea is also called the wind pipe. It is made up of cartilaginous rings. The opening of the trachea is called the **glottis**, which is covered by a flap called **epiglottis**. The epiglottis closes the glottis during swallowing thus stopping the food from entering into the trachea. During inhalation and exhalation it remains open.

iv. Bronchi

The trachea divides into two branches in the chest cavity, called Bronchi. Each bronchus (singular of bronchi) enters into a lung and divides into smaller tubes called bronchioles which open into air sacs called alveoli. The alveoli provides a large surface area for the exchange of gases between the blood and the air. Each alveolus is surrounded by many capillaries.

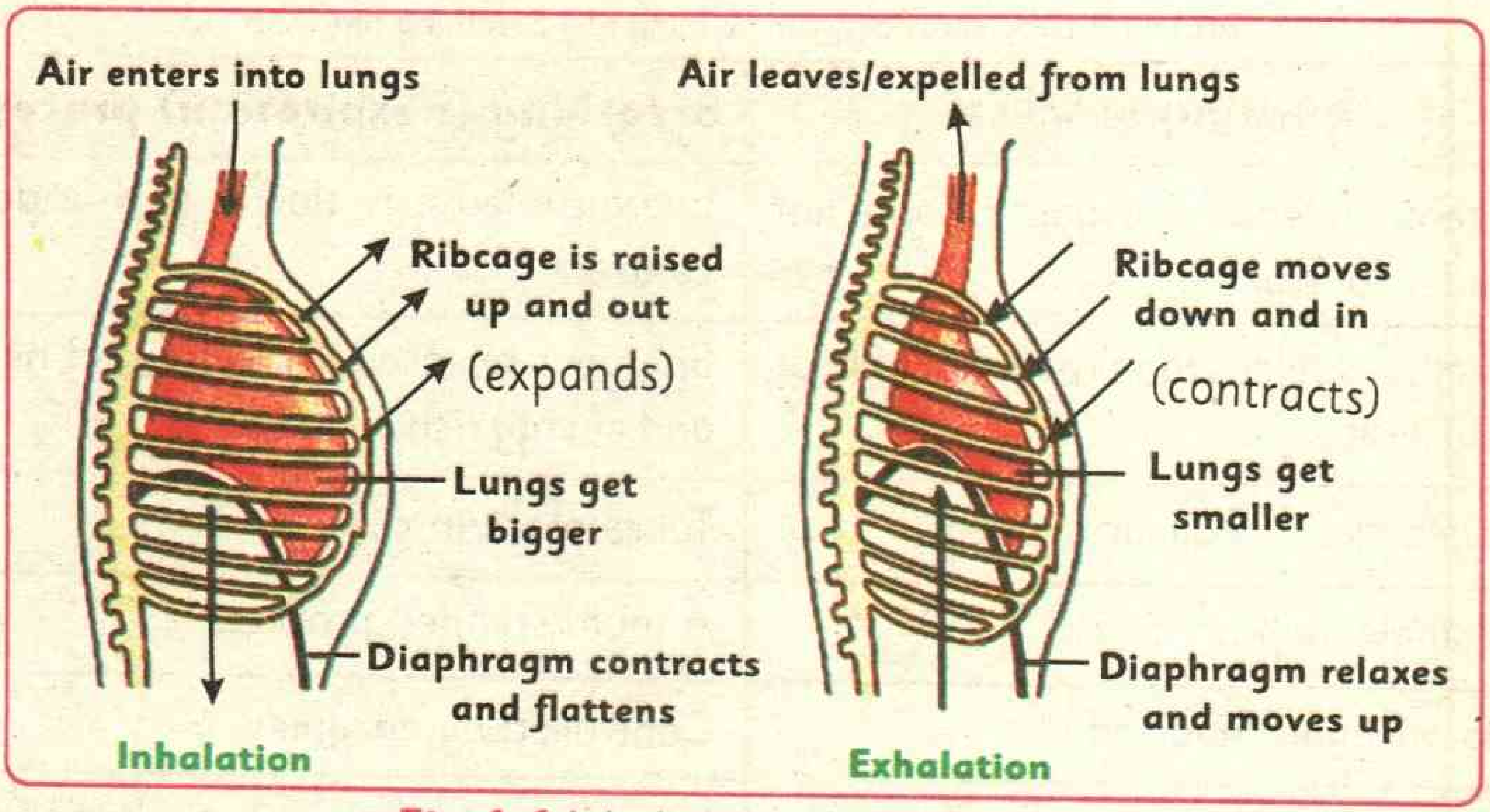


Fig.1.6 Inhalation and Exhalation

b) Internal Respiration or cellular respiration

Every cell of the body needs energy for its activities. This energy is provided when the oxygen and food molecules react with each other within the cell. Cellular respiration is a slow process which occurs at body temperature. The oxygen diffuses into the blood through the alveoli in lungs, while food gets into the blood through the capillaries in the villi of the small intestines. Thus blood takes the food and oxygen to each cell of the body, where they react with each other to release energy.

Food + Oxygen → Carbon dioxide + water + energy

The blood leaving the cells contains extra water and carbon dioxide. This blood reaches the lungs and the carbon dioxide is released into the air from the lungs.

1.3.1 Difference Between Breathing and Burning Processes

Both respiration and burning are energy-releasing processes and are similar in terms of raw materials and products. Respiration differs from burning processes in many respects.

by cleanliness, avoiding contact with TB patients and through getting vaccination. The treatment of TB is possible by completing a course of antibiotics. Pakistan is among the few countries that still have high rates of TB. Can you tell how unhygienic ways of living increase the risk of tuberculosis? TB is one of the deadliest infectious diseases in the world. Mostly, TB deaths occur in the developing countries like Pakistan, India and Afghanistan etc. However, TB is preventable and curable disease.

1.4.2 Pneumonia

Pneumonia is a lung infection caused by bacteria, fungi and viruses. A person suffering from cold or flu, may easily get pneumonia as it is harder for the lungs to fight against the agents of pneumonia. The general symptoms of pneumonia includes cough with mucus, high fever, severe chest pain, fast breathing etc. Pneumonia can be prevented by avoiding smoking, washing hands after use of toilet, keeping away from people who are suffering from pneumonia and through vaccination.

Key points

- The system which helps us to take food, digest and absorb it in the body to gain energy is called digestive system.
- Oral cavity, oesophagus, stomach, small intestine and large intestine are the organs of digestive system.
- Liver and pancreas are two glands associated with digestive system.
- The process in which large complex food is mechanically and chemically broken down into its simpler components is called digestion.
- Diarrhea and constipation are common disorders of digestive system.
- Breathing process can be divided into two sub processes inhalation and exhalation.
- Nose, larynx, trachea, bronchi, bronchioles, alveoli and lungs are the main organs of respiratory system.
- The chemical break down of food to release energy is called respiration.
- Respiratory disorders can be prevented by taking good care of presonal hygiene and cleanliness and by avoiding smoking and breathing in polluted air.

C. Write down detailed answers to the following questions.

i. How does the digestive system work? Describe the role of each organ.

ii. Explain the process of respiration, the main organs involved and their functions?

iii. Describe in detail any two diseases related to respiratory system.

Project

i. Place a piece of roti or bread slice on your tongue and close your mouth for one minute. Do not chew. What happened to the piece of bread? Did it change its form? Why?

ii. Now place a peanut on your tongue and close your mouth for two minutes. Do not chew the peanut. What happened to the peanut? Did it change its form? why?

iii. Compare the results of the two steps above and write your answer in note book.

Introduction

Living organisms always require certain materials for their life processes. These materials either move in or out of the body of an organism. Materials like water, salts, food etc. need to be transported into the body of an organism whereas waste products like urea, uric acid and CO_2 need to be moved out of the body. This movement of material into and out of the body or cells of an organisms is called transport.

Unicellular and less complex multicellular organisms do not have any specific organs for transport. They perform this process by simple diffusion. In higher animals and plants, for exchange of material with environment and for transport of materials within the body of organisms, special organs (heart, blood vessels etc. in human being, xylem and phloem vessels in plants as discussed earlier in grade VI) are present which collectively constitute the transport system. In this unit, we will discuss transport system in human beings and plants and their related organs in detail.

2.1 Human Transport System

Human beings have a transport system to carry useful materials to where they are needed and to remove waste materials from where they are produced. The transport system in human beings is also called the **blood circulatory system**. It consists of the heart, blood vessels and blood. The blood in the vessels transport useful substances to different parts of the body where they are required. This is achieved by the pumping action of the heart. Waste matter produced in the body is also transported by the circulatory system to excretory organs.

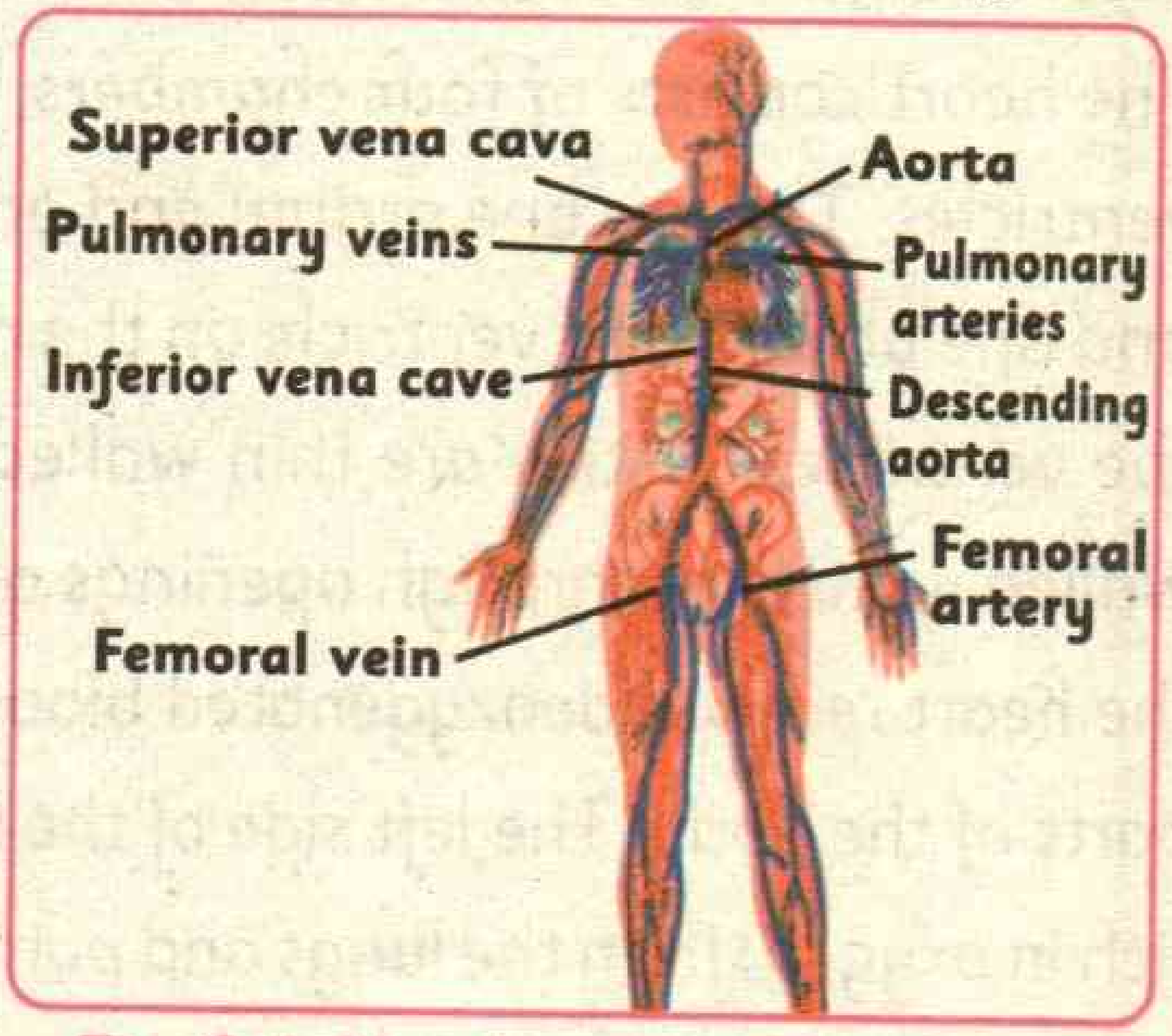


Fig.2.1 Blood circulatory system

carry blood away and back into the heart. There are three types of blood vessels: arteries, capillaries and veins.

i. Arteries

Arteries are blood vessels, which carry blood away from the heart to the other parts of the body. The arteries carry blood rich with nutrients, food and oxygen. Arteries have thick walls which support the pressure of blood. We can feel the pressure of blood in the artery through our pulse. The largest artery in the human body is called the Aorta. All arteries carry oxygenated blood to different parts of the body, except the pulmonary artery which carries deoxygenated blood from the heart to the lung.

ii. Capillaries

Arteries divide and re-divide to form narrow and thinner walled blood vessels called capillaries. The capillaries provide blood carrying nutrients and oxygen to the tissues and cells. These take waste materials and carbon dioxide from the cells and tissues to the veins. Exchange of materials between the blood and tissues occur through the walls of the capillaries. The capillaries in the tissues connect the arteries to the veins.

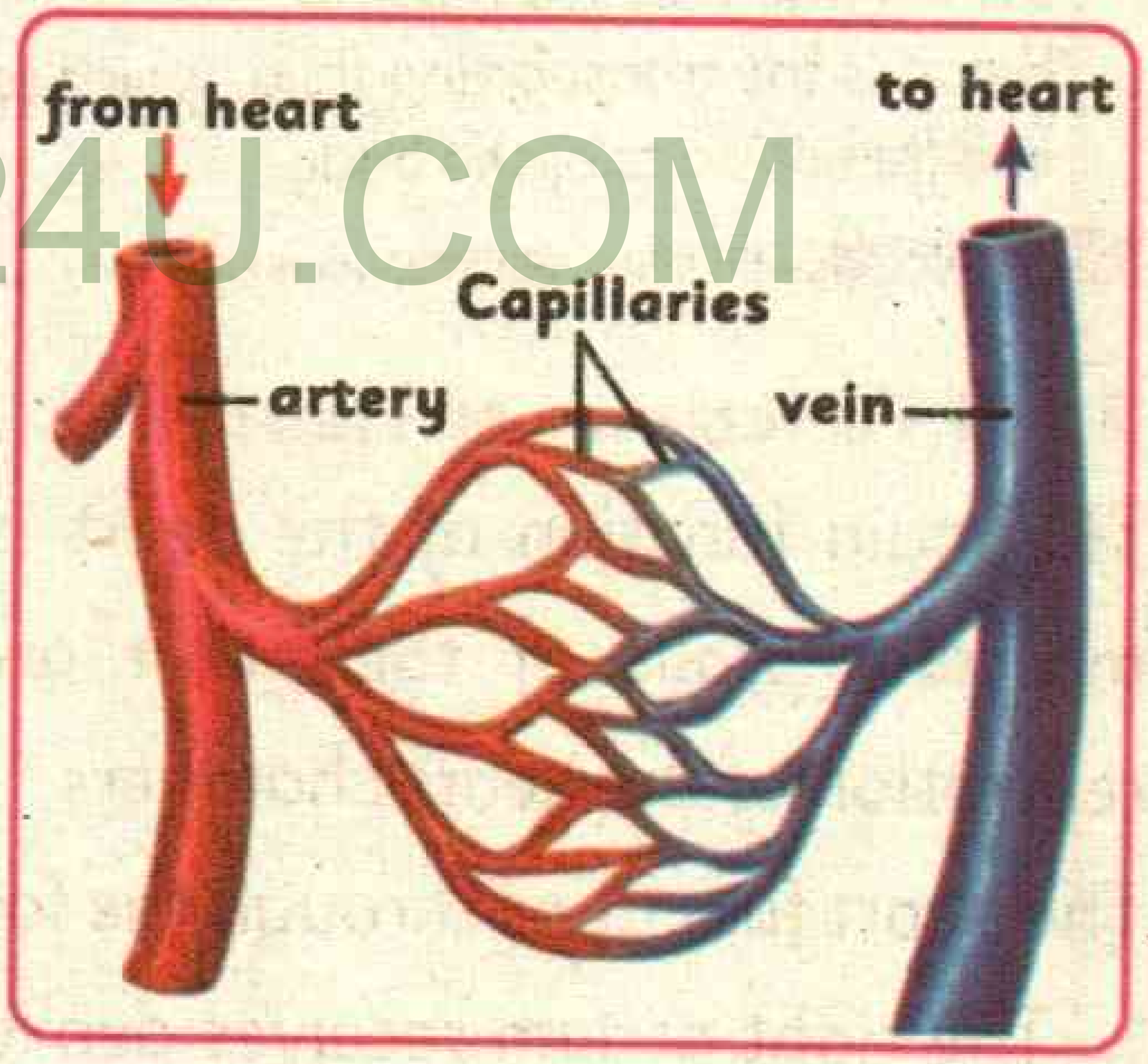


Fig. 2.3 Blood vessels

iii. Veins

The veins are vessels that take the blood carrying waste materials and carbon dioxide from the capillaries to the heart. The walls of veins are not as thick as those of the arteries. All veins carry deoxygenated blood to the heart except the pulmonary vein which carries oxygenated blood from the lung to the heart.

iv. After oxygenation, blood comes back from the lungs into the left atrium through the pulmonary veins.

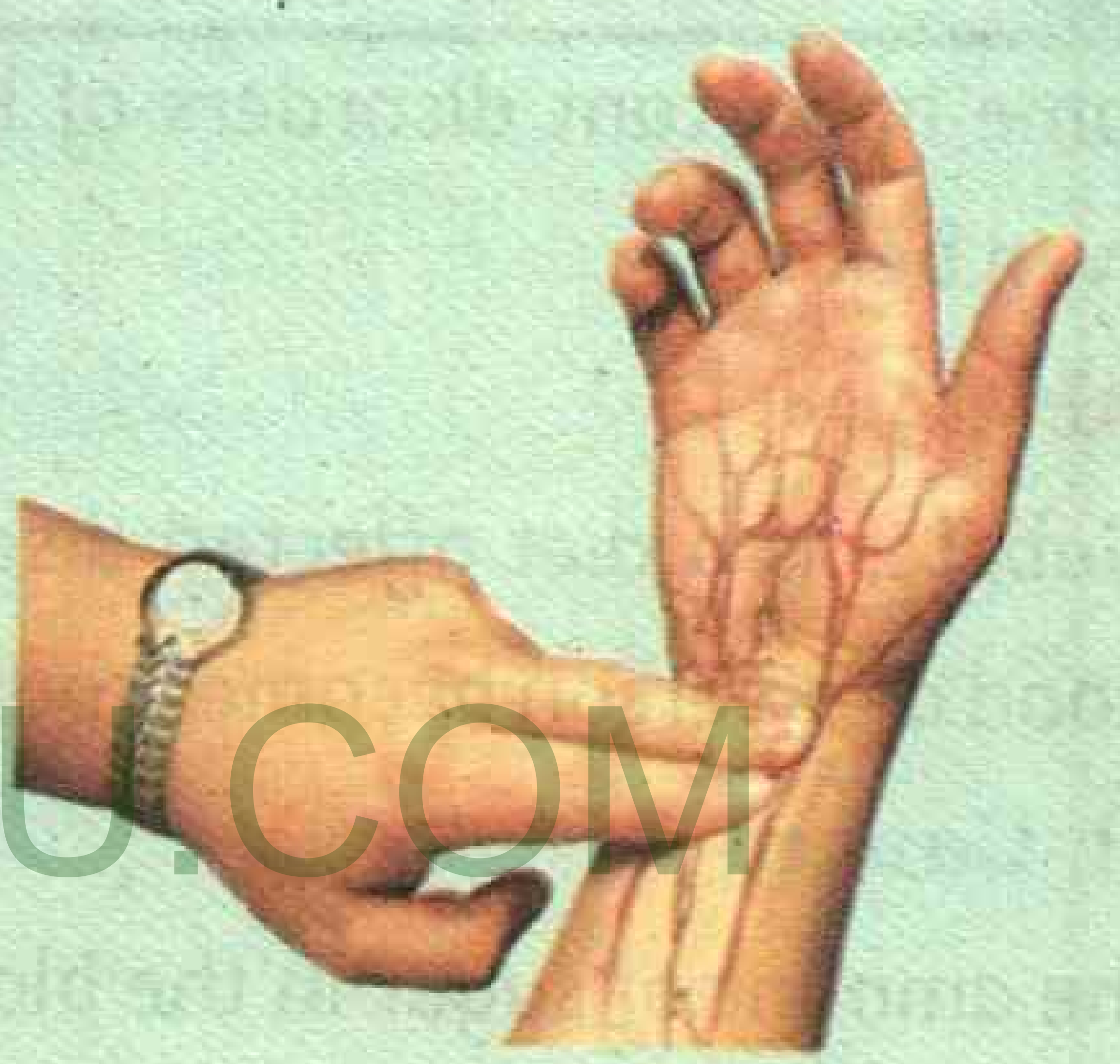
v. From the left atrium, the oxygenated blood goes into the left ventricle.

vi. The heart contracts and the oxygenated blood from the left ventricle is pushed with full force into the largest artery called aorta. The aorta then sends the oxygenated blood to the whole body.

Activity 2.1

Pulse rate: You can find out your pulse rate by slightly pressing on the inside of your wrist. Locate the pulse point on your wrist by feeling it with your index and middle fingers. With the help of a watch, count the number of beats in one minute.

Do some light exercise for 2-3 minutes like jumping up and down or push ups. Check your pulse again right after the exercise. Was there a change in your pulse rate? Can you tell why?



2.1.4 Working of Circulatory System

The circulatory system distributes and collects different substances in the body. The digested food is absorbed in the small intestine from where it is transported to other parts by means of blood. Oxygen is absorbed in the blood from lungs and transported to the different parts of the body where it reacts with food to release energy. In this process, some waste material and carbon dioxide are produced.

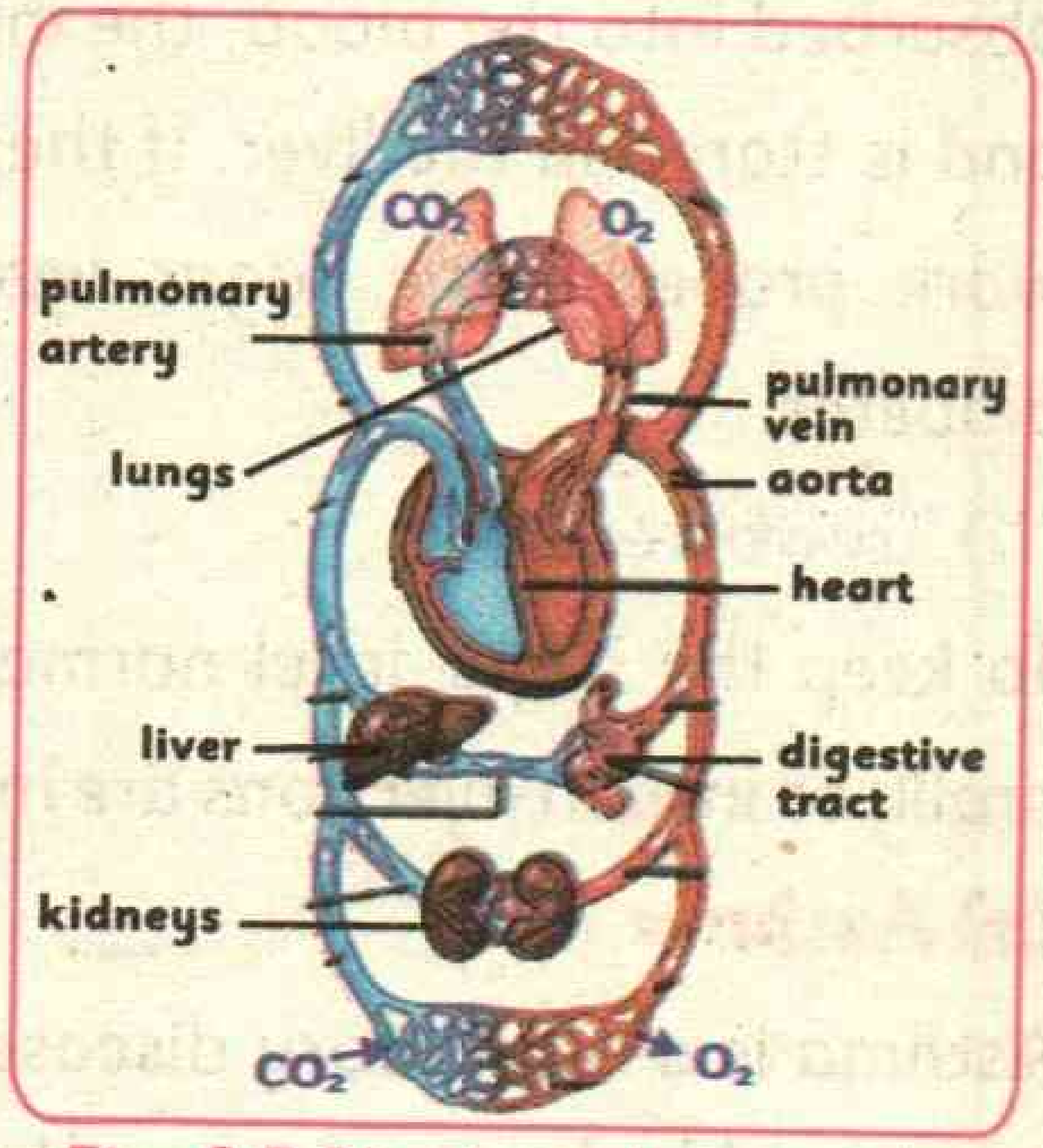


Fig. 2.5 Blood circulation in the human body

(i) Causes

This disease may be due to genetic or environmental factors such as pollens, spores, cold and pollution.

(ii) Treatment

There is no proper treatment for this disease. However, symptoms can be prevented by avoiding allergens or irritants or by using medicines through inhalers.

(c) Heart problems

Diet affected heart diseases include:

(i) Anaemia

Iron is necessary for the formation of red blood cells which carry oxygen to the tissues. Deficiency of iron in the body lowers the number of red blood cells (RBCs) in the blood and in turns supply of oxygen to the tissues is also lowered, this condition is known as anaemia.

Science tidbit

Angiography involves injecting a dye into an artery to allow study of the arterial tree. At the same time as the arteries are visualised, blockages or narrowings may be fixed through the insertion of stents. In addition, an MRI may be used to image arteries, called an MRI angiogram.

Deficiency of iron can be removed by eating iron-rich food such as dark-green leafy vegetables, pulses, nuts, beans, meat, fish and eggs.

(ii) Thrombosis

A fatty substance called cholesterol or a blood clot can block the narrow blood vessels, this blockage is called thrombosis. If the blockage is in the artery supplying blood to the heart, the heart stops beating which results in heart attack. This problems may be cured by avoiding the intake of fried food, which have high cholesterol content.

2.2.1 Scientific developments for treating problems with transport system

Although the diseases related to the circulatory system are increasing but

2.3 Transport in Plants

Water, mineral salts and other substances move from one part of the plant to another through a system of tissues, known as vascular tissues: These are of two types.

(i). Xylem tissues

These are the tissues made up of long tubes (xylem vessels) which transport the absorbed water and mineral salts from the roots through the stem to the leaves.

(ii). Phloem tissues

These are also made up of long cells (tubes) having pores, hence also known as seive tubes. Their function is to transport the food prepared in the leaves, to the storage areas like roots, fruits, seeds and to the growing points of a plant.

2.3.1 Absorption of water by the roots

Absorption of water from soil takes place by root hairs present on the roots behind the root tip. Water absorbed by the root hairs passes from cell to cell until it reaches the xylem vessels in the centre of the root from where it is transported to the upper parts through xylem in the form of a continuous column.

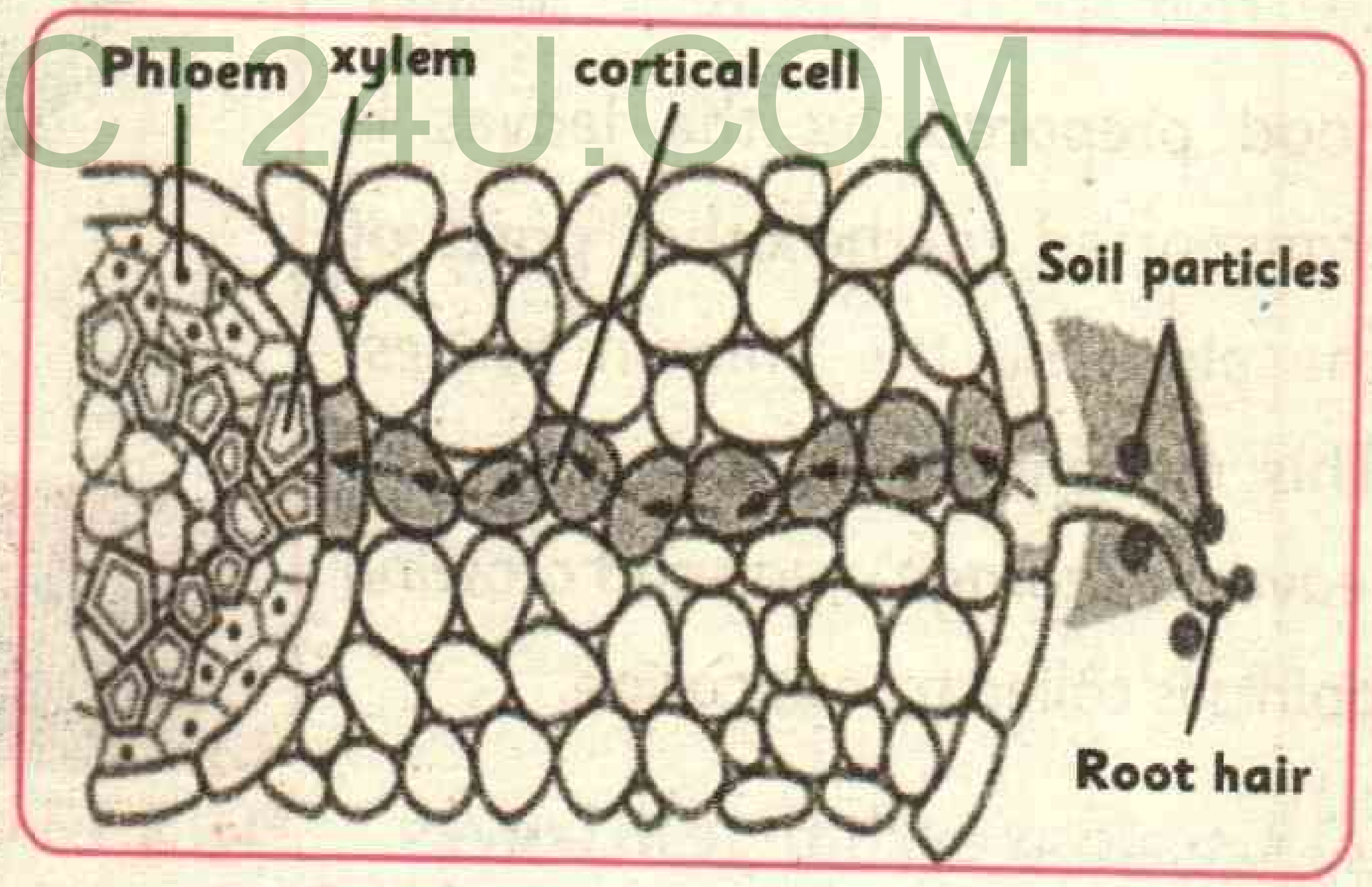


Fig. 2.7 Passage of absorbed water and salts by root

2.3.2 Movement of food, water and gases through the plants

(a) Flow of water

Water flows in a continuous stream through the plant. It enters through the

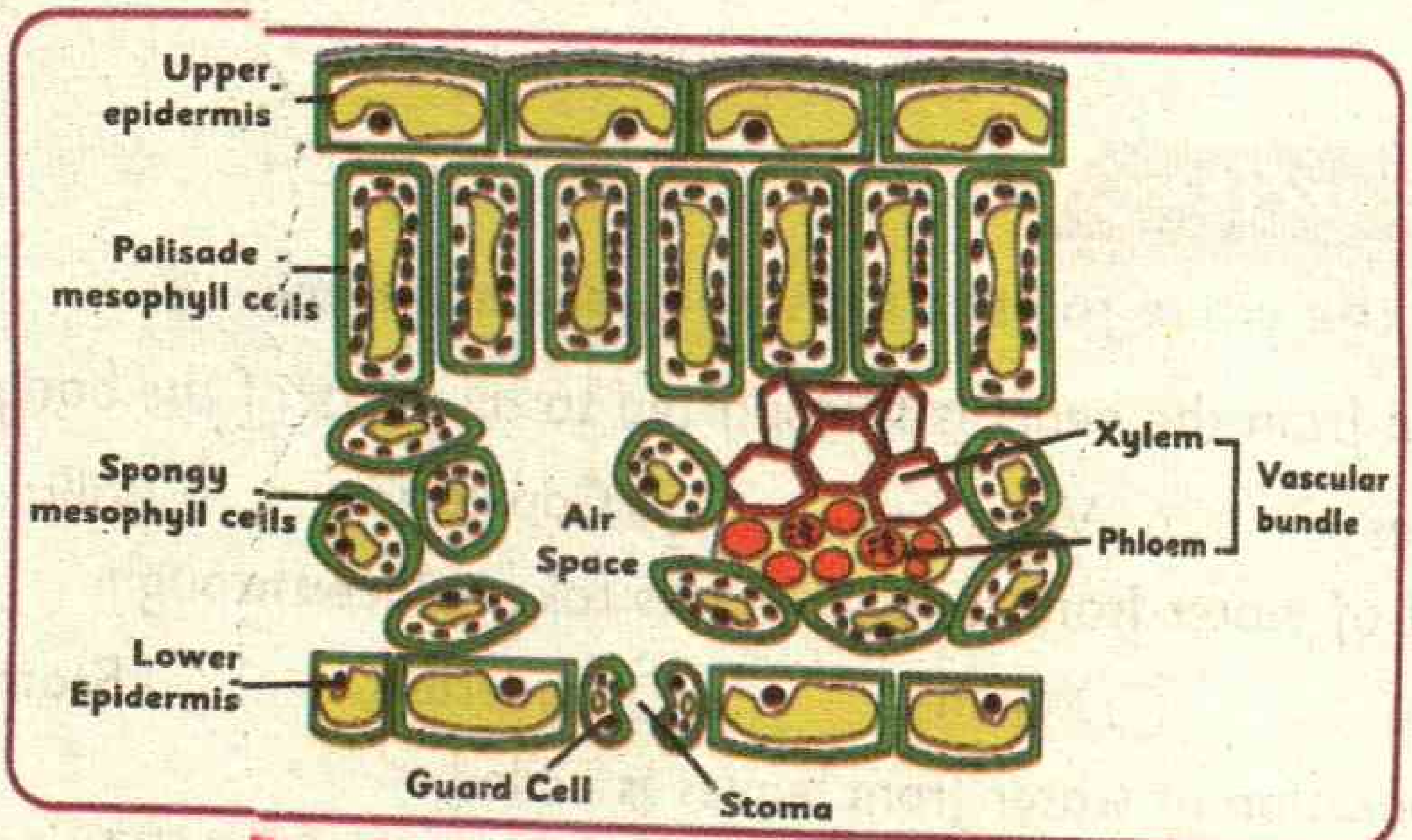


Fig. 2.10 Internal structure of leaf

Point to ponder?

Based on your understanding of photosynthesis, can you tell what would happen to our environment if all trees are cut down? Can you explain why trees and plants are important for life on our planet?

Key points

- Transport system in living organisms help in moving many materials into their bodies, within their bodies or out of their bodies.
- Heart is a pumping organ present in the chest cavity.
- The heart has four chambers; two atria and two ventricles.
- Right chamber of the heart contains deoxygenated blood whereas left chamber contains oxygenated blood.
- Atria and ventricles move in a rhythmic way to receive and distribute the blood.
- Arteries take the blood away from the heart and veins bring the blood back to the heart.
- Blood flows through arteries, capillaries and veins.
- Exchange of gases and nutrients take place between the tissue and blood in the capillaries.
- High blood pressure and high cholesterol cause heart attack or heart failure. Cause of many heart disorders is imbalanced diet.
- Tissue culture and stem cell technology can be used to form artificial organs which could be transplanted as the replacement of diseased organs.
- Plants transport system is composed of roots, stem and leaves.
- Xylem vessels transport water and phloem vessels transport food throughout the body of a plant.
- Stomata are the opening used to absorb gases which are transported by diffusion to all the cells of the plant body. Oxygen and water ***vapours*** are also diffuse out of the leaf through the stomata.

Unit 3

Reproduction in Plants

At the end of this unit, the students will be able to:

- Define pollination.
- Compare self and cross pollinations in plants.
- List various factors involved in cross pollination.
- Investigate plants which are cross pollinated.
- Differentiate between Sexual and Asexual reproduction.
- Describe fertilization.
- Describe seed and fruit formation.

Introduction

All living things have a life duration. Some organisms live for weeks, others for months and yet others for years before they die. One of the main characteristics of all living things is their ability to produce more organisms of their own kind before they die. This process is called

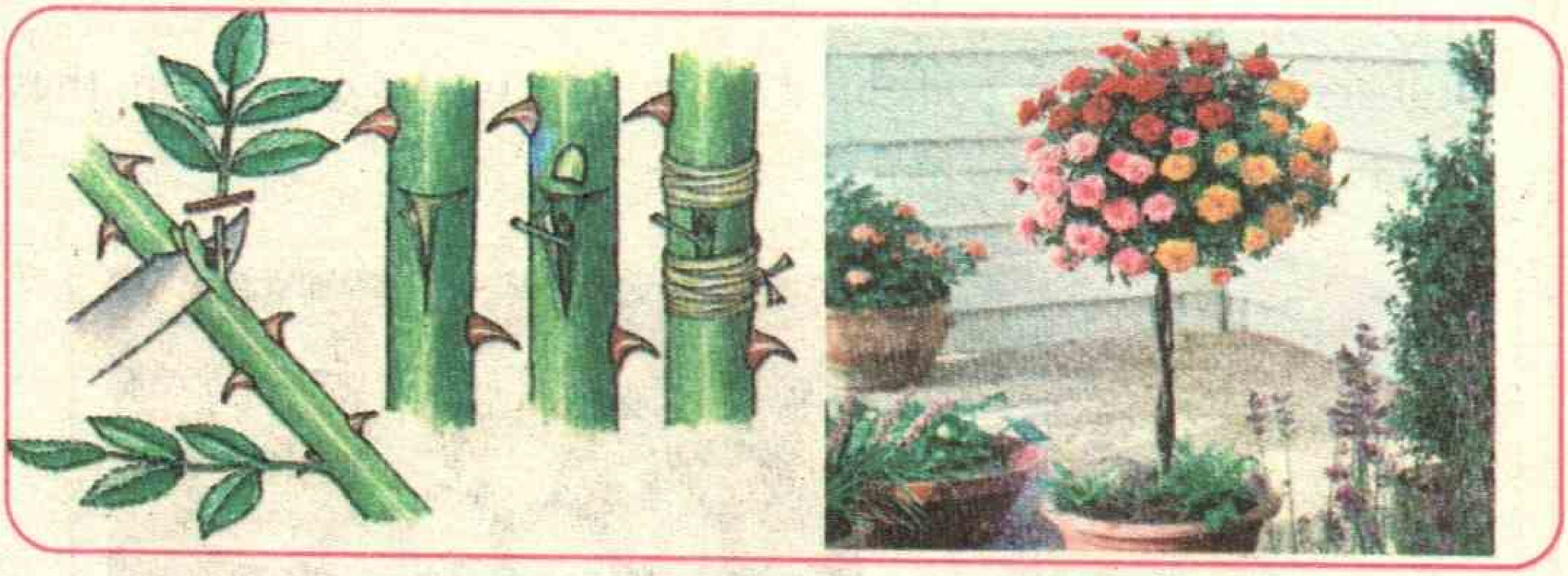


Fig. 3.2 Grafted plants

iii. Layering

When the branches of some plants (for example jasmine, lachi etc) are buried in the soil they develop roots and finally a new plant is formed. The branch which goes under the soil is cut off from the main plant which grows independently.

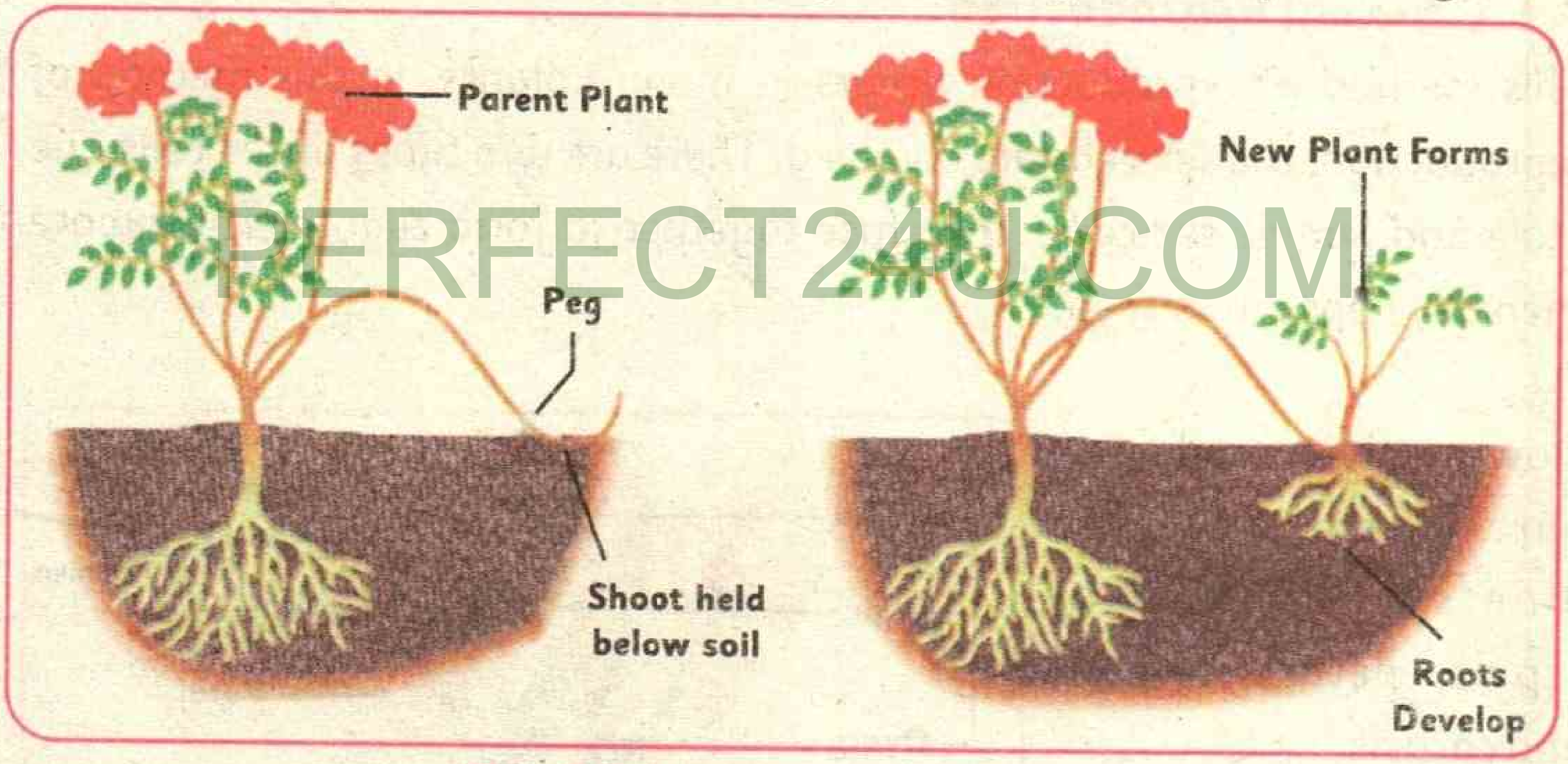


Fig. 3.3 Layering in plants

iv. Runners

In some plants like strawberries and cactus, stem grows just above the surface of the soil and produces buds. These buds detach from the parent plant and grow into new plants.

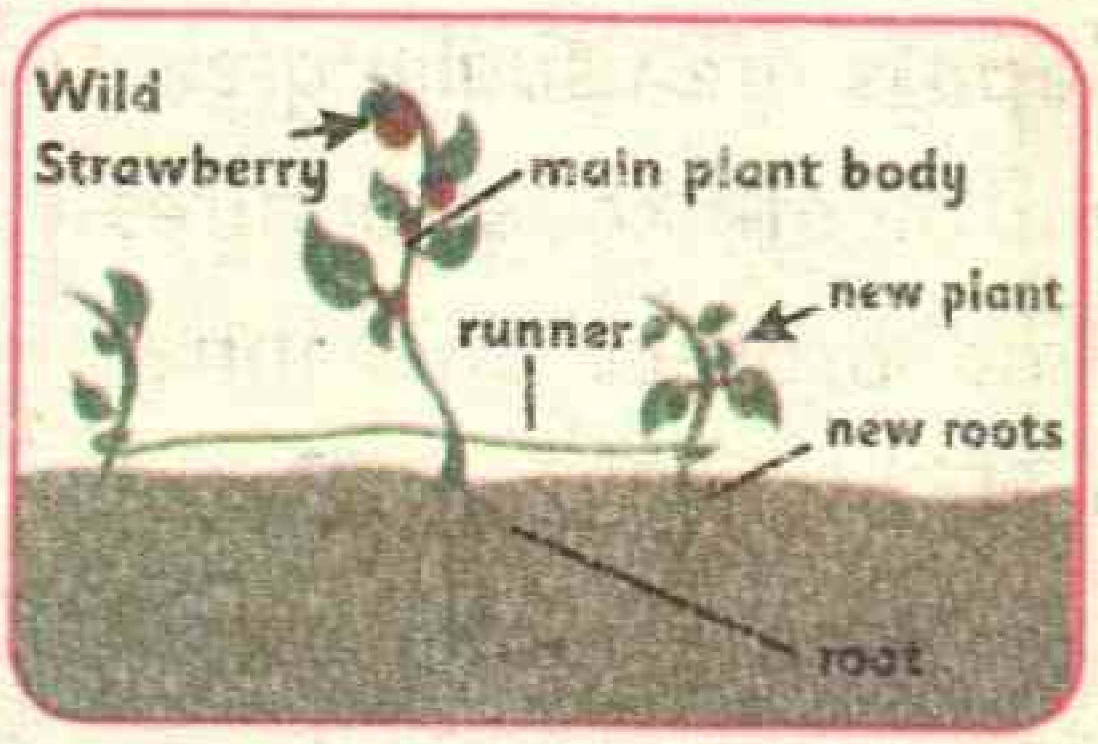


Fig. 3.4 Runners in plants

Each consists of long filament and anther. Pollen grains are produced in the anther. The filament holds the anther up. **Carpel** is the female reproductive organ. Each carpel has three parts, the ovary, style and stigma.

Activity 3.1

Take few flowers and observe them with a magnifying glass. Can you see different parts of flower and are these parts the same in number in all flowers?

Table 3.1 Comparison of Asexual and Sexual reproduction

No	Asexual reproduction	Sexual reproduction
1	One parent is involved to produce offsprings.	Two parents, one male and one female, are involved. The male and female parents produce sex cells or gametes.
2	The offspring arises from the body of the parent.	The gametes of the male and female parents fuse together to form a zygote.
3	Rapid increase in number through the reproductive process.	Slower increase in number through the reproductive process.
4	All offsprings are identical.	Offsprings may have variations from the parent's physical features.

3.2 Pollination

The transfer of pollen grains from the anther to the stigma of the carpel is called pollination. Pollination is necessary for successful sexual reproduction.

of nectar and are tube-shaped. The pollen grains are large and they stick to the feathers of birds. Example are Butea, Monarda etc.

Fig. 3.10 Pollination by bird

iii. Pollination by wind

Wind pollinated flowers are not brightly coloured and may have no nectar. The pollen grains are very light and are easily blown by wind. The examples of wind-pollinated flowers are grasses, grains and many large trees.

Fig. 3.11 Pollination by wind

iv. Pollination by water

Water-pollinated flowers are produced by the plants living in water. Pollen grains float in the water and are carried by the water to another flower. For example, water weed and hydrilla.

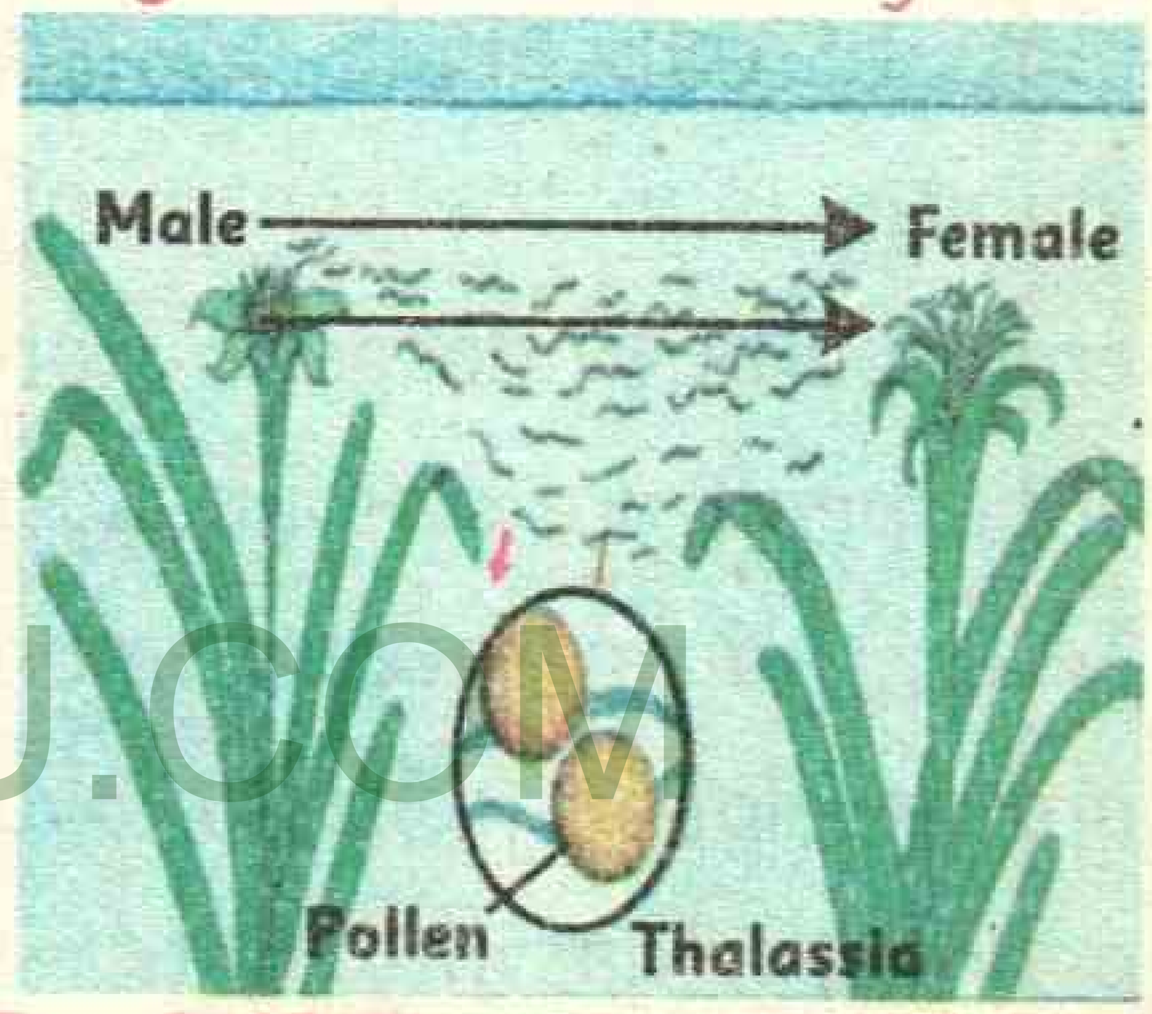


Fig. 3.12 The submerged flowers are pollinated by water

Activity 3.2

Make a list of five cross pollinated plants.

3.3 Fertilization

Fertilization is the fusion of male and female sex cells, to form zygote. The pollen grain produces a pollen tube after falling on the stigma. The pollen tube grows into the style of the carpel and reaches the ovule containing an

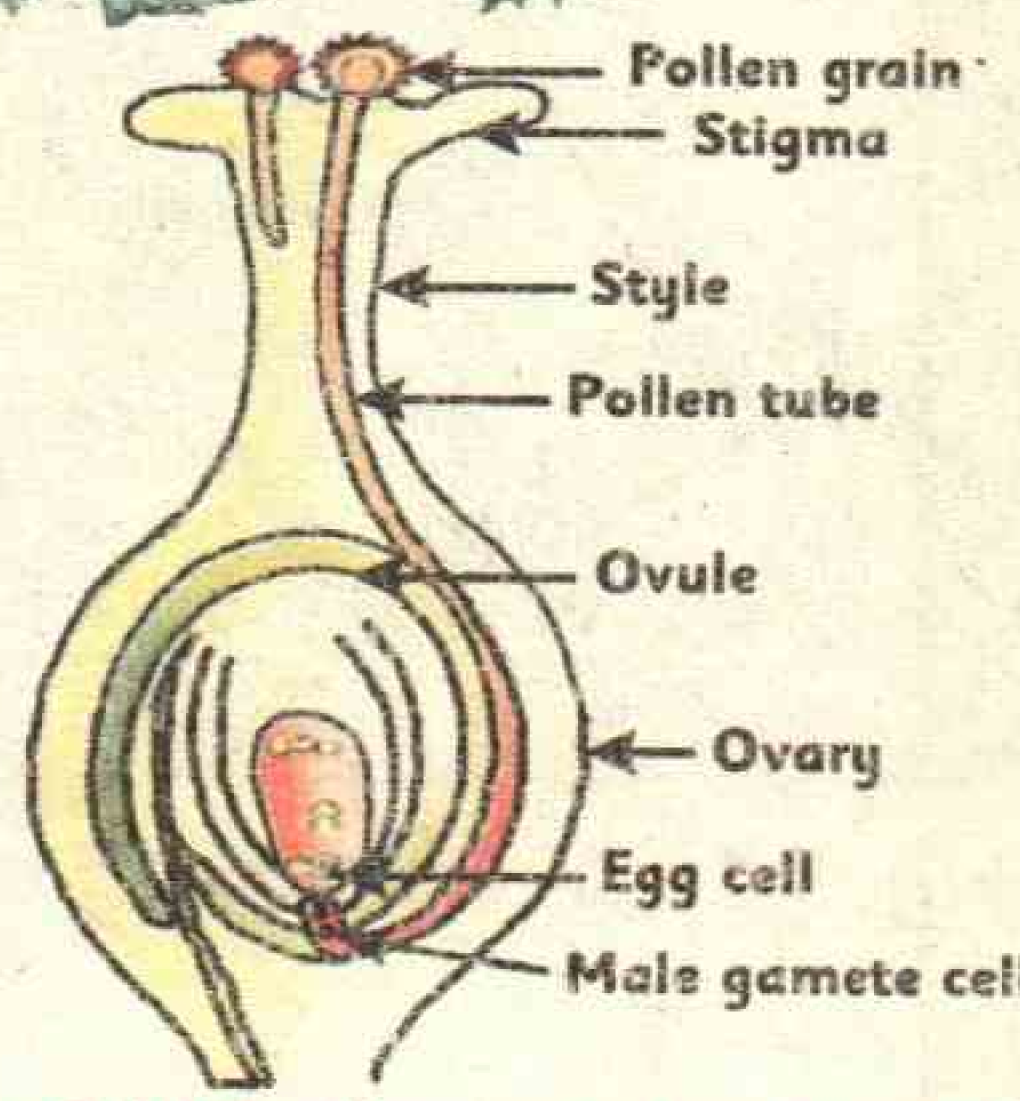


Fig. 3.13 Fertilization process in ovule

Key points

- Plants perform both asexual and sexual reproduction.
- Cutting, grafting, layering etc. are different methods of asexual reproduction in plants.
- A typical flower consists of sepals, petals, stamens and carpels.
- Sexual reproduction of plants take: place through pollination.
- Pollination is of two types; self and cross pollination.
- When pollen from the stamen of a plant is transferred to the stigma of the same flower, the process is called self-pollination.
- When pollen from a plant's stamen is transferred to another plant's stigma of the same species, is called cross-pollination .
- Those plants which are insect pollinated bear brightly coloured flowers which attract insects.
- The process of fusing male and female sex cells is called fertilization. A zygote is formed as a result of fertilization which becomes the plant embryo inside the seed.
- Walls of the ovary store food and make a fruit.

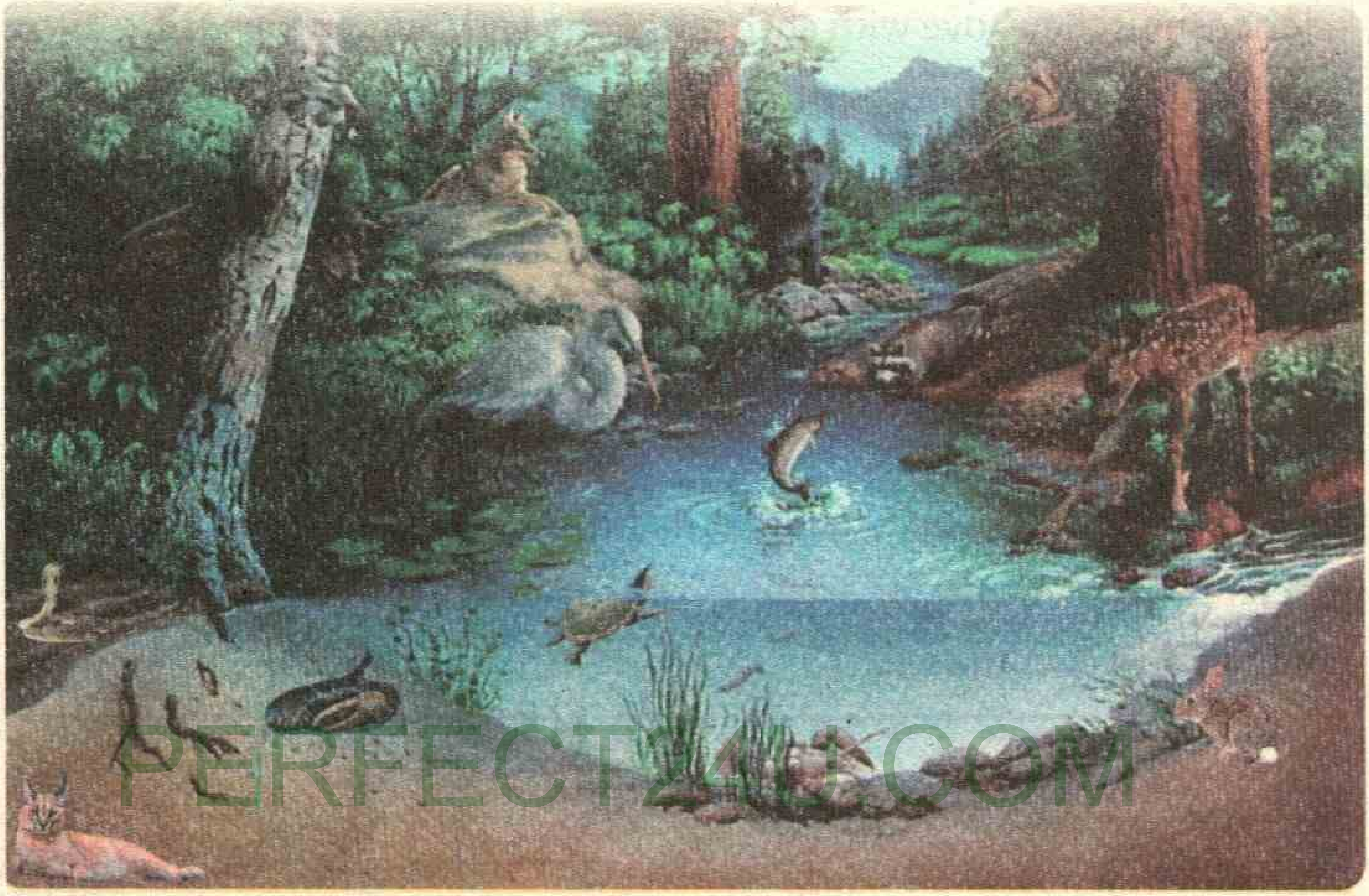
Project

Propagation of Roses

Steps

1. Towards a side at your home or at school, which gets some shade during the day, dig a trench that should be around 6 inches deep.
2. Choose a stem about the thickness of a pencil from the rose, you wish to propagate. It should be a young branch at least 9 inches (23cm) long.
3. Then remove the leaves and thorns from the bottom half.
4. Insert the cutting in the soil so that it is two-thirds buried (6 inches buried), making sure that its base is well into the soil. Firm the soil around the base.
5. Keep the cuttings watered regularly. After few days, you will observed the new buds arising on the cutting.

Unit 4
Environment and Feeding Relationship



At the end of this unit, the students will be able to:

- Explain the ecosystem.
- Define the term habitat.
- Compare the different kinds of habitats.
- Investigate the various features that allow animals and plants to live in a particular habitat.
- Identify the factors that cause daily and yearly changes in a habitat.
- Explain how living things adapt to daily and yearly changes in their habitat.
- Explain the ways in which living things respond to changes in daily environmental conditions, such as light intensity, temperature and rainfall.
- Explain why food chains always begin with a producer.
- Illustrate the relationship between a producers and consumers.
- Describe two food chains in the environment around them.
- Explain a food web.

An ecosystem can be defined as the basic functional unit of an environment. Within an ecosystem, a chain of interactions takes place between organisms and their environment. **Ecology** is the study of relationship of living organisms with their environment. It is also called as environmental biology. Each ecosystem has two components **biotic** (living things like animals, plants and micro organisms) and **abiotic** (light, water, air etc) components. For example, sunlight is the source of energy for plants to carry out photosynthesis. Plants obtain nutrients from the soil and Carbon dioxide from the air. The Carbon dioxide and nutrients are returned to the environment when living things excrete, respire or when they die. There is a constant exchange of materials between the living and non living things in an environment. The biotic components can be further categorized as producers, consumers and decomposers.

Producers include all the green plants. Plants produce their own food through the process of photosynthesis by using water and carbon dioxide in the presence of sunlight. During this process, energy and oxygen is released. **Consumers** are animals feeding on producers (plants) and other animals for their food. Consumers include herbivores, carnivores and omnivores.

Herbivores are primary consumers and depend directly on plants for their survival. For example cows, goats, sheep and buffaloes etc.

Carnivores (the meat eater) are secondary consumers feeding on primary consumers. They get food from other animals. For example cats, dogs, lions etc.

Omnivores depend on both plants and animals for their food. For example human beings, crows and sparrows. Omnivores are tertiary consumers.

i. Water/Wet Land

There are places where water is present for some time in a year. These are found near the bank of rivers, lakes and flat areas with enough rainfall. Cows, buffaloes, goat, frogs, ducks, turtles, fish, starfish, shark are animals of water land. Cotton, wheat and rice are abundantly found in such habitat.

Fig. 4.3 Water land

ii. Forest

A forest is a place which gets enough rainfall and have warm temperature for lots of trees to grow. Forests grow where there is plenty of water. When the autumn season arrives, the leaves will turn red, orange and yellow.

Once winter comes, the trees lose their leaves. Forest acts as a natural absorber of water. It allows rain water to seep through. The animals of forests are of many types e.g. Spider, squirrels, monkey, chimpanzees, tiger etc. Fungi and mosses are mostly found in forest habitat.

Fig. 4.4 Forest Ecosystem

animals. Lions, zebras, giraffes, rabbits and elephants are common animals of grass land. The species of grasses that are found in this habitat include purple needle grass, wild oats, foxtail and buffalo grass etc.

Fig. 4.6 Grass land

v. Tundra

Tundra is an environment that is very cold and windy. It is a treeless area. The land is covered with ice and snow almost throughout the year. Much of the land is permanently frozen. It is also called the polar lands which are the north and south poles and covered with ice. Seals, polar bear, snow fox and dogs with long fur are common animals. The tundra is characterized by **permafrost,** a layer of soil and partially decomposed organic matter that is frozen year-round. Plants found in the tundra habitat include: Moss, Willow, Bearberry etc.

Fig. 4.7 Tundra Ecosystem

Relationship

4.2.2 Adaptations of living things to changing environment

Living things have to face adverse changing conditions in their environment. All animals and plants, including human beings respond to changes in their surroundings. They have to adapt themselves to interact with the changes in the environment, otherwise, they will die and become extinct.

An adaptation is a way through which an animal's body helps it to survive or live in its environment.

Types of adaptations are daily, behavioral and physical.

a. Daily Adaptations

There are some changes to the habitat which occur daily therefore many species have adapted the ways that allow them to survive there. Most plants have flowers that open during the day to allow them to be pollinated by insects. They close at night or when it rains, for protection. Many small mammals, such as mice, voles and rabbits come out only at night to avoid predators. However, some predators such as owls also come out at night. Many desert animals hide during the day to avoid the heat of sun but come out at night to feed when it is cooler and when less water evaporates from their bodies.

Fig. 4.8 Daily Adaptations

b. Behavioral Adaptations

Some behavioral responses are discussed below:

i. Migration

Migration is the movement of animals to far-away places. Animals move from one habitat to another to survive. They are looking for warmer weather or searching for food. Many birds migrate in the autumn season.

Birds can fly very long distances. Many fish migrate to deeper and warmer water. Many insects also migrate. Whales, butterflies, bats, hummingbirds, robins, geese, ducks, salmons are some animals that migrate.

Point to ponder

Have you noticed huge flocks of birds flying high in the sky in one direction? Ask your teacher which species of birds are these and why do they fly in such huge formations?

Fig. 4.9 Animal Migration

ii. Hibernation

Hibernation is a state of inactivity in animals during winter season. These animals go into a deep sleep and use very little energy. The animal's body temperature drops and its heartbeat and breathing slows down. In the fall, these animals get ready for winter by eating extra food and store it as body fat. They use this fat for energy while hibernating.

Bears, skunks, frogs, chipmunks and some bats hibernate. During winter, insects look for shelter in holes in the ground, under the bark of trees, deep inside rotting logs or in any small crack they can find.

Fig. 4.10 Hibernating animals

iii. Aestivation

Aestivation is similar to hibernation but occurs in some animals during summer or dry period. Ground squirrels in the desert will aestivate in their burrows to avoid exposure to the heat. Some toads aestivate to escape the hot and dry summer. Many amphibians and reptiles also aestivate, as do some insects, snails and fish.

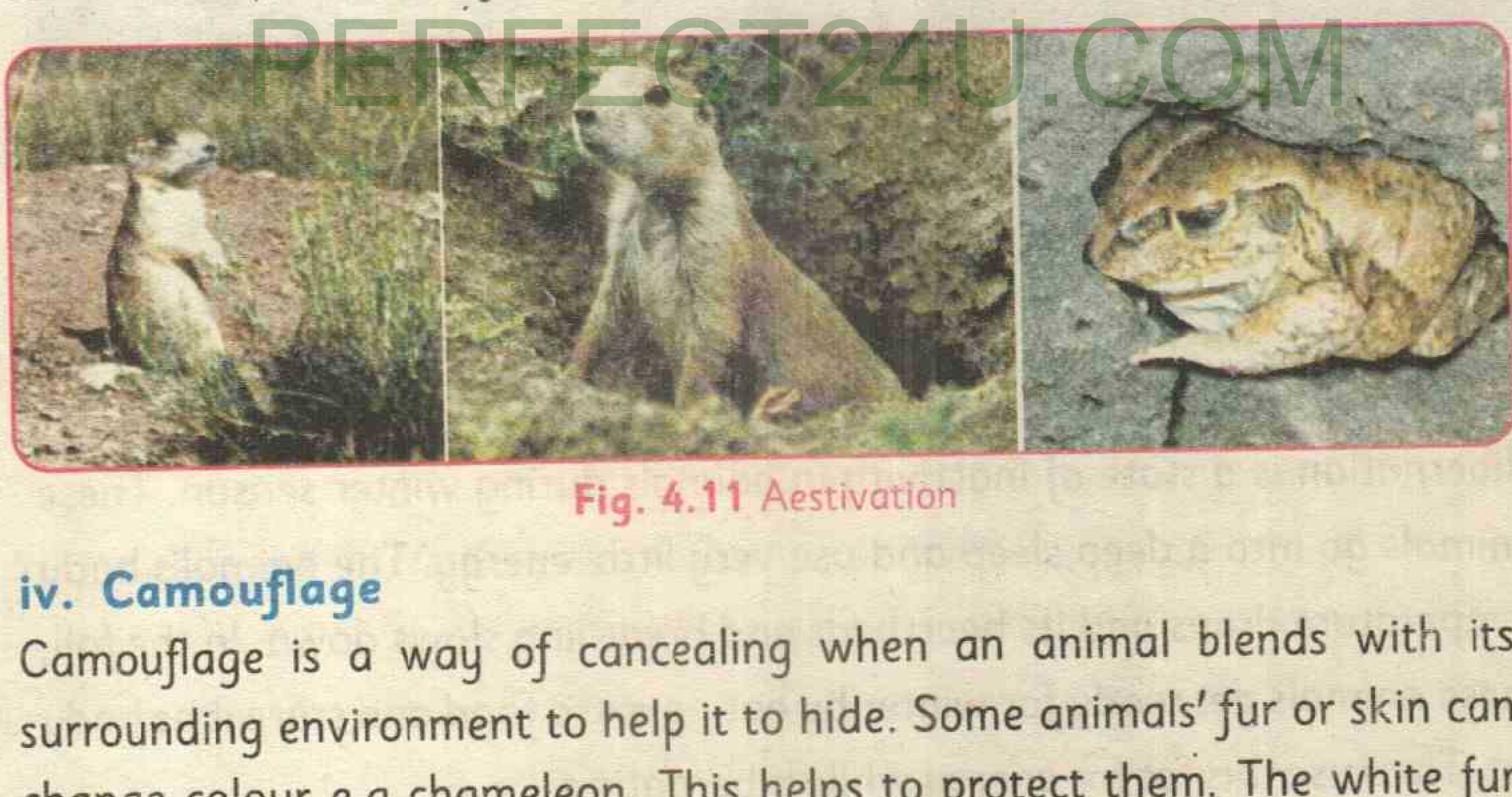


Fig. 4.11 Aestivation

iv. Camouflage

Camouflage is a way of cancealing when an animal blends with its surrounding environment to help it to hide. Some animals' fur or skin can change colour e.g chameleon. This helps to protect them. The white fur coat of a polar bear enables it to blend into its snow habitat. Likewise, snake skin colour is the color of sand and soil and helps it to hide from enemies and attacks its prey unnoticed.

Fig. 4.12 Camouflage

v. Dormancy

Dormancy is a period of inactivity in plants. Adverse conditions of weather may slow the growth and development of plants, whereas favorable weather conditions may again accelerate the growth and development. Many familiar trees produce new leaves in the spring and lose them in the autumn due to seasonal changes in temperature and light. Trees that lose their leaves are dormant in winter. e.g Miltonia, Japanese Maple etc.

Fig. 4.13 Dormancy

c. Physical Adaptations

Some animals grow new and thick fur in the fall to keep them warm in the winter. An armadillo has a covering of hard plates to protect its body. The porcupine uses its quills for defense. A turtle can pull its head, feet and tail inside its shell for protection. The hair of hairy animal becomes dense in winter. Some animals have sharp and pointed teeth for hunting. A giraffe has a very long neck to find its food. In some insects a weapon is present in the shape of sting. Wasps, snakes, scorpions etc are some examples of animals with chemical defense.

Fig. 4.14 Animals of physical adaptations

4.2.3 Interdependence of living things

i. Food

Every organism is a source of food for the other organisms in a habitat. God has made plants (producers) for animals (consumers) and finally bacteria and fungi (decomposers) feed on dead plants and animals to release nutrients for plants.

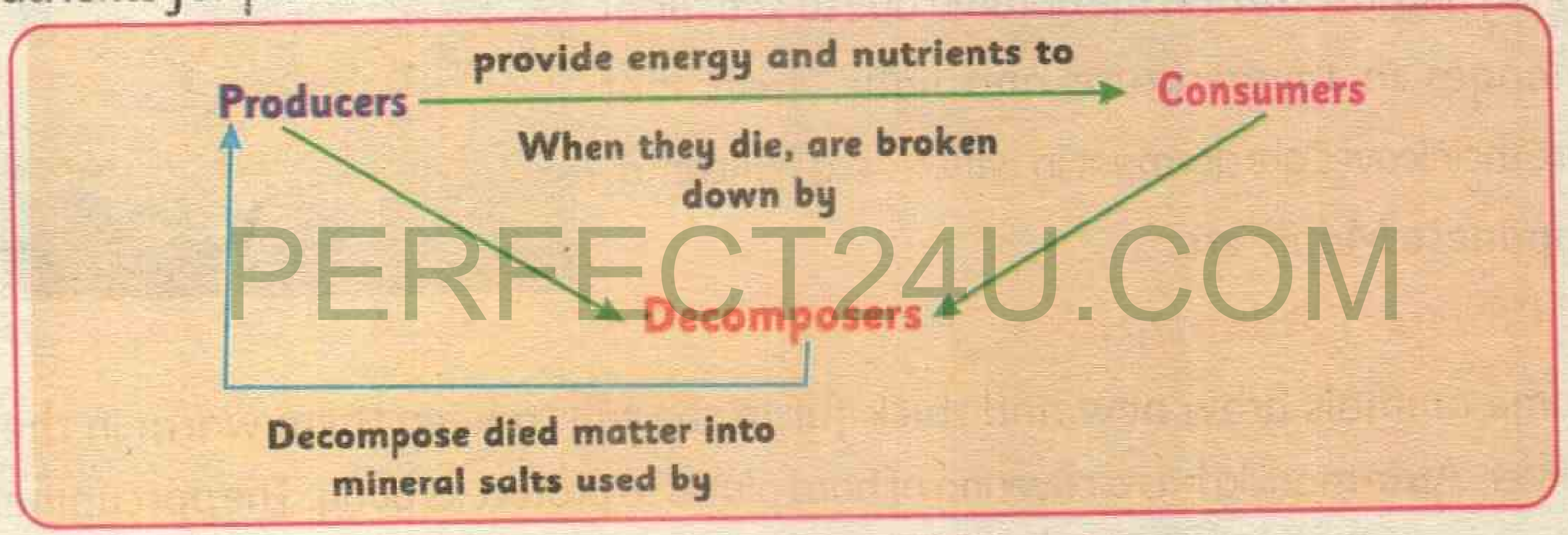


Fig. 4.15 Interdependence of living things

ii. Shelter

Organisms depend on one another for shelter, for example birds live in trees.

iii. Water

Water is the necessity of all organisms. Water is the basis of relationship between plants and animals. This is the reason the most habitats are generally found near the water.

4.3 Food chains always begin with a producer

All living things need food to grow and live. Green plants make their own food by photosynthesis using sunlight, carbon dioxide and water.

Plants are the only living things that can make their own food. They are called producers. Animals that feed on plants are called primary consumers. Primary consumers such as sheep, deer and giraffe are also called as herbivores. Animals that feed on primary consumers are called secondary consumers. Examples of secondary consumers include lions, tigers, dogs etc. Tertiary consumers feed on secondary consumers.

Primary consumer **Fig. 4.16** Secondary consumer

i. Food chains

A food chain shows the way how energy flows in the form of food through organisms in an ecosystem. A food chain is the order in which animals eat plants and other animals. The sun is the primary source of energy in a food chain. Plants get their energy from the sun. Without the sun, we would not have any plants. A food chain always starts with a plant, which is an organism which can make its own food.

Science tidbit
Each organism in the food chain is called a link.

Examples of Food Chains

Fig. 4.17 Food chain

ii. Food web:

In the natural ecosystem, feeding relationships are not as simple as in a food chain. There may be several food chains in every habitat which are connected with each other. There may be many types of animals feed on same plant and there are many predators that feed on same kind of prey. A food web is a network of more than two food chains.

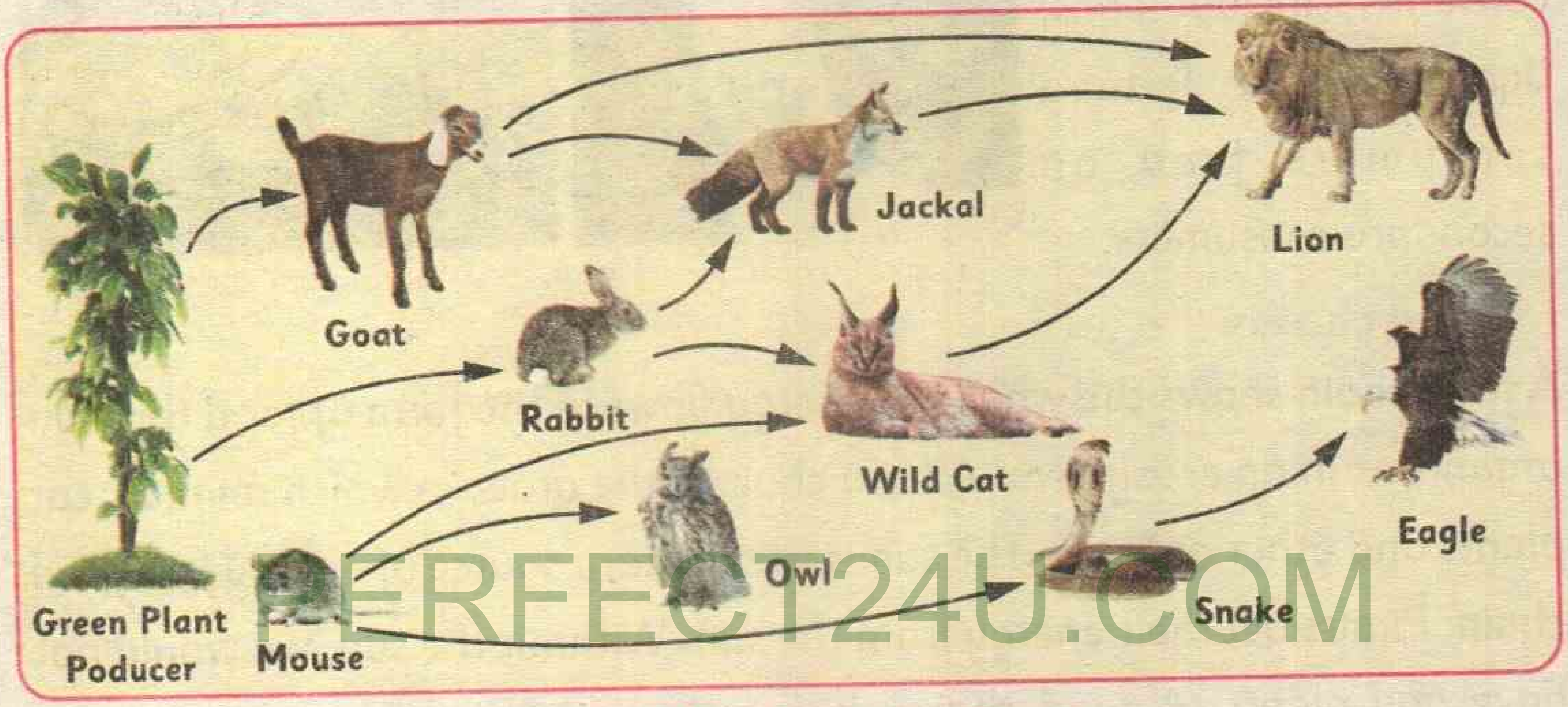


Fig. 4.18 Food web in a Forest

Try it out

a. Name the
i. producer, ii. primary consumer,
iii. secondary consumer and
iv. tertiary consumer in the food chains given above.

b. State whether each consumer is a/an herbivore, carnivore or omnivore.

Point to ponder

Will the changes to the populations of producers or consumers, have any effect on a food web? Explain your answer.

Exercise

A. Colour the circle for the best suitable answer.

i. Living place of an organism is called:
- ○ Habitat ○ Environment ○ Ecosystem ○ Species

ii Many food chains unite to make a:
- ○ Food cycle ○ Food web ○ Food pyramid ○ Mega food chain

iii. An animal that feed on plants is called:
- ○ Producer ○ Primary consumer
- ○ Secondary consumer ○ Decomposer

iv In winter most cold blooded animals disappear because they:
- ○ Die ○ Hibernate ○ Migrate ○ Eaten away

v. The meat eaters are also known as:
- ○ Herbivores ○ Carnivores ○ Omnivores ○ Producers

B. Write down the short answers of the following questions.

i. How desert habitat is different from forest habitat?

ii. A scientist during an experiment, eliminated all the producers from an ecosystem. What will happen to that ecosystem?

iii. Name the basic components of an ecosystem.

iv. There is no rainfall for two years in an ecosystem. What will happen to consumers?

v. What is the ultimate source of energy in an ecosystem?

C. Write down detailed answers of the following questions.

i. Define habitat? Give only three types of habitat with their producers and consumers.

ii. Explain the food chain and food web with examples.

iii. How do living things interact with changes in their environment. Explain with examples.

Key points

- Every thing which is present in the surrounding of a living organism is called its environment.
- Ecology is the study of relationship of living organisms with their environment. It is also called as environmental biology.
- An area where living organisms interact with each other and with their physical (non living) environment is called an ecosystem.
- An ecosystem is always composed of two components; biotic component which includes all living organisms and abiotic component which includes all non living materials.
- In an ecosystem the natural place where the animals or plants live is called their habitat.
- Changes in an ecosystem have great impact on the life and survival of organisms living in it. These changes may be daily, seasonal, yearly or behavioral and physical.
- The organisms do some adaptations to survive in their changing environment.
- Feeding relationship among organisms could be described by a food chain.
- Many food chains combines to form food web.

Project

Collect as many pictures as you can from magazines and divide them into producers, consumers and decomposers. Make food chains (at least two) from the pictures you have collected.

Food chain 1

Food chain 2

Unit 5

Water

At the end of this unit, the students will be able to:

- Describe the ways in which clean water is vital for meeting the needs of humans and other living things.
- Identify the sources of water.
- Recognize the substances present in water that make the water impure.
- Suggest different ways to clean the impure water.
- Decribe the various uses of water in our country.
- Investigate the consumption of water in our daily life and suggest the ways to reduce wastage of water.

Introduction

Water is one of the most vital natural resource. About 71% of the Earth's surface is covered by water. It is the second most essential requirement for the survival of life, after air. Without water, human beings cannot survive for more than a week. In fact, if water do not exist, no organic matter would exist. Water comprises approximately 66 percent of the weight of an adult human body. Thus all life processes depends upon water. Water is also important in factories and industries. It is also used in many manufacturing processes and in construction work.

5.1 Clean Water and life

Water is an essential element for life. Inadequate access to safe drinking water affects the well being of people . A large number of people have inadequate sanitation facilities. This is too often the cause of diseases, unnecessary suffering and even death. The human being, however, can survive only a few days without clean and safe drinking water.

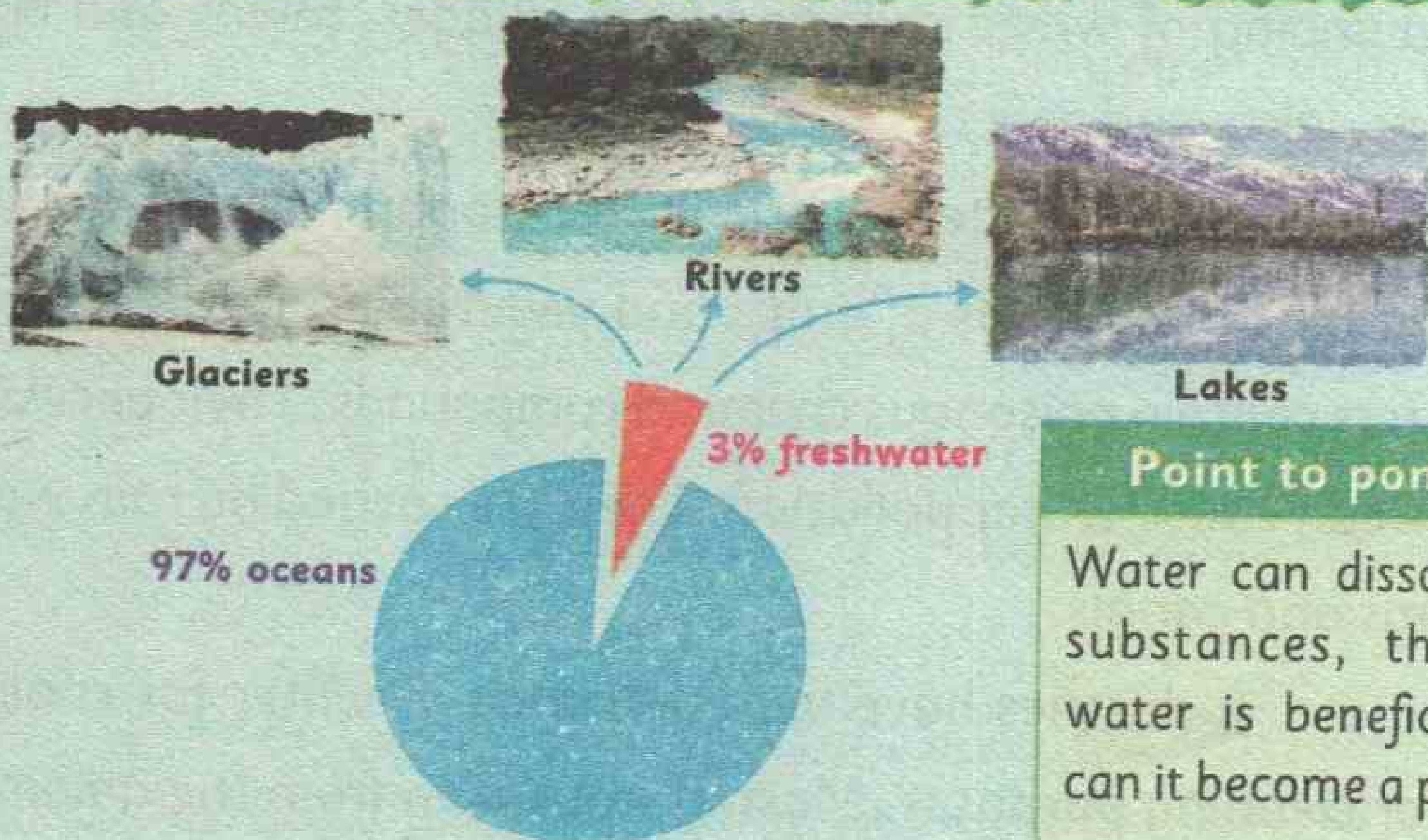
The effects of water pollutants are not only harmful to human beings but also to animals, fish and birds. Polluted water is not suitable for drinking, recreation, agriculture and industry. It reduces the beauty of lakes and rivers. Contaminated water destroys aquatic life and reduces its reproductive ability. It is a hazard to human health.

Fig.5.1 Water and life

5.2 Sources of water

The major sources of water on earth surface are oceans, ice caps, glaciers, underground water, inland water and atmospheric water (water vapours). Oceans contain more than 97 percent of the total water. The inland water includes rivers, lakes, canals, streams and soil moisture. Beside this, atmosphere also contains a considerable quantity of water as water vapours.

Although an enormous amount of water is present on the earth's surface, yet the fresh water needed for human requirements is nearly 1% of the total. This is because most of the water present in the oceans is unfit for human consumption due to high concentration of salts. The remaining water is locked in ice sheets and glaciers. On land most of the fresh water lies underground.



Point to ponder

Water can dissolve a variety of substances, this property of water is beneficial for us. How can it become a problem for us?

Fig.5.2 Natural sources of water

5.3 Impurities in water

Water is an excellent solvent and can dissolve a vast variety of substances. Therefore natural water, when it flows or seeps through the surface of the earth, dissolves minerals salts and other substances. Despite these mineral impurities, water of most lakes, rivers, springs and wells is considered fit for drinking and other domestic uses. Water pollution occurs when undesirable foreign substances are introduced into natural water. Substances that cause water pollution are called **pollutants**. Pollutants in water are dangerous for human or animal consumption and also harm the crops. The major sources of water pollutants are as follows.

Science tidbit

Fresh water is defined as water with a salinity of less than 1% that of the oceans. i.e. below around 0.35%

i. **Domestic waste:** Domestic water pollution is mainly caused by sewage. Sewage is the waste derived from homes, schools, offices etc. It include human excreta, soaps, waste food and detergents etc. Water pollution is caused by uncontrolled dumping of waste collected from villages, towns and cities into ponds, streams, lakes and rivers.

ii. **Agricultural waste:** In modern agriculture manure, pesticides and fertilizers are used for better yields of crops and vegetables. Pesticides and most of the fertilizers contain poisonous chemical compounds. Their excessive and improper use can cause water pollution. They are carried by rain water into rivers, streams and canals.

iii. **Industrial waste:** Industries have high demands of water for cooling, processing and for cleaning purposes. Most of it is taken from the adjoining river, canal, stream or underground source and again discharge it into the same source laden with toxic chemical. Industrial waste contains highly toxic compounds of mercury, cadmium, lead, chromium, arsenic and antimony. In addition to the above, it also contains acids, bases, dyes, oils and grease.

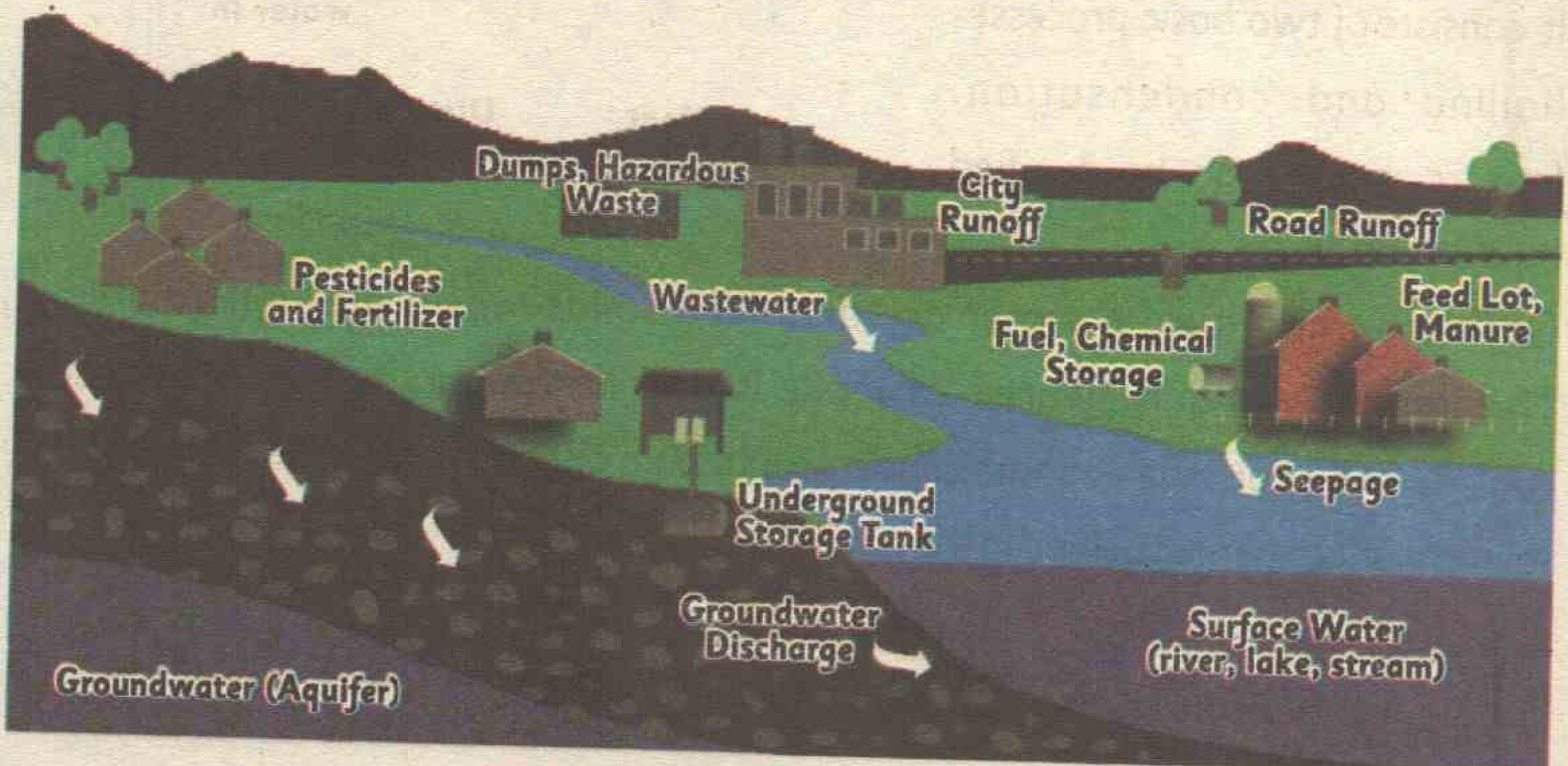
iv. Acid Rain: Some industries emit in air, great variety of acidifying gases such as oxides of nitrogen and sulphur. These gases dissolve in rain water and make it acidic. Acid rain cause acidification of streams, rivers and lakes and also damage plants and aquatic animals.

Science tidbit

Acid rain also causes the decay of building material, statues and sculptures. For example, Taj Mehal structure is damaged due to acid rain.

Activity 5.1

Observe in your surroundings some of the factors which are contaminating water.



Major sources of water pollution

Point to ponder

Why it is advisable to drink boiled water?

5.4 Cleaning of water

Sources of drinking water can be contaminated and require appropriate treatment to remove impurities and disease causing agents. Water purification plays a key role in ensuring access to safe drinking water. Various methods are used to provide safe drinking water.

5.4.1 Distillation

Distillation is a separation technique, which can be used to separate a volatile substance (i.e. one which evaporates readily) from a non-volatile substance. It consists of two basic processes boiling and condensation. Impure water can be purified by distillation.

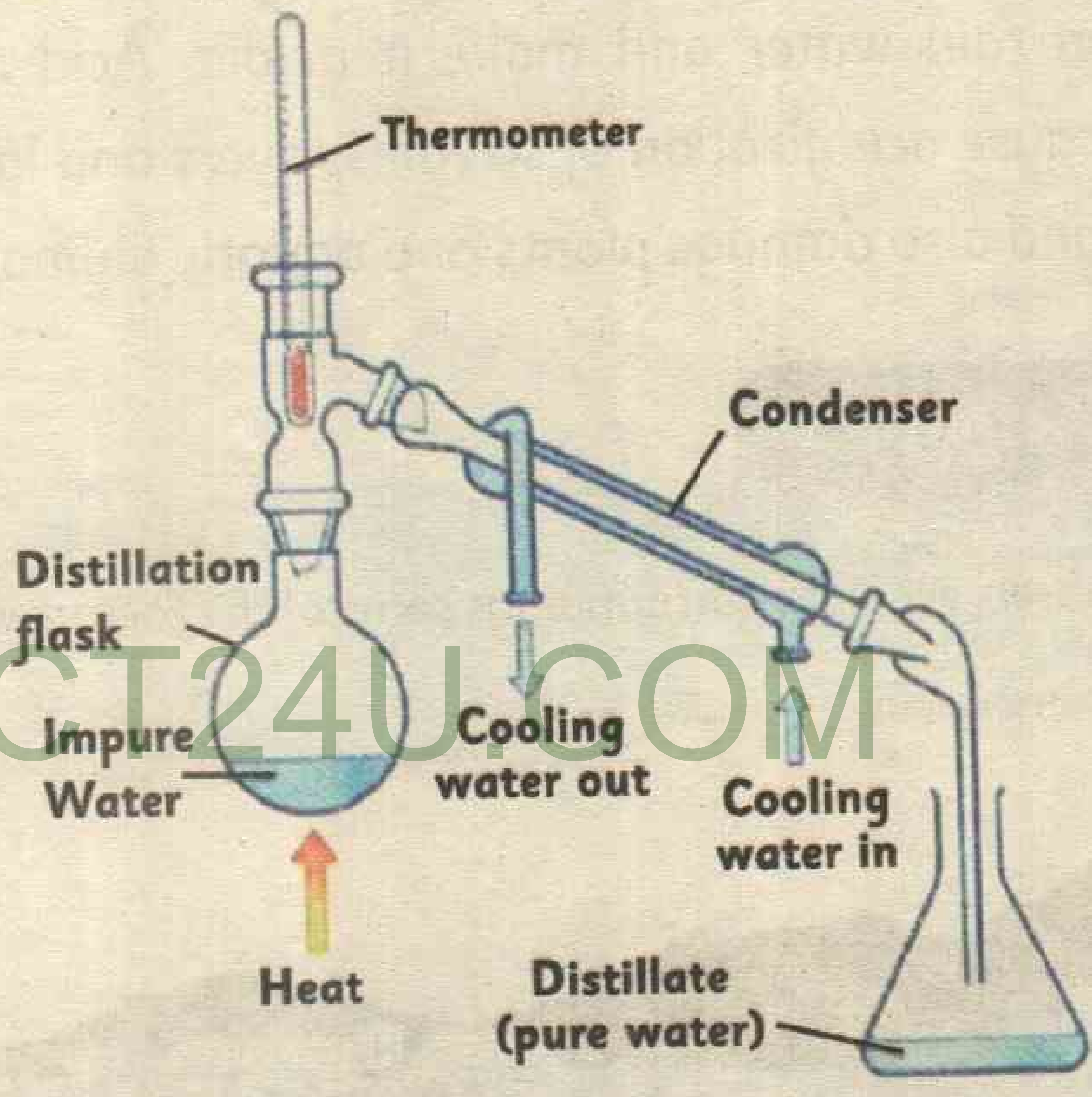


Fig. 5.3 Water distillation

Ordinary impurities in water are dissolved solids which are non-volatile. The impure water is heated to make it boil, its vapours are collected and cooled. As it cools, the vapours condense into pure distilled water. The non volatile solid impurities remain behind in the distillation flask.

5.4.2 Water treatment plant

Following steps are used in the treatment of water in a plant:

Step i

Screening: Water from lakes, rivers or the ground passes through a screen as it enters the water treatment plant. In this step, large natural contaminants such as plants, wood, fish etc are removed.

Step ii

Coagulation and Flocculation: During this step, the removal of suspended particles from water take place. Potash alum and lime water are added to the water. Suspended particles stick together forming larger particles called floc.

Step iii

Sedimentation: Floc settles to the bottom of the tank containing water due to its weight. This settling process is called sedimentation.

Step iv

Filtration: Once the floc has settled to the bottom of the water supply, the clear water on top will pass through different filters (sand, gravel and charcoal) in order to remove dissolved particles, such as dust, parasites, bacteria, viruses and chemicals.

Step v

Disinfection: After the water has been filtered, a disinfectant (for example, chlorine) may be added in order to kill any remaining parasites, bacteria, and viruses and to protect the water from germs when it is supplied to homes.

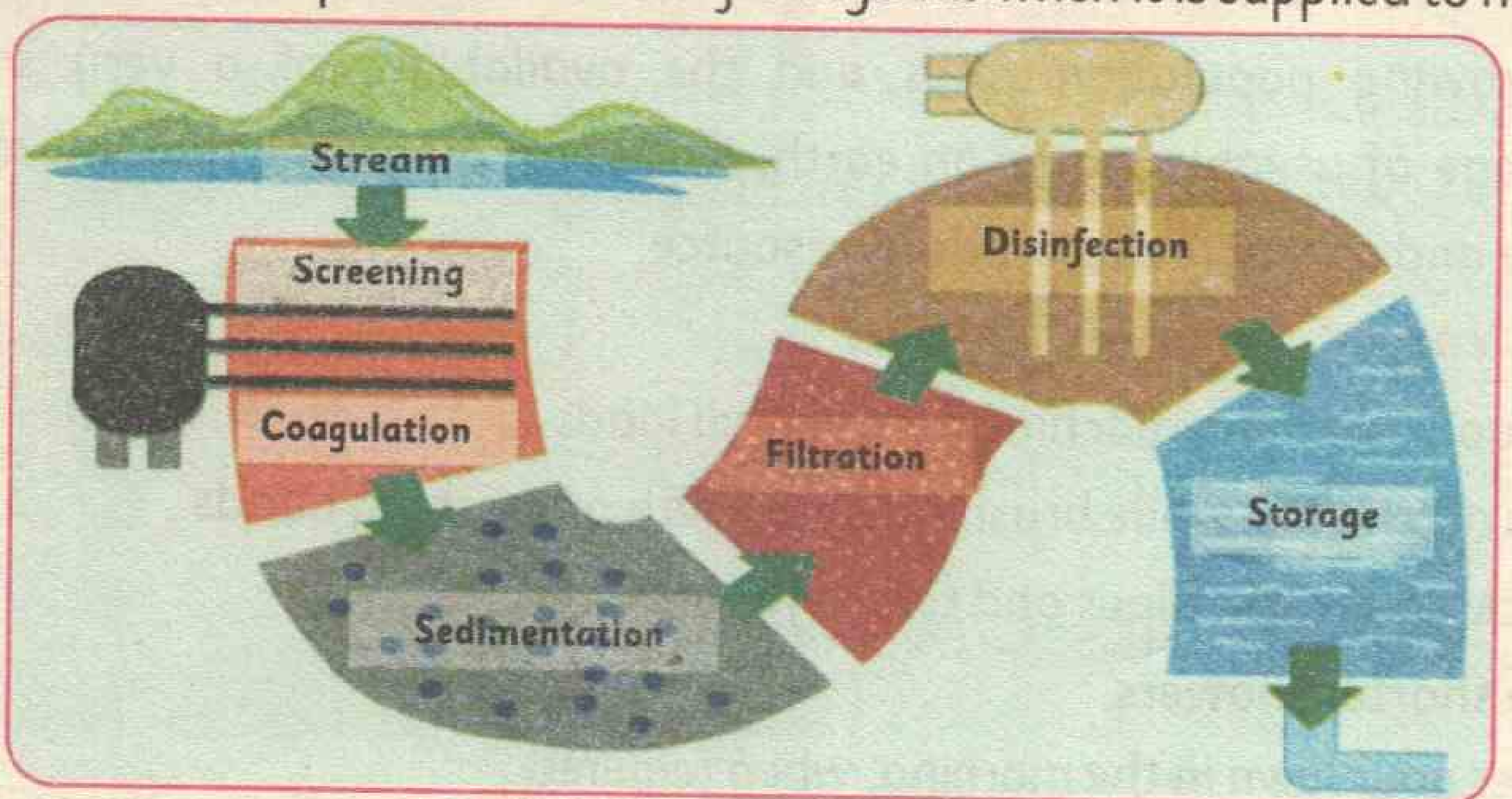


Fig.5.4 Water treatment plant

5.5 Uses of Water

Water is used for the following purposes:

i. Domestic Purposes: Water in our homes is used for cooking, cleaning, drinking, bathing and washing.

ii. Industrial Purposes: Water in industry is used as coolant, ingredient, reagent, cleansing agent and as a source of heat.

iii. Generating Electricity: Water is a source of energy and is used in power plants to generate electricity.

iv. Agricultural Purposes: Water is used for farming, gardening, fisheries, growing crops and vegetables.

v. Recreational purposes: Swimming, rafting and boating are water sports.

vi. Communities: In cities, water is used for fire fighting, street cleaning and watering public areas such as parks, grass, trees, shrubs and flowers.

vii. Transportation: Water ways i.e rivers, canals and oceans are used for transportation by ships and boats.

5.5.1 Prevention of water wastage

With growing population rates and the availability of a very small percentage of useable water on earth, it is very important that we must preserve and conserve this precious resource.

5.5.2 Water Conservation Tips

i. Run your washing machine for only full loads.

ii. Turn off the tap while brushing your teeth or washing hands.

iii. Check your taps, pipes and toilets for leaks.

iv. Take shorter showers.

v. Water your lawn in the morning, when required .

vi. Wash your car with a nozzle on the hose.

Fig.5.5 Some causes of wasting water.

Activity 5.1

Make a list of different ways of consumption of water in your daily life. Design an awareness campaign on conservation of water and share it with lower grades and with family members.

Key points

- Water is one of the most vital natural resource.
- From the simplest organisms to the most complex plants and animals, water plays a vital role in their survival.
- Although an enormous amount of water is present on the earth's surface, yet the clean water needed for human requirements is only nearly 1% of the total.
- Water is an excellent solvent and can dissolve a vast variety of substances.
- Water pollution occurs when undesirable foreign substances are introduced into natural water.
- The effects of water pollutants are not only harmful to people but also to animals, fish and birds.
- Sources of drinking water can be contaminated and require appropriate treatment to remove impurities and disease causing agents.
- Water in our homes is used for cooking, drinking, bathing and washing.
- With growing population rates and the availability of a small percentage of useable water on earth, it is very important that we must preserve and conserve this precious resource.

Exercise

A. Colour the circle for the best suitable answer.

i. Percentage of water on earth surface is about:
- ○ 50%
- ○ 60%
- ○ 70%
- ○ 80%

ii Pesticides and fertilizers are the sources of:
- ○ Domestic waste
- ○ Agriculture waste
- ○ Industrial waste
- ○ Acid rain

iii. Harmful bacteria are removed from water by passing:
- ○ Oxygen gas
- ○ Nitrogen gas
- ○ Chlorine gas
- ○ Carbon dioxide gas

iv Suspended particles from drinking water are removed by:
- ○ Table salt
- ○ Chlorine
- ○ Charcoal
- ○ Potash alum

v. Distillation is a technique of:
- ○ Separation
- ○ Preparation
- ○ Filtration
- ○ Disinfection

B. Write down the short answers to the following questions.

i. Water is an excellent solvent. How this beneficial property is harmful for us?

ii. Suggest some ways to reduce wastage of water.

iii. What is acid rain? What are its harmful effects?

iv. How clean water is important for us?

v. Differentiate between distillation and filtration processes.

C. Write down detailed answers to the following questions.

i. Describe various sources of water.

ii. Define water pollution. Describe various sources of water pollution.

iii. Sketch and discuss a water treatment plant for purification of water?

Project

Purification of salty/sea water

Material required.

- 3 cups of water
- 2 spoons of salt
- Plastic wrap
- Cup
- Glass Bowl
- Small rock

Steps:

- Pour the salty water into the bowl.
- Put the cup into the bowl without letting any salt water get into the cup.
- Place the plastic wrap over the bowl and seal the edges.
- Place the small rock on top of the plastic wrap in the middle of the surface.
- The plastic should slant slightly towards the cup in the middle of the large bowl.
- Place the setup under a hot sunny area for one hour. Water drops should start to form underneath the plastic.
- The water drops will flow into the middle of the bowl and fall into the cup.
- After a few hours, remove the plastic. The cup should now have a reasonable amount of water in it.
- Taste the water in the cup.

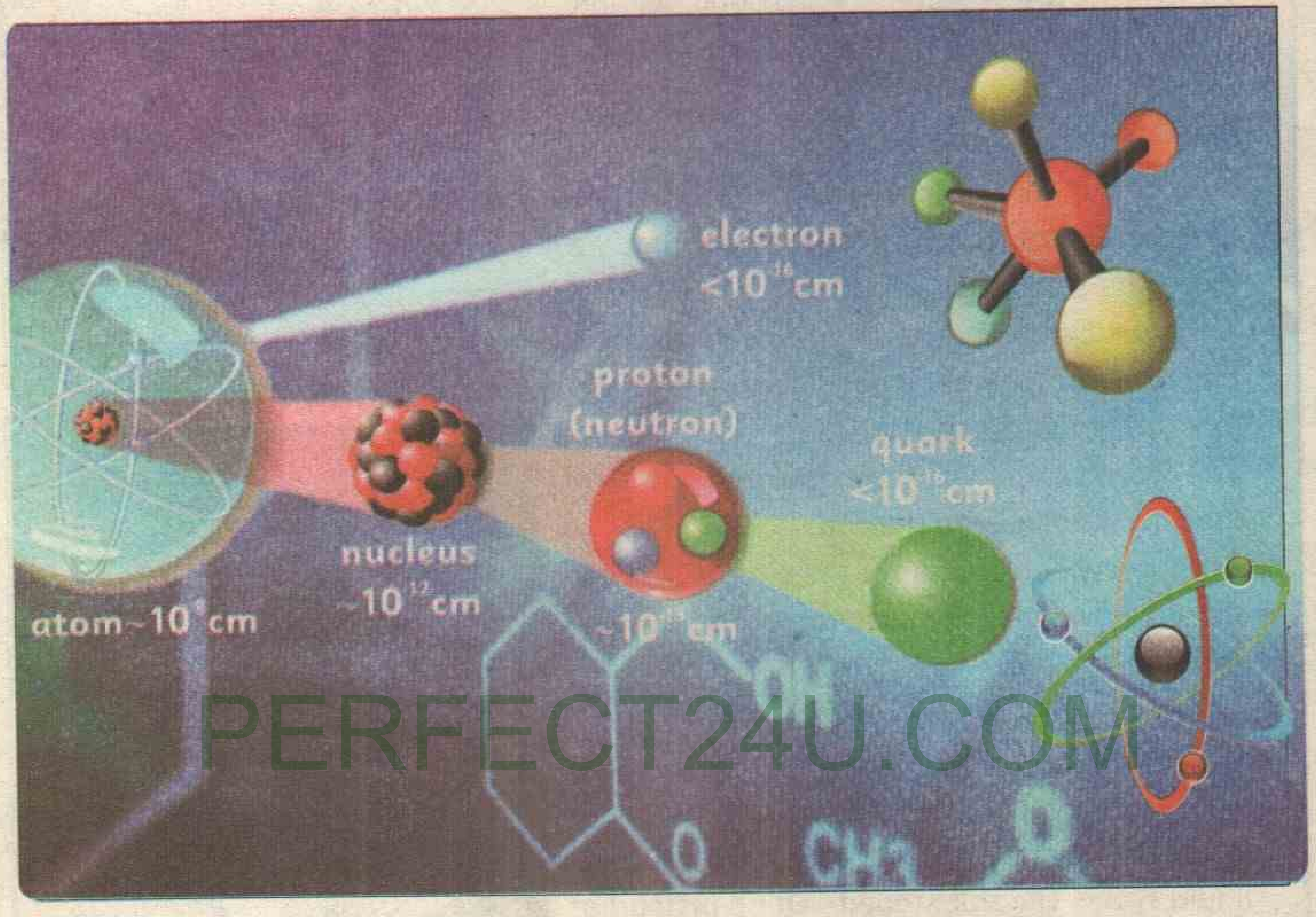
Conclusion:

The water vaporized due to the sun heat inside the plastic wrap and then returned to its liquid state. The salt stayed behind instead of evaporating. Thus, salt is taken out of salty water.

Structure of Atom

Unit 6

Structure of an Atom



At the end of this unit, the students will be able to:

- Describe the structure of an atom
- Differentiate between atomic number and mass number
- Draw diagram of the atomic structure of the first 18 elements in the periodic table.
- Define valency
- Explain formation of ions.
- Differentiate between cations and anions
- Describe isotopes and their uses in medicines and agriculture.
- Identify the types and number of elements present in simple molecules and compounds.
- Make chemical formulae from list of anions and cations.
- State the law of constant composition and give examples.

Introduction

Matter has mass and occupies space. Atoms are the basic building blocks of matter and can take part in a chemical reaction. The idea that all matter is made up of atoms was first proposed by the Greek philosopher Democritus in the 5th century BC. The word atom is derived from the Greek word "atomos" which means indivisible. Democritus concluded that matter could be broken down into small and indivisible particles called atoms. In grade VI, you have studied about atoms and molecules. Here, in this unit, you will learn more about the atom and its structure.

6.1 Structure of an Atom

With the passage of time the scientists John Dalton, J.J. Thomson, Rutherford and Bohr presented different models related to the structure of an atom. Modern investigation and experiments have revealed that atoms are composed of three types of particles: protons, neutrons, and electrons. These particles are called sub-atomic or fundamental particles. Protons and neutrons are responsible for most of the atomic mass. Both the protons and neutrons reside in the nucleus. Protons have a positive (+) charge, neutrons have no charge. Electrons revolve in orbits around the nucleus. They have a negative charge (-).

6.1.1 Arrangement of electrons

Electrons revolve around the nucleus in particular paths called orbits or shells. The orbit near the nucleus is called first orbit (K-shell). The next orbits are called second (L-shell), third (M-shell) and so on.

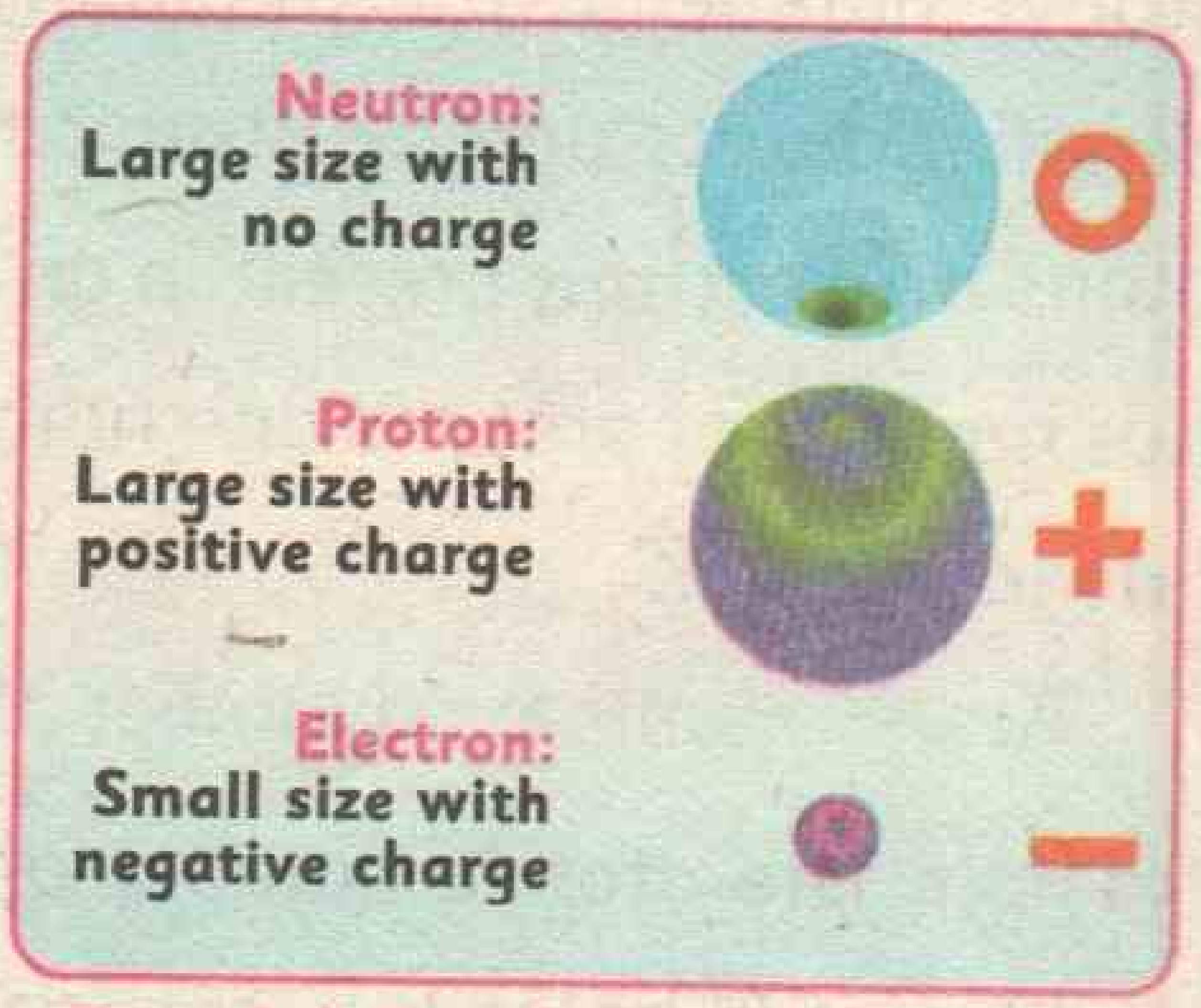


Fig. 6.1 Fundamental particles

Electrons are distributed in shells according to the general formula $2n^2$, where n is the number of shell.

$$n = 1,2,3........$$

For 1st shell

$$n = 1$$
$$2 \times 1^2$$
$$2 \times 1 = 2$$

The maximum number of electrons in first orbit K = 2, in second orbit L=8, in third orbit M=18 and in fourth orbit N=32. However, it is found that the outer most orbit cannot have more than 8 electrons.

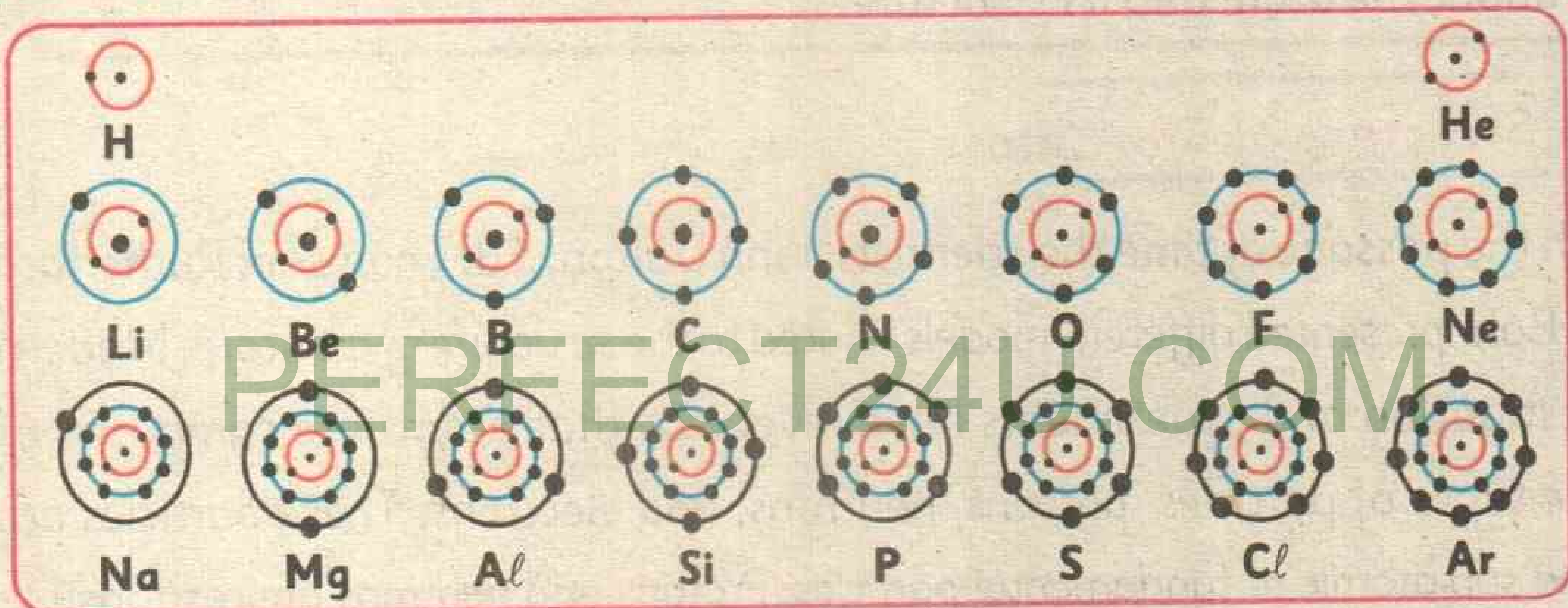


Fig. 6.2 Schematic presentation of atomic structure of the first eighteen elements

6.1.2 Atomic Number

Atomic number is the fundamental property of an atom. Every atom is identified by its unique atomic number. Atomic number is the number of protons or electrons present in an atom. Since an atom is electrically neutral, thus number of protons and number of electrons are equal. Atomic number is denoted by 'Z'.

Atomic number = Number of protons or Number of electrons

Example: The atomic number of hydrogen is 1, helium is 2, lithium is 3, beryllium is 4, boron is 5, carbon is 6, nitrogen is 7, oxygen is 8, etc.

Activity 6.1

1. Atomic number of calcium is 20. Calculate the number of electrons and protons in calcium.
2. Number of protons in sodium atom is 11, find the atomic number and number of electrons in a sodium atom.

6.2 Mass Number or Atomic Mass

Mass number of an atom is defined as the sum of the number of protons and number of neutrons. Mass number is nearly equal to the atomic mass of an atom and is denoted by "A". Since protons and neutrons reside in the nucleus, thus they are also known as nucleons. This means that

Mass number of an atom = Number of protons + Number of neutrons

Example 1: Atomic mass of aluminium is 27 and its atomic number is 13, find the number of protons and number of neutrons in aluminium.

Solution: Since, Atomic number = 13

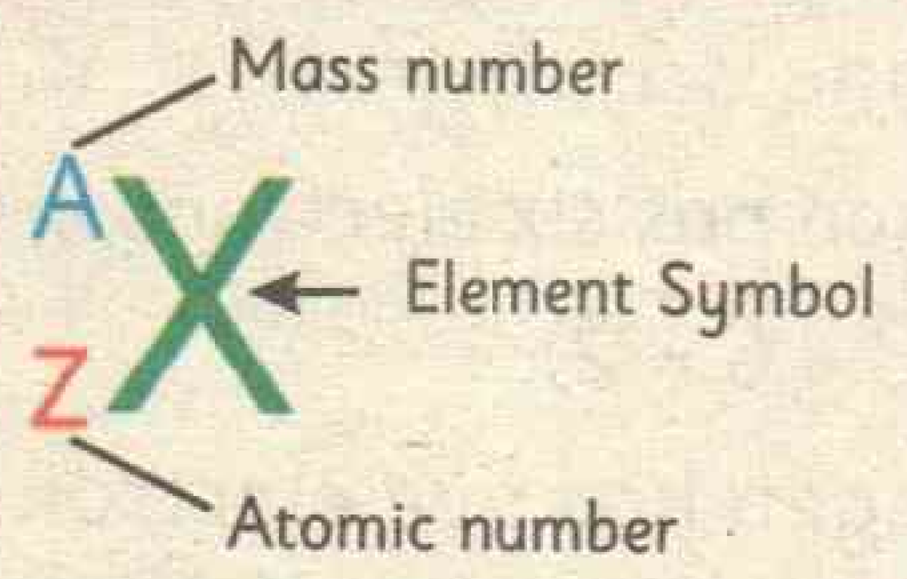
Therefore, number of proton = 13

We know that; Mass number = Number of protons + Number of neutrons(n).

Therefore, $27 = 13 + n$, $n = 27 - 13 = 14$

Hence, number of proton = 13 and number of neutron = 14

Science tidbit



Activity 6.2

$^{12}_{6}C$

a. Name the element whose chemical symbol is given above.
b. Write down its atomic number.
c. State the number of protons and electrons of this element.
d. Find the number of neutrons in this atom?

6.3 Valency and Ions

6.3.1 Valency

The combining capacity of the atoms to form molecules either with same or different elements is known as valency. Valency depends upon number of electrons present in the outermost shell. Atom containing less than four electrons in its outermost shell, its valency is equal to the number of electrons present in the valence shell.

Examples

a. Sodium has one electron in its outermost shell, so the valency of sodium is 1.
b. Calcium has two electrons in its outermost shell, so the valency of calcium is 2.
c. Aluminum has three electrons in its outermost shell, so the valency of aluminum is 3.

If the outermost shell has more than four electrons, its valency will be equal to 8 minus the number of electrons in the outermost shell.

Examples

a. Chlorine has seven electrons in its outermost shell, so the valency of chlorine is 1 $(8-7=1)$.
b. Oxygen has six electrons in its outermost shell, so the valency of oxygen is 2 $(8-6=2)$.
c. Nitrogen has five electrons in its outermost shell, so the valency of nitrogen is 3 $(8-5=3)$.

6.3.2 ION

Ion is a charged particle that is formed by the removal or addition of one or more electrons from an atom or molecule.

There are two types of ions.

CATION: If an electron or more than one electrons are removed from an atom, it becomes a positive ion which is also known as "cation".

For example: Na^{+1}, K^{+1}, Ca^{+2}, Mg^{+2}, Al^{+3}.

ANION: If an electron or more than one electrons are added to an atom, it becomes a negative ion which is also known as "anion".

For example: Cl^{-1}, O^{-2}, N^{-3}.

6.4 Chemical Formula

The representation of a molecule of a compound in the form of symbols is called chemical formula. With the help of formula we can find:

- Name of elements present in the molecule.
- Number of atoms of each element.
- Composition of a compound.

Table 6.1 Chemical formulae of some compounds

Name of chemical compound	Chemical formula
Calcium carbonate (lime stone)	$CaCO_3$
Sulphuric acid (battery acid)	H_2SO_4
Sodium chloride (table salt)	NaCl
Ammonia	NH_3
Hydrochloric acid	HCl

Activity 6.3

Identify the number of atoms of each element in the following compounds,

Table salt: NaCl

Sugar: $C_{12}H_{22}O_{11}$

Ammonia: NH_3

Sulphuric acid (Battery acid): H_2SO_4

How to write a chemical formula using cation and anion.

Step i Write Cation on left hand side and anion on right hand side.

Step ii Cross the charges to the lower right.

Step iii If the charges are same do not cross.

Example-1

metal → Calcium   non-metal → oxide

Ca^{+2} O^{-2}

CaO

Example-2

Calcium   Bromide

Ca^{+2} Br^{-}

+2   −1

$CaBr_2$

Activity 6.4

Make chemical formulae from cations and anions given in the table.

	Cl^{-1}	O^{-2}	N^{-3}
Na^{+1}			
Ca^{+2}			
Al^{+3}			

6.5 Isotopes

Atoms of same element having same number of protons but different number of neutrons are called isotopes. The chemical properties of isotopes are the same, although the physical properties of some isotopes may be different. Some isotopes are radioactive i.e they "radiate" energy. The atoms of same elements which have same atomic number but different mass number are called Isotopes.

For example,

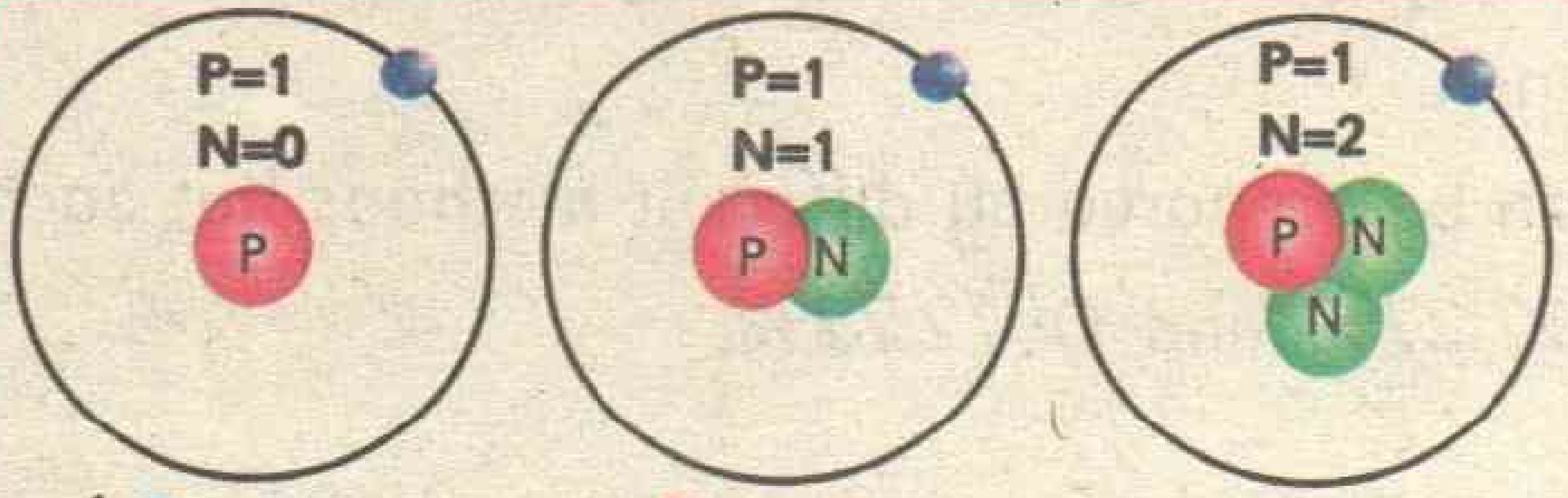
Hydrogen has three isotopes

i. Ordinary Hydrogen or Protium, "H".
ii. Heavy Hydrogen or Deuterium, "D".
iii. Radioactive Hydrogen or Tritium, "T".

i. Protium: Ordinary naturally occurring hydrogen contains the largest percentage of protium. It is denoted by symbol H. It has one proton, no neutron in its nucleus and one electron revolves around the nucleus.

ii. Deuterium: It is also called heavy hydrogen. The percentage of deuterium in naturally occurring hydrogen is about 0.0015%. It has one proton, one neutron in its nucleus and one electron revolving around its nucleus. It is denoted by symbol D.

iii. Tritium: It is a radioactive isotope of hydrogen. It is denoted by symbol "T". The number of tritium isotope is one in ten millions. It has one proton and two neutrons in its nucleus. It has one electron revolving around its nucleus.



Protium Deuterium Tritium

6.5.1 Uses of isotopes

1. An isotope of uranium is used as fuel in a nuclear reactor.
2. An isotope of cobalt is used in the treatment of cancer.
3. For treating goiter, an isotope of iodine is used.
4. An isotope of carbon (C-14) is used to determine the age of old material like trees.
5. Radio isotopes are used to detect the leakage of pipelines.

Science tidbit

Isobars

Atoms of different elements with different atomic numbers but have the same mass number are called isobars.

Example: $_{18}Ar^{40}$, $_{19}K^{40}$ and $_{20}Ca^{40}$.

6.6 Law of Constant Composition

Law of constant composition was presented by Joseph Proust. This law states that

"Every sample of pure substance always contains same elements in fixed proportion regardless of its source and method of preparation".

For example,

We can obtain water from many sources or prepare it by many methods but water obtained from any source always contain 11.11% hydrogen and 88.88% oxygen.

Similarly, CO_2 can be prepared by different methods but each sample of CO_2 contains C=27.27% and O=72.72%.

Key points

- Atom, according to old concepts, is indivisible but modern investigations have revealed that it is divisible.
- Atom consists of the sub-atomic particles called protons, neutrons and electrons.
- Protons and neutrons are present in the nucleus, whereas electrons revolve around the nucleus in various shells.
- Protons are positively charged particles, electrons are negatively charged and neutrons carry no charge.
- Atom, as a whole, is a neutral particle.
- Atomic number is the number of protons in the nucleus.
- Mass number is the sum of protons and neutrons number in the nucleus.
- Electrons are distributed in shells according to the general formula $2n^2$.

Project

Make the models of atomic structures of helium, sodium, carbon, oxygen and calcium atoms.

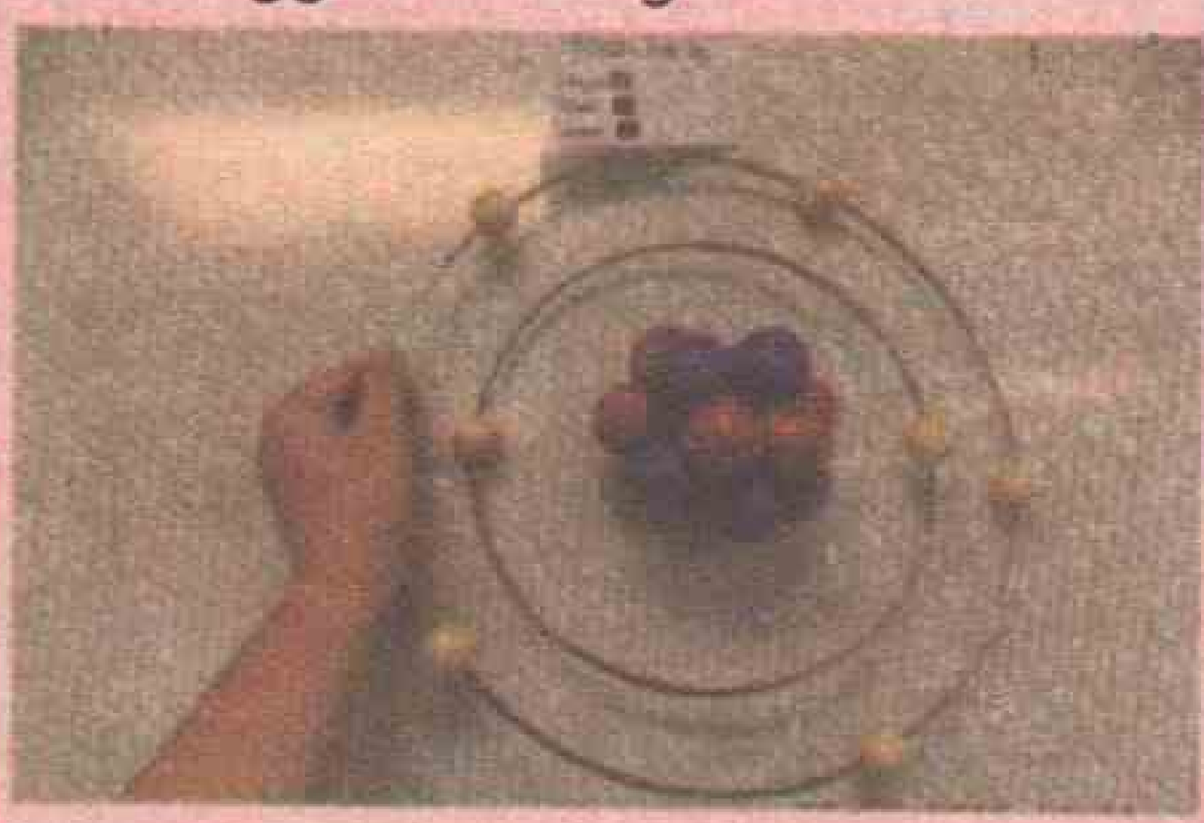
Material Required:

Ping pong balls or other small round objects of three different colours.

String, Cardboard and Glue

Steps for making model

i. Glue balls together to represent protons and neutrons in the nucleus.
ii. Glue the nucleus to the centre of the cardboard.
iii. Determine how many rings you need for the electrons.
iv. Glue the string around the nucleus to make the energy level rings.
v. Apply a few drops of glue to each ring.
vi. Glue the electrons on the rings, spacing them evenly.



Note

Make sure you do not exceed each ring's maximum number of electrons.

Exercise

A. Colour the circle for the best suitable answer.

i. These have the same number of protons in each atom but the neutron number can vary

○ Isotopes ○ Molecules ○ Ions ○ Isobars

ii The particle that carries a negative electrical charge.

○ Proton ○ Neutron ○ Nucleus ○ Electron

iii. An atom of carbon contains 6 protons and 6 neutrons, its mass number will be

○ 12 ○ 6 ○ 18 ○ 24

iv The center or core of an atom is called

○ Orbital ○ Nucleus ○ Proton ○ Neutron

v. An element has seven electrons in its valence shell. Its valency is

○ 7 ○ 0 ○ 1 ○ 8

B. Write down the short answers to the following questions.

i. An atom is a neutral particle .Why?

ii. Why cation carries positive charge?

iii. Find the number of electrons, protons and neutrons in Sodium (A=23, Z=11), Chlorine (A=35, Z=17) and Magnesium (A=24, Z=12)

iv. Differentiate between atomic number and mass number with examples.

v. What is a chemical formula and how it is written?

C. Write down the detailed answers to the following questions.

i. Describe the fundamental particles of an atom.

ii. Define isotopes. Discuss the isotopes of hydrogen.

iii. State and explain the law of constant composition with examples.

Unit 7

Physical and Chemical Changes and Processes

At the end of this unit, the students will be able to:

- Differentiate between physical and chemical changes.
- Identify the physical and chemical changes taking place in their environment.
- Explain the use of hydrocarbons as fuels.
- Explain the physical and chemical properties of fertilizers, which make them useful in agriculture.
- Discuss the harmful effects of improper use of fertilizers.
- Describe the chemical process in which vegetable oil changes into fat.
- Describe the simple process for the manufacture of plastics.
- Distinguish between reversible and non-reversible changes in materials.
- Identify a variety of reversible and non-reversible changes in materials in their surroundings.

Introduction

Matter is all around us. The chairs we sit at, the air we breathe and the water we drink all are examples of matter. But matter doesn't always stay the same. It can change in many different ways. In this unit, we are going to take a closer look at physical and chemical changes that occur in matter. We see different types of changes, everyday in our surrounding. Growth of plants, melting of ice, rusting of iron, digestion of food, burning of coal, paper, wood etc. are the examples of changes around us.

7.1 Properties and Changes in Matter

Physical Properties: A physical property is a property that is measurable and whose value describes a state of a physical system. The shape, size, colour, odour and state of substances are known as physical properties.

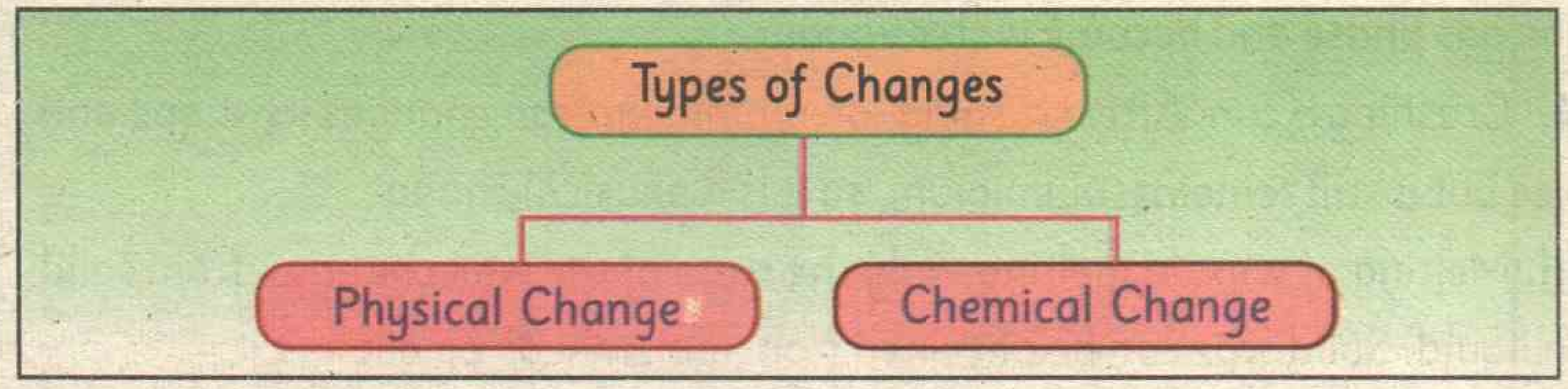
Chemical Properties: The properties which are related with the chemical reactions occurring in a substance are called chemical properties. It is a property or characteristic of a substance that is observed during a reaction in which the chemical composition or identity of the substance is changed. e.g burning , rusting, radioactivity etc.

Reversible changes: Changes or processes, that can be reversed are called reversible changes. For example, Melting of ice, evaporation of water and freezing of water etc.

Irreversible changes: Changes or processes, that cannot be reversed are called irreversible changes. For example, when milk turns into curd, it cannot be changed back to milk and hence is an irreversible change. Similarly, boiled egg cannot be changed back to its original form.

7.1.1 Types of Changes

Changes may be classified as



Physical Change

Change in which only physical properties of a substance change and no new substance is formed is called physical change. Most of the physical changes are reversible, this means we can get the substance back even after the change. Changes in state such as melting, freezing, evaporation, boiling and condensation are physical / reversible changes. For example, change of ice into water and water into vapours and vice versa.

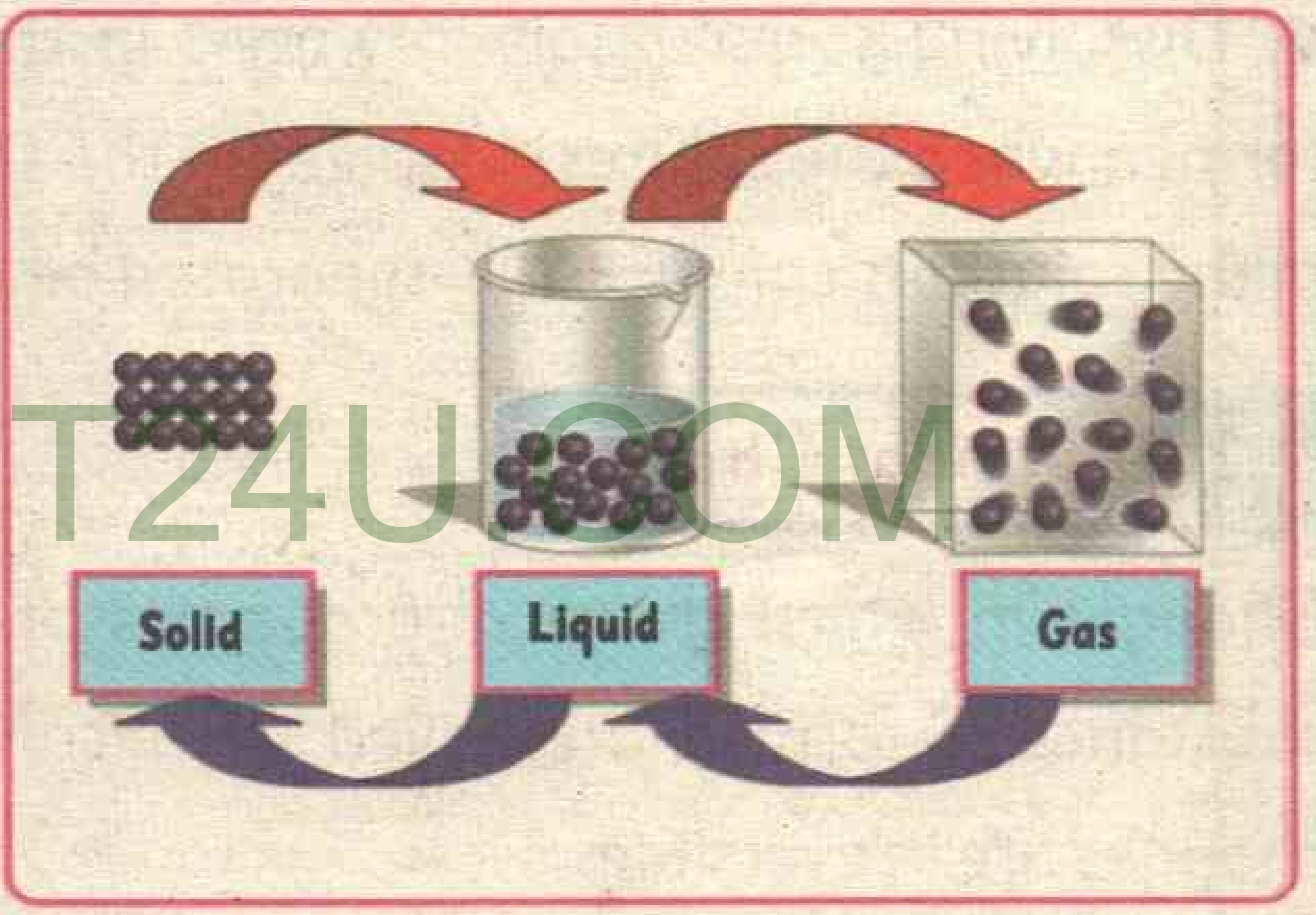


Fig. 7.1 Reversible Changes

Activity 7.1

Take some water in the beaker and dissolve 3 spoons of table salt in the water. Put the beaker on the tripod stand. Boil off the water and observe what remain in the beaker. Is dissolving of table salt into water is a physical change?

7.1.2 Examples of physical change

i. Boiling of water: Water molecules vibrate faster as it boils, they enter the gas phase and become water vapour.

ii. Crushing a can: After crushing, an aluminium can changes its shape and size but it still remainssaluminium, so it is a physical change.

iii. Melting of wax: In melting, only the state of the wax changes, from solid to liquid. Solid wax can be obtained from molten wax by cooling it.

iv. Stretching of a rubber band: In this change, only the size of the rubber band changes. The rubber band comes back in its original shape and size, once it is released. This is a physical and reversible change.

v. Dissolving sugar / salt in water: In this change, no new substance is formed when the solutes dissolve in the solvents. The solutes and solvents in the solutions can be easily separated by evaporation or distillation.

7.2 Chemical Changes

Changes in which chemical properties of a substance change and a new substance is formed are called chemical changes. Most of the chemical changes are irreversible.

Point to ponder

How a chemical change can be judged?

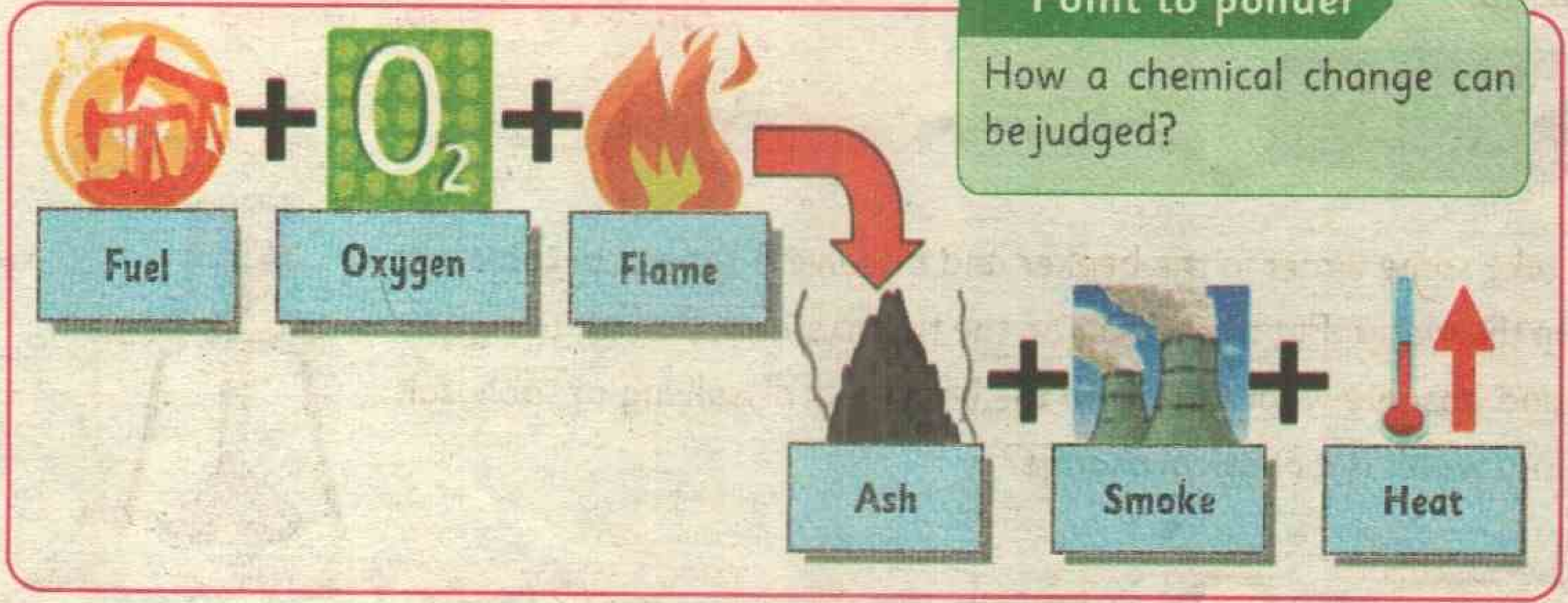


Fig. 7.2 Irreversible Changes

7.2.1 Examples of chemical changes

i. Burning

When something like wood, coal, petrol and paper are burnt, new substances (e.g Carbon dioxide and water etc.) are formed.

ii. Conversion of milk into curd

Milk changes into curd by the action of bacteria. Properties and composition of milk and curd are different.

iii. Digestion of food

It is a chemical change because enzymes break down large food particles into small and digestible food particles.

iv. Photosynthesis

It is a chemical process because plant make new compounds. In this process, plants use carbon dioxide and water, in the presence of sunlight and generate glucose molecules, along with oxygen.

v. Respiration

It is a chemical reaction in which energy is released from the break down of glucose molecules.

vi. Rusting of Iron

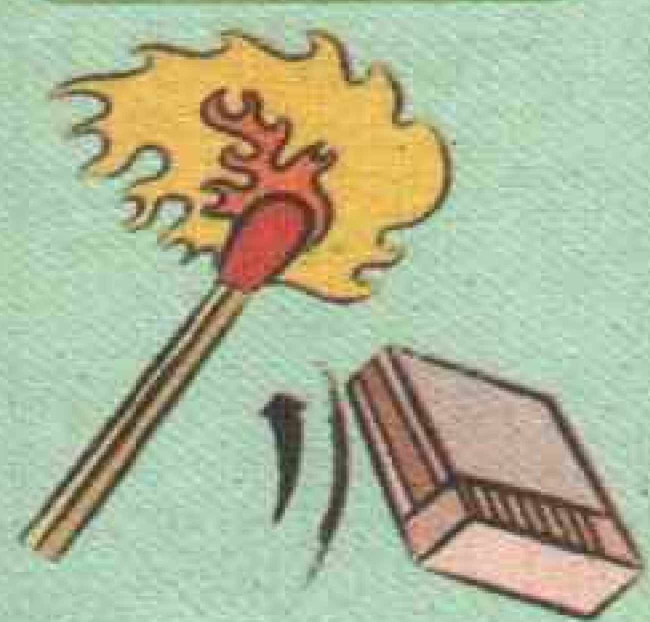
You must have seen that when we leave an object made up of iron in open air, a reddish brown layer called rust is formed on its surface. The chemical structures of iron and rust are completely different.

Table 7.1: Differences between physical and chemical changes

Physical changes	Chemical changes
Physical properties change.	Chemical properties change.
No new substance is formed.	New substance is formed.
Mostly reversible changes.	Mostly irreversible changes.

Activity 7.2

Identify the following changes



Lighting a match

Melting chocolate

Freezing water to make ice

Frying an egg

Mixing paints to make a new colour

7.2.2 Hydrocarbons

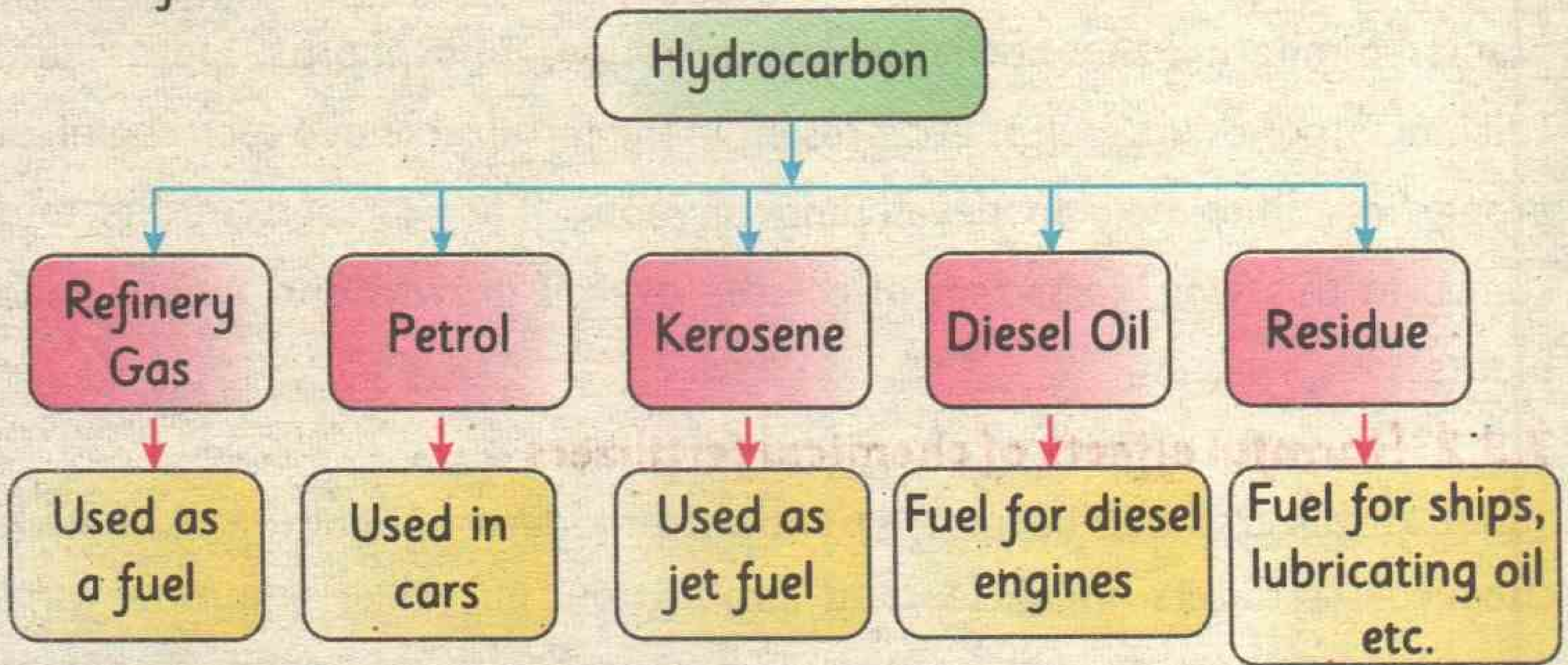
Hydrocarbons are organic compounds that are made up of only hydrogen and carbon atoms. They are found in coal, crude oil and natural gas. They serve as fuels and lubricants as well as raw materials for the production of plastics, fibers, rubbers, solvents, explosives and industrial chemicals.

Use of Hydrocarbons as fuel

Hydrocarbons burn in air producing carbon dioxide , water and large amount of energy.

Natural gas + oxygen $\rightarrow$ carbon dioxide + water + energy

The chemical process that gives out heat is called combustion. Thus, hydrocarbon such as natural gas, diesel, kerosene and gasoline etc are used as fuels.



7.3 Fertilizers

Plants require a number of soil nutrients like nitrogen, phosphorus and potassium for their growth. But soil nutrient level can decrease over time when crops are continuously harvested. These essential nutrients are recovered through the natural process of decomposition of plants and animals. Sometimes these nutrients are compensated by adding fertilizers.

Fertilizers are natural or artificial substances composed of the chemical elements that increase plant growth and productivity by adding nutrients to the soil. Natural fertilizers include manures, plant ashes, lime and gypsum. Chemical fertilizers may be derived from natural sources or may be synthetic compounds.

Fig. 7.3 Fertilizers

7.3.1 Physical and chemicals properties of fertilizers

Physical properties of fertilizers like size, shape, solubility, flowability etc. help them in their absorption in soil and easy availability to the roots of plants. Similarly, the nutrients like nitrogen, phosphorus, potassium, calcium, magnesium, sulfur etc. present in the fertilizers have such chemical properties which help in developing of roots, flowers, seeds, fruits and stems. In this way, fertilizers affect the overall growth and yield of the plants.

7.3.2 Harmful effects of chemical fertilizers

Today fertilizers have become essential to modern agriculture. Although chemical fertilizers increase crop production but their improper and excessive use has brought hazards to human health and environment as well. The biggest problem caused by chemical fertilizers is groundwater contamination. Fertilizers dissolve in water and absorb easily into the soil. Groundwater contamination has been linked to health problems, acid rain, ozone layer depletion and emission of ammonia gas.

7.4 Plastic

Plastic is a synthetic material that can be moulded, when soft and formed into a desirable solid shape. Plastic appears in many different forms e.g balls, lawn furniture, toys, grocery bags, fabric, credit cards and much more.

7.4.1 Manufacturing of plastic

Plastic is prepared from petroleum by the process called polymerization. Polymerization is a process in which many similar and smaller molecules called monomer, combine to form a larger molecule called polymer (poly means many and mer means parts). For example, polythene (plastic bags) is obtained by the polymerization of ethene. Examples of plastic are Nylon, polythene, PVC, Teflon etc.

Fig. 7.4 Things made up of plastic

7.4.2 Conversion of vegetable oil into fat

Vegetable oil (corn, olive, sunflower, mustard etc.) are liquid at room temperature. In ghee industry, vegetable oil is converted into solid fat (banaspati ghee) by a process called hydrogenation i.e addition of hydrogen. This process takes place in the presence of nickel element at 250-300°C.

$$\text{Vegetable Oil} + H_2 \xrightarrow[250\text{-}300^\circ C]{Ni} \text{Vegetable Ghee}$$

Similarly, vegetable oil changes into soap, the process is called saponification.

Key points

- A physical change is the one during which the chemical composition of the matter does not change.
- A chemical change is the one during which entirely new (different) substances are formed.
- A chemical change is also called a chemical reaction.
- Hydrocarbons are the compounds of carbon and hydrogen only. They are mainly used as fuels.
- Natural gas, petrol, diesel, gasoline oil etc are all hydrocarbons.
- The combustion products of hydrocarbons are carbon dioxide and water. Heat is also released.
- Fertilizers are the compounds used to make soil fertile, by increasing the amount of essential elements like nitrogen, phosphorus and potassium.
- Improper use of fertilizers may cause environmental pollution.
- Animal fats and vegetable oils act as raw materials in making soap.
- Plastics are polymers (large-molecules) which are usually made from smaller molecules (monomers) under high pressure and temperature.
- A change which can easily be reversed by changing the conditions is termed as reversible change while a change that cannot be easily reversed is called irreversible change.

Project

Classify the changes involved in the following processes as physical or chemical changes:

- Photosynthesis
- Dissolving sugar in water
- Burning of coal
- Melting of wax
- Beating aluminum to make aluminum foil
- Digestion of food

Exercise

A. Colour the circle for the best suitable answer.

i. During a physical change, the chemical composition of the substance:
- ○ Changes
- ○ Does not change
- ○ Permanently changes
- ○ Temporarily changes

ii. Hydrocarbons are the compounds of carbon and:
- ○ Oxygen
- ○ Hydrogen
- ○ Nitrogen
- ○ Chlorine

iii. Polythene is a:
- ○ Monomer
- ○ Polymer
- ○ Element
- ○ Fertilizer

iv. The products of burning hydrocarbons are:
- ○ Carbon dioxide and water
- ○ Carbon dioxide and oxygen
- ○ Oxygen and water
- ○ Nitrogen and oxygen

v. Vegetable oil is converted into a solid fat by a process called:
- ○ Respiration
- ○ Photosynthesis
- ○ Polymerization
- ○ Hydrogenation

B. Write down the short answers to the following questions.

i. Differentiate between physical and chemical changes with examples.

ii. When a candle burns, both physical and chemical changes take place. Identify these changes. Give another example of a familiar process in which both the chemical and physical changes take place.

iii. Explain why burning of wood and cutting it into small pieces are considered as two different types of changes.

iv. Explain how painting of an iron gate prevents it from rusting.

C. Answer the following questions in detail.

i. Describe the manufacturing of plastic.

ii. What are reversible and irreversible changes? Explain your answer by giving examples from your surroundings.

iii. Define fertilizers? Discuss their role in agriculture and harmful effects due to improper use of fertilizers.

Unit 8

Transmission of Heat

At the end of this unit, the students will be able to:

- Explain the flow of heat from hot body to cold body.
- Explain conduction, convection and radiation through experimentation.
- Recognize three modes of transfer of heat from environment.
- Suggest how birds can glide in the air for hours.
- Identify examples of appliances that make use of different modes of transfer of heat.
- List heat conducting materials in their surroundings.
- Describe the working and principle of vacuum flask.
- Explain how a vacuum flask reduces the transfer of heat.

Introduction

In the previous grade, you have learnt that **kinetic energy** is the energy of matter in motion. You know that all objects are made up of tiny particles called molecules. In cold objects, the molecules move slowly while in hot objects, the molecules move faster. The movement of molecules in an object produces thermal energy. The faster the molecules are moving inside an object, the hotter the object will be.

Thermal energy is the energy that comes from heat. In fact, the word 'thermal' refers to heat. If we put ice in hot water, the ice will melt and the water will become cooler. Do you know why? It is because the ice absorbs the heat energy from the water, which inturn melts the ice and cools the water. This shows that thermal energy moves from hotter objects to cooler objects.

8.1 Transfer of Heat

Thermal energy transfers or moves between objects in three different ways: conduction, convection and radiation.

8.1.1 Conduction of Heat

Conduction occurs when thermal energy is transferred between two objects that are touching each other. You know that atoms and molecules in a solid are in a fixed frame as shown in figure 8.1. They are bound with bonds (like springs). The molecules vibrate around a central point.

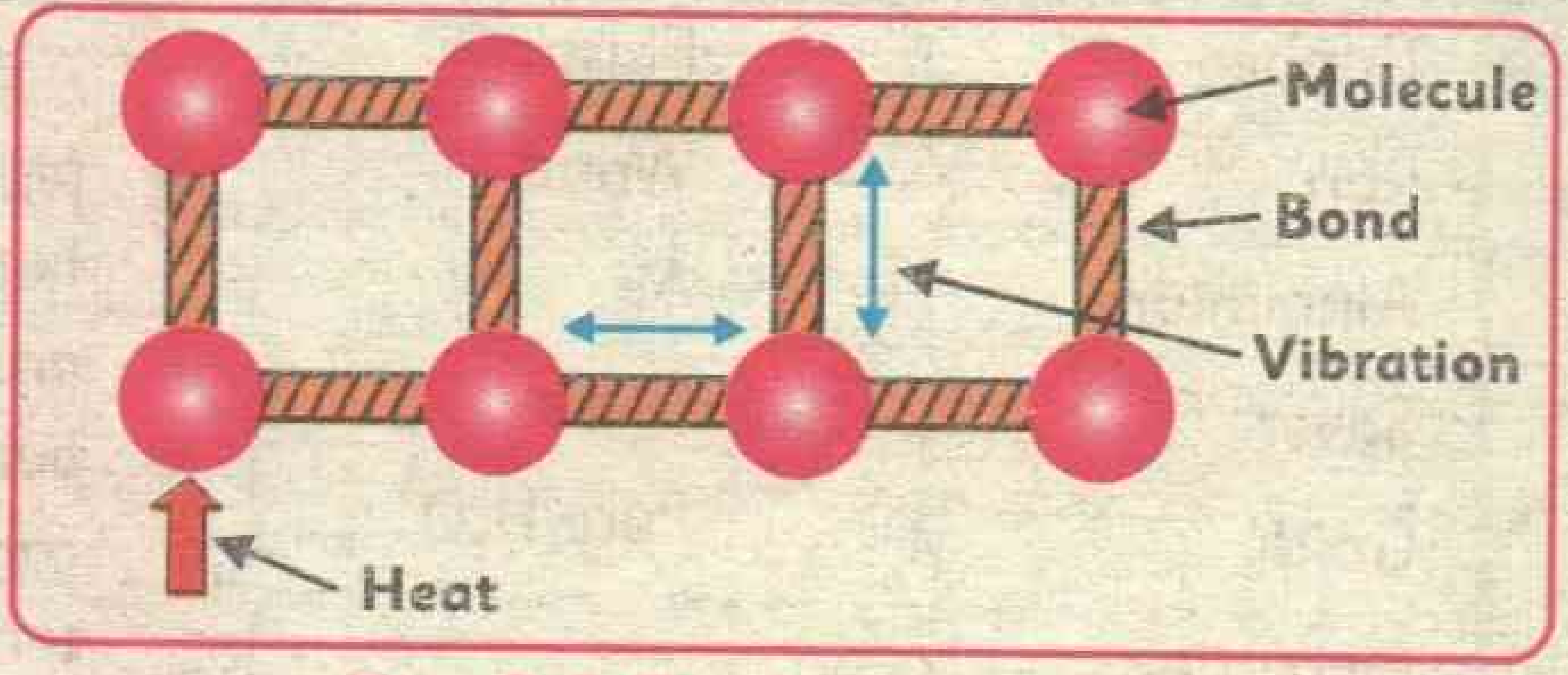


Fig: 8.1 Conduction of heat

If we apply heat, the molecules vibrate with vigorous vibrations and in turn set their neighbour molecules in vibration. Thus heat passes vibrations to their neighbours. If the vibrations are passed on easily, the material is a good conductor.

Activity 8.1

Take a spoon. Hold it on the flame of spirit lamp/candle. After a few minutes you will find that the other end of the spoon also becomes hot. How does the heat flow from the hotter to the colder end of the spoon? The spoon is made up of closely packed steel atoms. Due to high thermal energy, the atoms in the hotter part of the spoon vibrate more vigorously than those in the colder part. These atoms with greater thermal energy pass some of this energy to their neighbour atom, which in turn pass thermal energy to their own neighbours. This particle to particle mode of heat transfer is called **"conduction"**. None of the particles leave their own position but transfer the heat by vigorous vibrations about their mean position.

A. Good and Bad Conductors

Some materials allow heat to conduct through them easily. They are called good heat conductors. Those materials, which do not allow heat to flow easily through them are called bad heat conductor.

Table. 8.1 Examples of good and bad conductors

Good conductor	Bad conductor
Copper	Plastic
Iron	Wood
Aluminium	Air
Silver	Glass
Gold	Pure H_2O
mercury	

Science tidbit

A stone floor feels cold to the bare feet, but a carpet on the same floor feels warm. This difference arises from the fact that stone is a better conductor of heat than a carpet. Copper conducts heat ten times better than iron.

B. Everyday Application of Conductors

The good as well as the bad conductors have useful application in our daily life. Cooking pots are made of aluminum or stainless steel because they readily conduct heat from the flame of the stove. Handles of these cooking pots are made up of plastic or wood to reduce conduction of heat.

Point to ponder

Most pots have steel handles. How do you handle such pots when they are on the stove? What do you use for removing such pot from the stove?

8.1.2 Convection of Heat

Convection occurs only in liquids and gases. Convection requires particles to be free to move about, hence it cannot take place in solids. When a liquid is heated, the molecules at the bottom move with stronger vibrations. They take up more space which means that the density of the liquid goes down. The less dense fluid rises. It gives its energy to the fluid above and cools down. It becomes dense and falls back to the bottom, in this way convection current is set up.

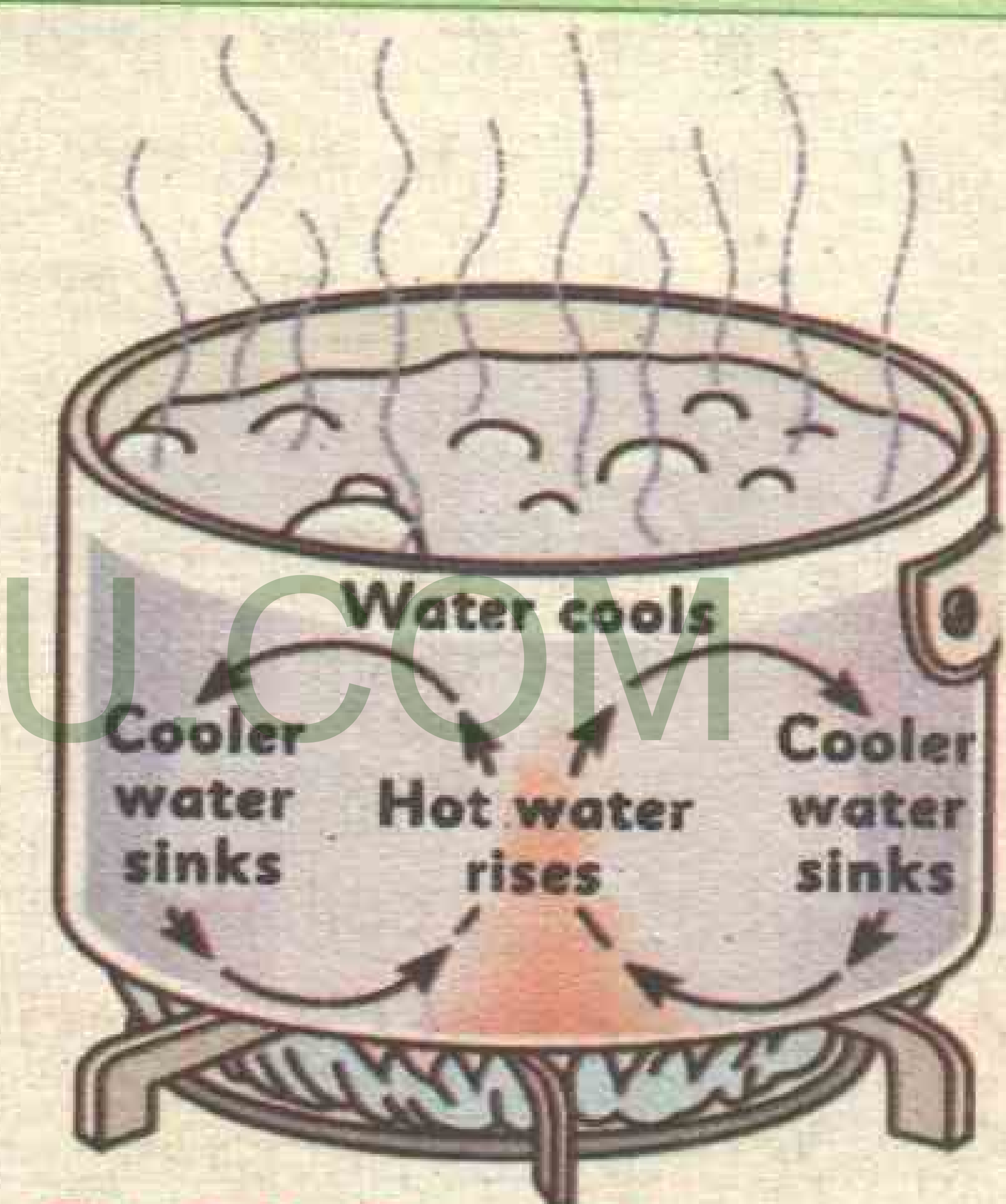


Fig 8.2: Convection currents

Activity 8.2

Drop a small crystal of copper sulphate ($CuSO_4$) in a beaker filled with water and heat it on a spirit lamp or Bunsen burner. See how the coloured water moves.

Water from the bottom begins to rise and water from the sides takes its place. This process is seen by the movement of coloured water. The water at the bottom becomes hot and less dense. This water becomes lighter and rises upward. The water goes on circulating and becomes hotter and hotter. In this way, each part of water is heated in turn.

Science tidbit

Convection currents are used to ventilate our homes in daily life. In some homes or classrooms ventilators are constructed near the ceiling. They are like windows high up in the walls. Have you ever seen them? The warm air inside the room rises and escapes through the openings near the ceiling. Fresh and cold air is drawn into the room through the doors and windows.

A. Ocean Currents and Winds

Coastal breeze is also produced by convection. During the day time, the sun shines equally on land and sea. As the land heats up more quickly than the sea. The hot air over the land rises and the cold air from the sea blows to replace it. Thus, there is a sea breeze during the day. At night the land cools more quickly than the sea. The hot air over the sea rises and the cold air from land blows towards sea to replace it. This movement of air is called land breeze.

Science tidbit

A radiator in a room heats up the room by convection not by radiation. Similarly, some hot gases from the fires in houses and factories rise up and escape through the chimneys.

B. Application of Convection Current

We know that hot air rises. Some birds can glide and fly for hours. Eagles and vultures glide for miles. Do you know how they do it? If the power does not come from their wings, where does it come from? Birds take advantage of upward movements of air called thermals. Riding thermals are great energy savers for birds when they can find them. The sun has to heat the ground enough for thermals to happen. Many large birds wait on the ground until 11 o' clock in the morning for the thermals to form.

Fig: 8.3: Bird using thermals to glide in air

These birds are resting on the piles of air that are moving upwards. Many birds find these thermals and use them for the upward push they give. These birds are gliding downward on a constantly rising current of air.

8.1.3 Radiation of heat

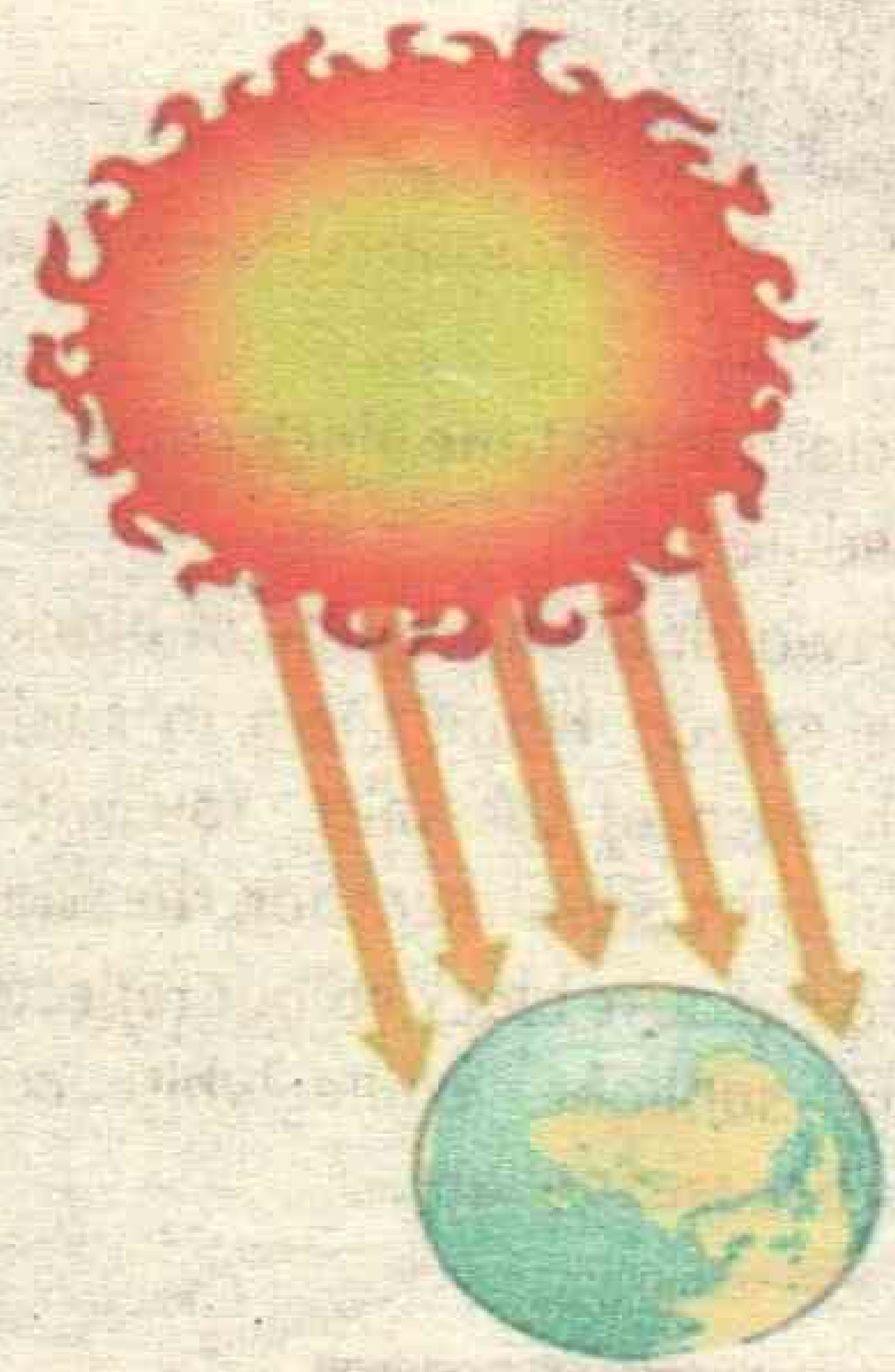


Fig 8.4: Radiation of heat

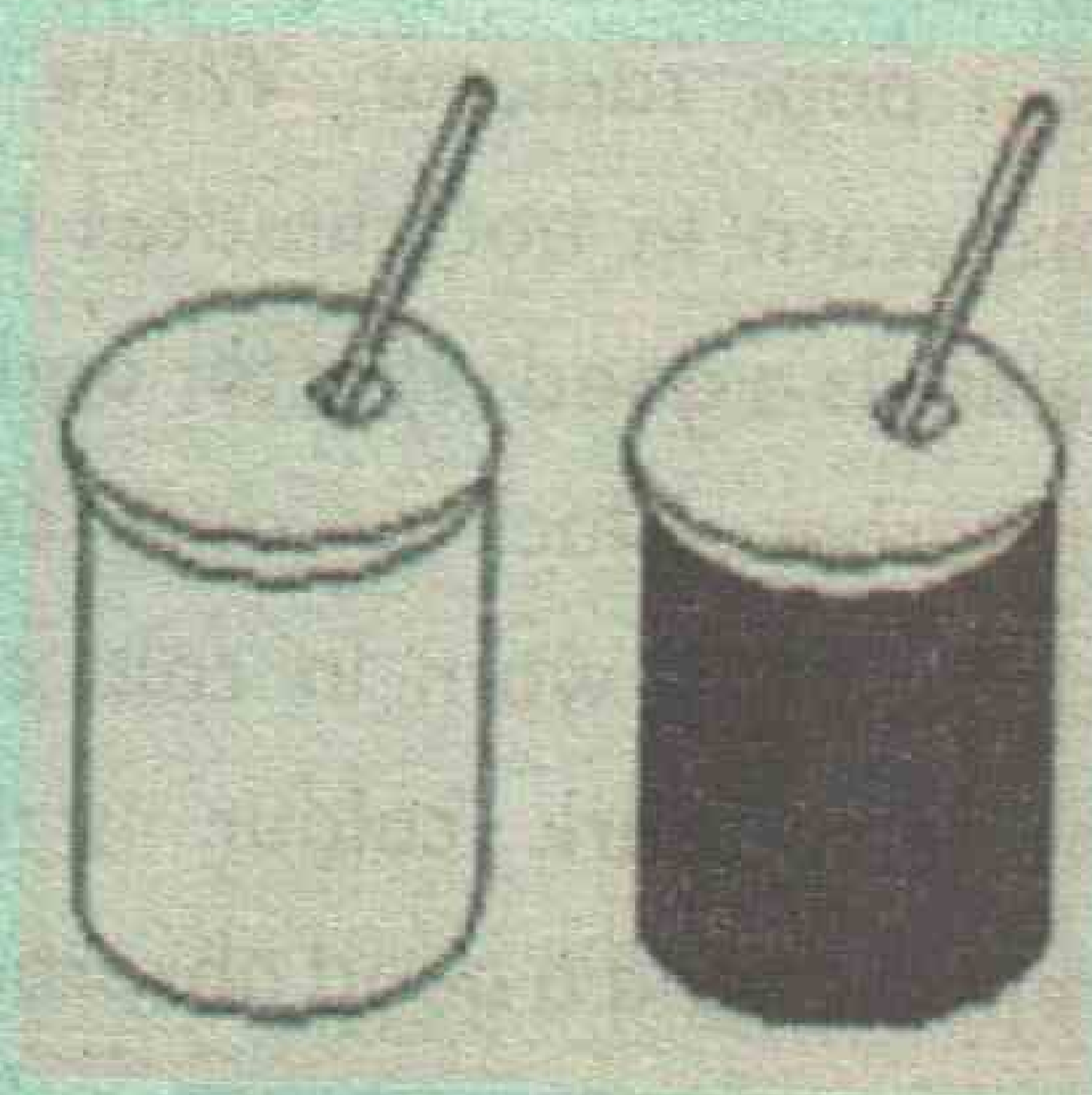
Sun heat reaches us through a mode of transfer called radiation. The heat and energy transfer from a hotter place to a colder place with or without having a material medium in between, is called radiation." All bodies, whether cold or hot radiate heat. A hotter body radiates more heat than an identical colder body.

Activity 8.3

To show dark colour surfaces radiate heat efficiently than the light colour surfaces:-

Apparatus:

2 tea cups (one of light colour surface and other of dark colour surface), 2 thermometers.



Procedure:

Take two tea cups, one of which has dark colour on outer surface and the other has light colour on outer surface.

Fill both the cups with warm water. Put the thermometers in each cup and note the temperatures. Take both the cups to a dark cool room. After 20 minutes again note the temperatures of water in both the cups. You will observe that the dark colour surface cup has low temperature than the light colour surface cup. It is so because dark colours absorb and radiate heat more efficiently than the light colours.

Activity 8.4

To show black colour surfaces are good absorber of heat.

Apparatus:

Two cloth shirts (one black colour and one white colour).

Procedure:

Take two cloth shirts, one of black colour and the other of white colour. Hang them in sunlight. After 20 minutes, touch each of the shirt. You will observe that the black colour shirt is warmer than the white colour shirt.

It is so because black colour reflects least and absorbs most of the sunlight. While white colour reflects most and absorb least sunlight.

Do you know

The solar heat energy reaching the earth each year is more than 10000 times than the world's energy needs.

A. Everyday Application of Radiation

In general, a good absorber is a good radiator and a poor absorber is a poor radiator. White clothes are worn in hot climates because white is a good reflector and a poor absorber. Black or dark coloured clothes are worn in cold climates because dark colour is a poor reflector and a good absorber.

Science tidbit

A body kept at constant temperature radiates as much heat to its surroundings as it receives from the surroundings. Some surfaces are better absorbers of radiation than others. A dull black kettle absorbs more heat than others. Some surfaces are better emitters of radiation than others. A black saucepan cools down quickly than any other.

8.2 Vacuum flask

A vacuum flask or a thermos flask is a type of flask that aims to stop all three forms of heat transfer; conduction, convection and radiation.

A thermos flask prevents heat transfer through conduction and convection using a partial vacuum between two containers, one placed within the other. This partial vacuum prevents the transfer of thermal kinetic energy between the molecules within the flask and those outside it, making it suitable for keeping chilled drinks cold and hot drinks warm. The inner flask is often made from glass of low thermal conductivity to further aid in preventing conduction. Flasks may also feature a silver coating that prevents heat transfer through radiatior

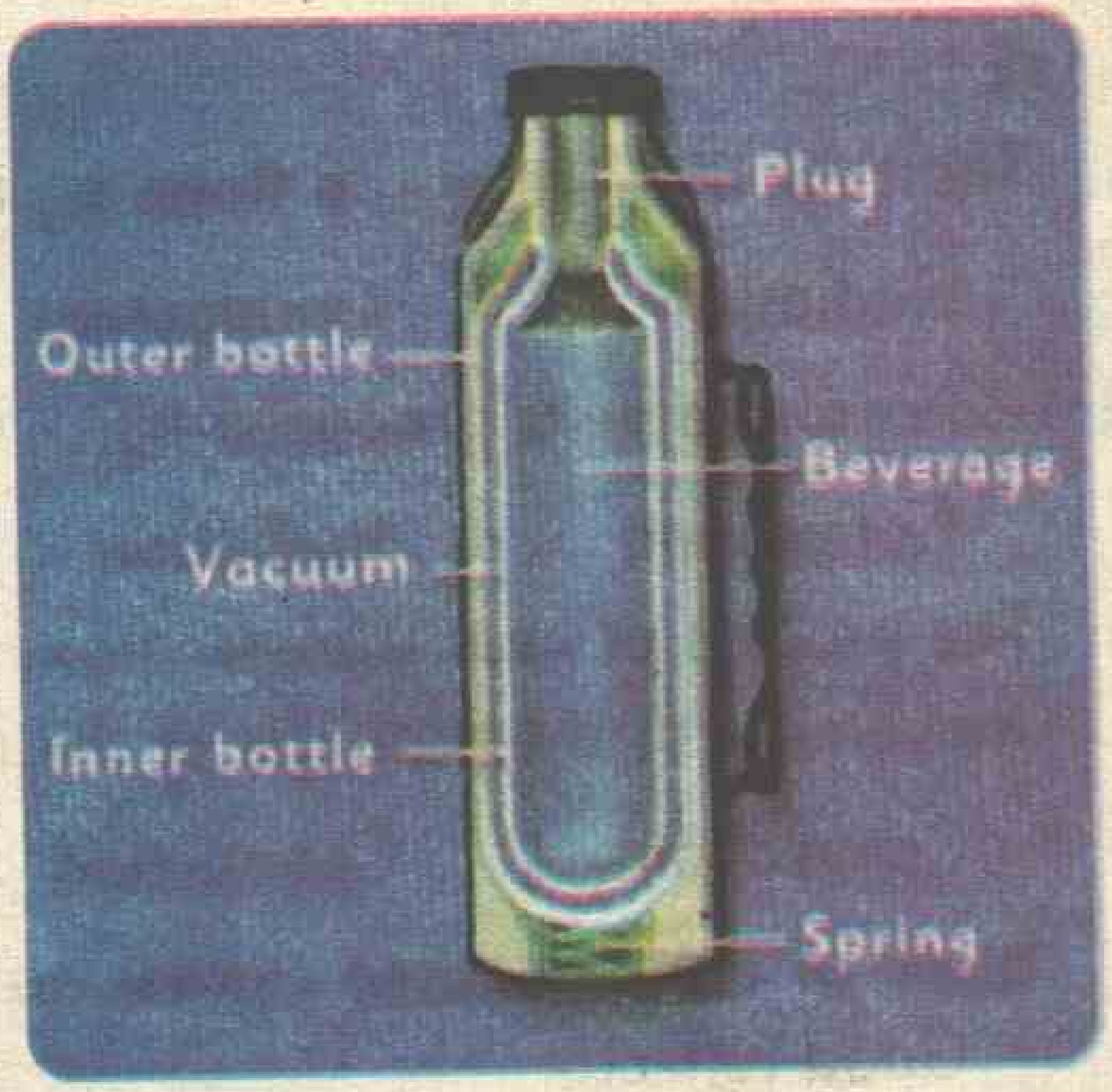


Fig. 8.5 Thermos flask

Science tidbit

The flask is made in such a way that radiation is reflected back of the side, which is made up of a shiny material. Also, the flask is not transparent; it is made of an opaque material, usually plastic or metal. The only way radiation can escape is by the lid being taken off.

Key points

- Heat is a form of energy that transfers from hotter objects to colder objects because of temperature difference.
- Conduction, convection and radiation are three different modes of heat transfer.
- In conduction, the molecules vibrate about their central points.
- In convection, molecules are free to move about.
- Convection occurs only in liquids and gases.
- Coastal breeze is produced by convection.
- Radiation of heat can occur with or without a material medium.
- Vacuum flask is a type of flask that aims to stop all three forms of heat transfer.

Exercise

A. Colour the circle for the best suitable answer.

i. The heat in a metal rod flows by the process of:

- ○ Radiation ○ Conduction ○ Convection ○ Magnetization

ii Coastal breeze is produced by:

- ○ Convection ○ Radiation ○ Conduction ○ Rain

iii. The process of heat transfer from a hotter place to a colder place by actual movement of the particles of the medium is known as:

- ○ Convection ○ Conduction ○ Radiation ○ Evaporation

iv Black or dark coloured clothes are worn in cold climates because these are:

- ○ Good reflector ○ Good reflector and poor absorber
- ○ Poor absorber ○ Poor reflector and good absorber

v. Convection occurs only in:

- ○ Liquids and gases ○ Solids and gases
- ○ Liquids and solids ○ Liquids and metals

B. Write down the short answers to the following questions.

i. Can conduction of heat takes place in vacuum? Explain your answer.

ii. Suggest why convection cannot happen in solids?

iii. Why radiation is so important in our life?

iv. Write the names of three appliances that make use of different modes of transfer of heat?

v. Why are cooking vessels made up of metals?

B. Write answers to the following question.

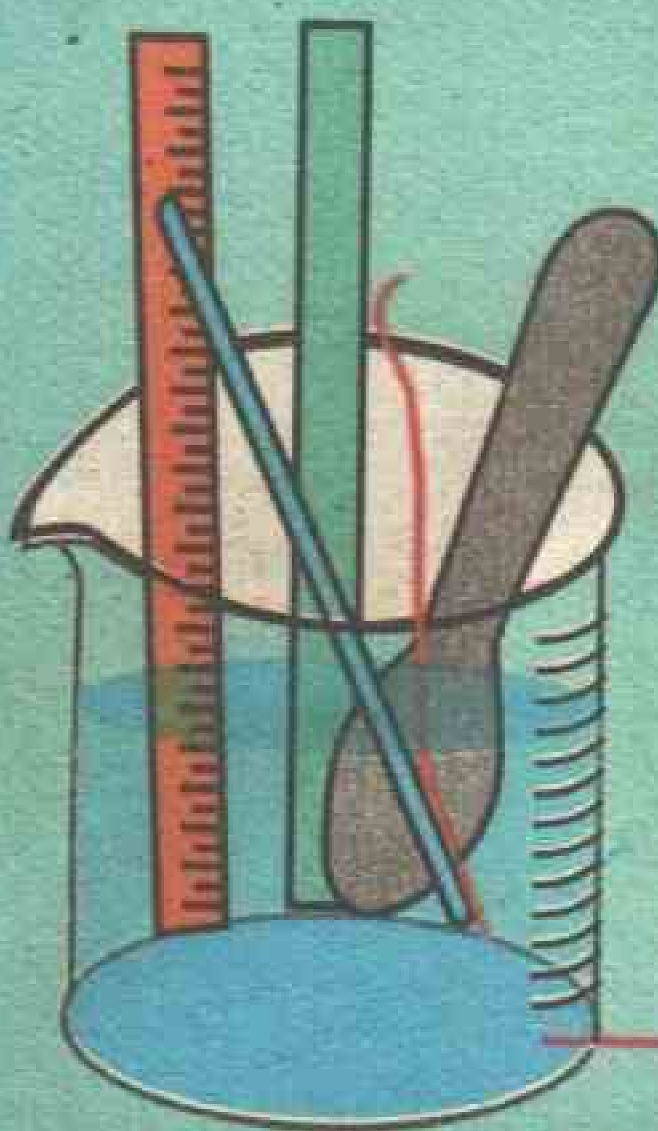
I. State a simple experiment you could do to explain conduction, convection and radiation?

ii. Explain the importance of convection currents in blowing coastal breeze and bird's gliding in the air.

iii. Describe the working and principle of vacuum flask.

Activity 8.5

To separate the heat conductors and insulators



Material require

- Beaker
- Hot water
- Thick copper wire piece.
- Steel spoon
- A glass rod
- A plastic spoon
- A wooden scale

Steps

1. Take some hot water in a beaker.
2. Dip one end of each of above things i.e copper wire, glass rod, plastic spoon, steel spoon and wooden scale in the hot water.
3. Wait for 2-3 minutes.
4. Then touch the other end of each article with your finger.
5. Separate the articles which become hot (conductors of heat) and which do not (Insulators of heat).

Unit 9

Dispersion of Light

At the end of this unit, the students will be able to:

- Explain refraction of light and its causes.
- Discuss the effects of refraction with examples.
- List the colours of light using a prism.
- Describe the dispersion of light by a prism.
- Identify different uses of lights of different colours at home, school and country and explain the relationship of choice of colours to their purpose.
- Define spectrum of light.
- Identify primary colours and show how they are combined to form secondary colours.
- Identify a device in their surroundings that uses different combinations of colours.
- Demonstrate how spinning of a rainbow results in the appearance of white disc.
- Explain why an opaque or non-luminous object appears to be of certain colour.

Introduction

In previous grades, you have learnt that light cannot travel through an opaque materials, however, it can travel through any transparent medium such as air, vacuum, glass or water. You already know that in a given transparent medium light travels in a straight line. Moreover, you have also learnt about a few properties of light such as transmission, absorption and reflection of light. In this unit, you will learn about some more properties of light i.e. refraction and dispersion of light.

9.1 Refraction of Light

Light travels with different speeds in different transparent media. The medium in which light travels fast, is called rare medium and the medium in which light travels slow, is called denser medium. Air is rare than water and water is rare than glass. Light travels fastest in vacuum.

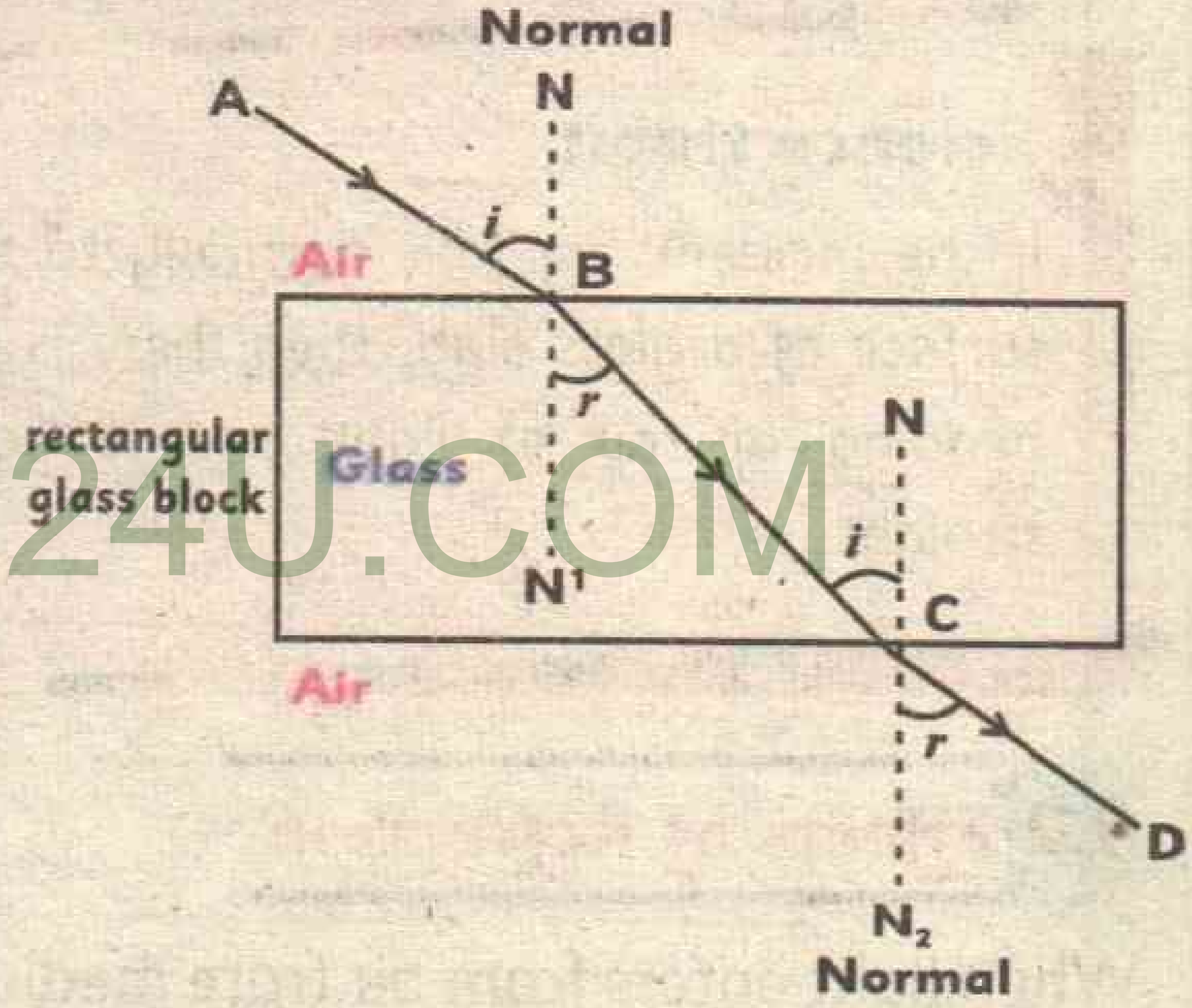


Fig. 9.1 Refraction of light

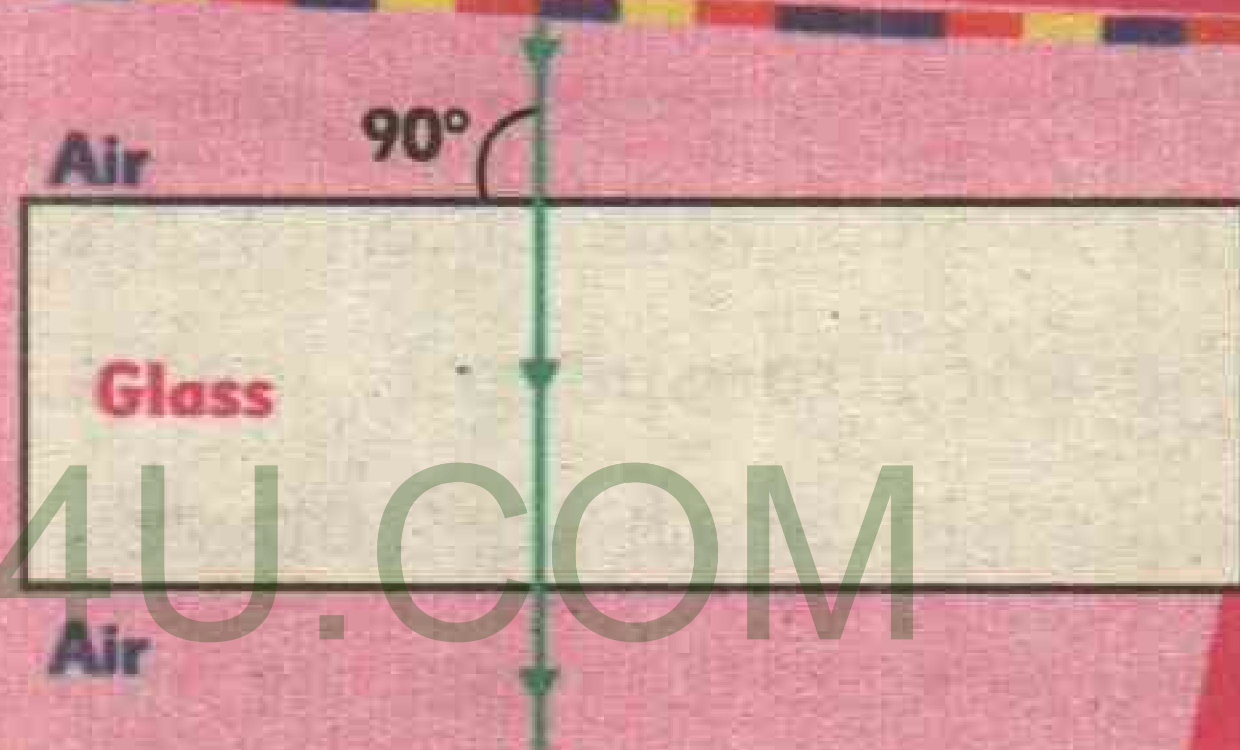
Science tidbit

Incident Ray: The light ray that strikes a surface.
Refracted Ray: The light ray that bends in the second medium.
Normal: An imaginary perpendicular line which is drawn at the point of incidence of light ray.
Angle of Incidence: An angle which incident ray makes with the normal, denoted by 'i'.
Angle of Refraction: An angle which a refracted ray makes with the normal, denoted by 'r'.
Rare medium: Where particles of the medium are not so closed.
Denser medium: Where particles of the medium are closely packed.

When light enters from one medium to another, it bends slightly from its original path. This bending of light from its original path is called refraction of light. Refraction of light occurs due to change in the speed of light in the two media. When light enters from rare medium to denser medium, it bends towards normal and if it enters from denser medium to rare medium it bends away from the normal. Figure 9.1 shows a light ray that bends towards normal as it travels from air into glass and bends away from the normal as it travels from glass into air. In first case, the angle of refraction is smaller than the angle of incidence while in second case, the angle of refraction is greater than the angle of incidence.

Science tidbit

If the incident ray falls normally to the surface of a glass slab, then there is no bending of ray of light and it goes straight.



9.2 Effects of Refraction

When light enters from air (rare medium) into water (denser medium), its speed slows down and refracts. The example of this effect can be observed, if a pencil is immersed in a glass of water, it looks bent where it enters the water, as shown in figure 9.2. Similarly, when light enters from water into air, its speed increases and it refracts. The example of this phenomenon can be seen in a water tank, where a brick and the bottom of the tank seem much closer than they really are, as shown in figure 9.3.

Fig 9.2 Pencil immersed in a water glass

Fig 9.3 Brick in the water

The depth at which an object (brick) is actually lying in the water is called real depth whereas, the depth at which an object seems to a person closer due to refraction, is called apparent depth.

Science tidbit

Why the boat-man appears to be rowing with broken oars?

9.3 Laws of Refraction and Refractive Index

Following are the two laws of refraction:

1. The incident ray, the refracted ray and the normal at the point of incidence, all lie in the same plane.

2. The ratio of the speed of light in air or vacuum to its speed in another transparent medium is always constant. This ratio is called refractive index of a transparent medium.

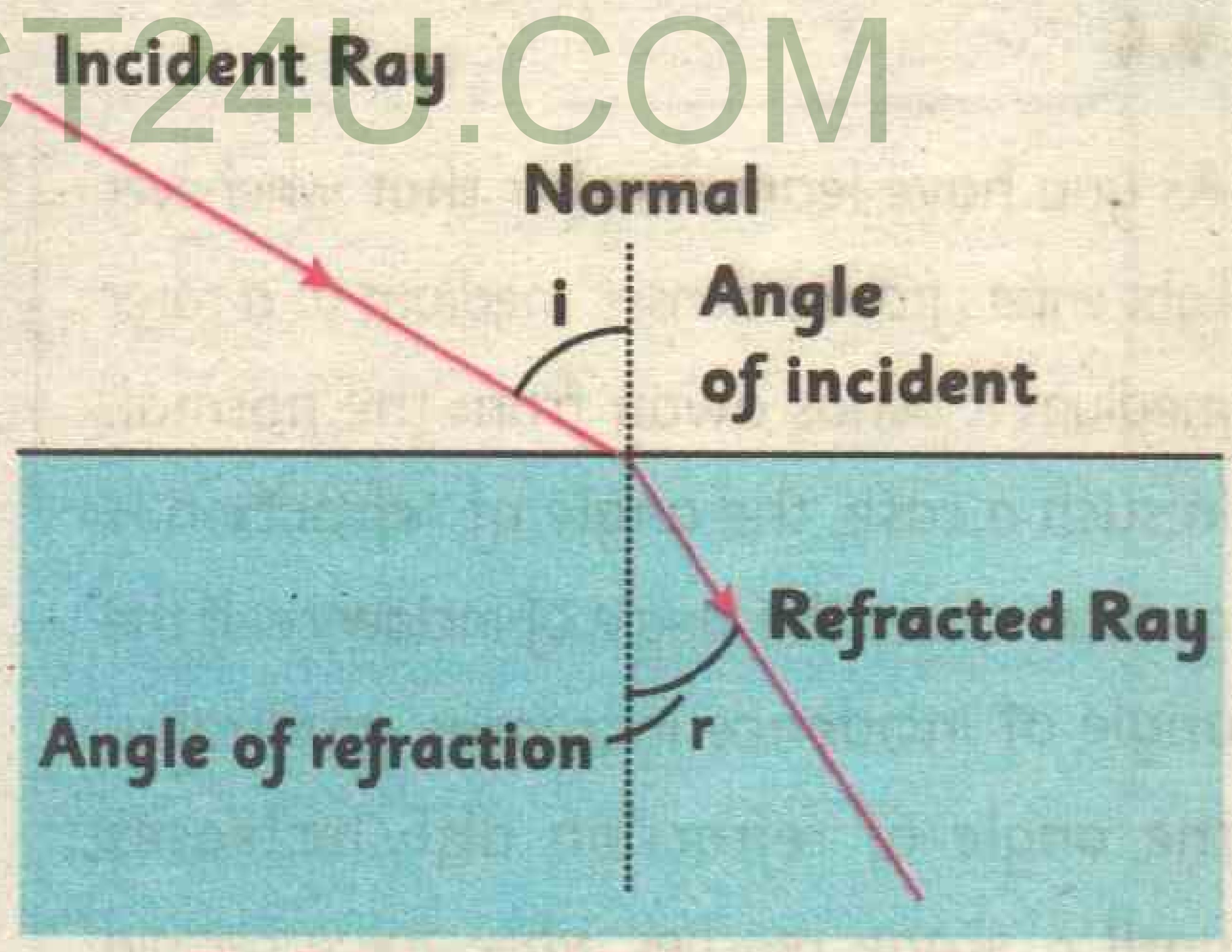


Fig 9.4 Law of Refraction of light

Thus refractive index of a transparent medium = $\frac{\text{speed of light in air or vacuum}}{\text{speed of light in the medium}}$

The refractive index determines the degree to which a medium can bend light.

Let us take glass as the medium and calculate its refractive index. The speed of light in air is $3 \times 10^8\ ms^{-1}$ and the speed of light in common glass is $2 \times 10^8\ ms^{-1}$. So,

$$\text{Refractive index of glass (n)} = \frac{\text{speed of light in air or vacuum}}{\text{speed of light in the glass}}$$

Refrective index of glass can be calculated as:

$$n = \frac{3 \times 10^8}{2 \times 10^8}$$

or $$n = \frac{3}{2}$$

or $$n = 1.5$$

Therefore, the refractive index of this glass is 1.5.

Science tidbit

The refractive index of air is 1.0003
The refractive index of ice is 1.31
The refractive index of water is 1.33
The refractive index of crown glass is 1.52
The refractive index of diamond is 2.42

9.4 Critical Angle

As you have learnt earlier that whenever light enters from a denser medium to a rarer medium it bends away from the normal. In such a case, the angle of refraction is greater than the angle of incidence. If the angle of incidence increases gradually, the angle of refraction also increases until a stage reaches when for a certain angle of incidence, the angle of refraction becomes 90°. This is the stage of maximum refraction. The angle of incidence for which the corresponding angle of refraction is 90° is called critical angle.

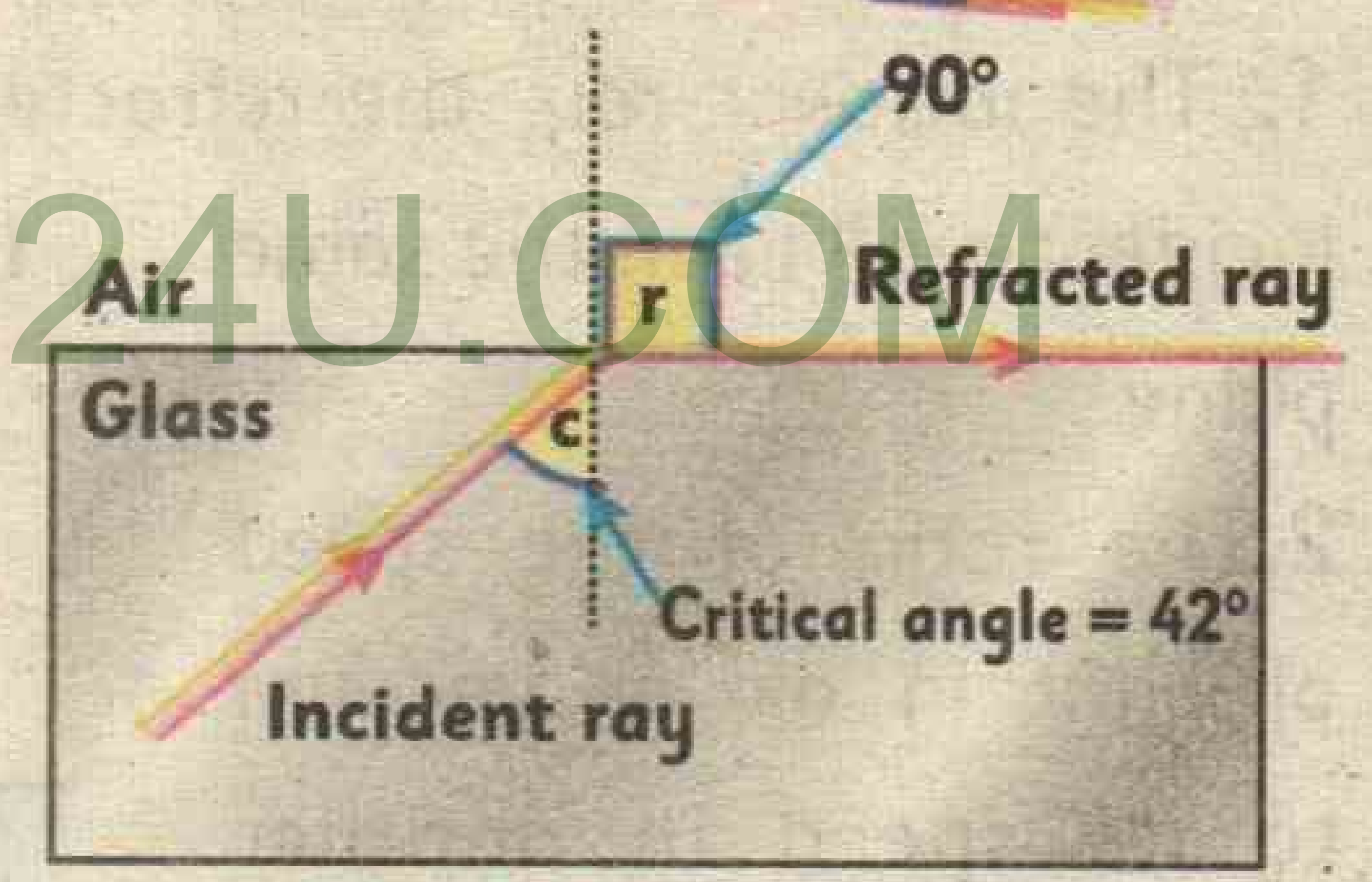


Fig 9.5 Critical angle

Science tidbit

The critical angle for water is 49° and for glass is 42°

9.5 Total Internal Reflection

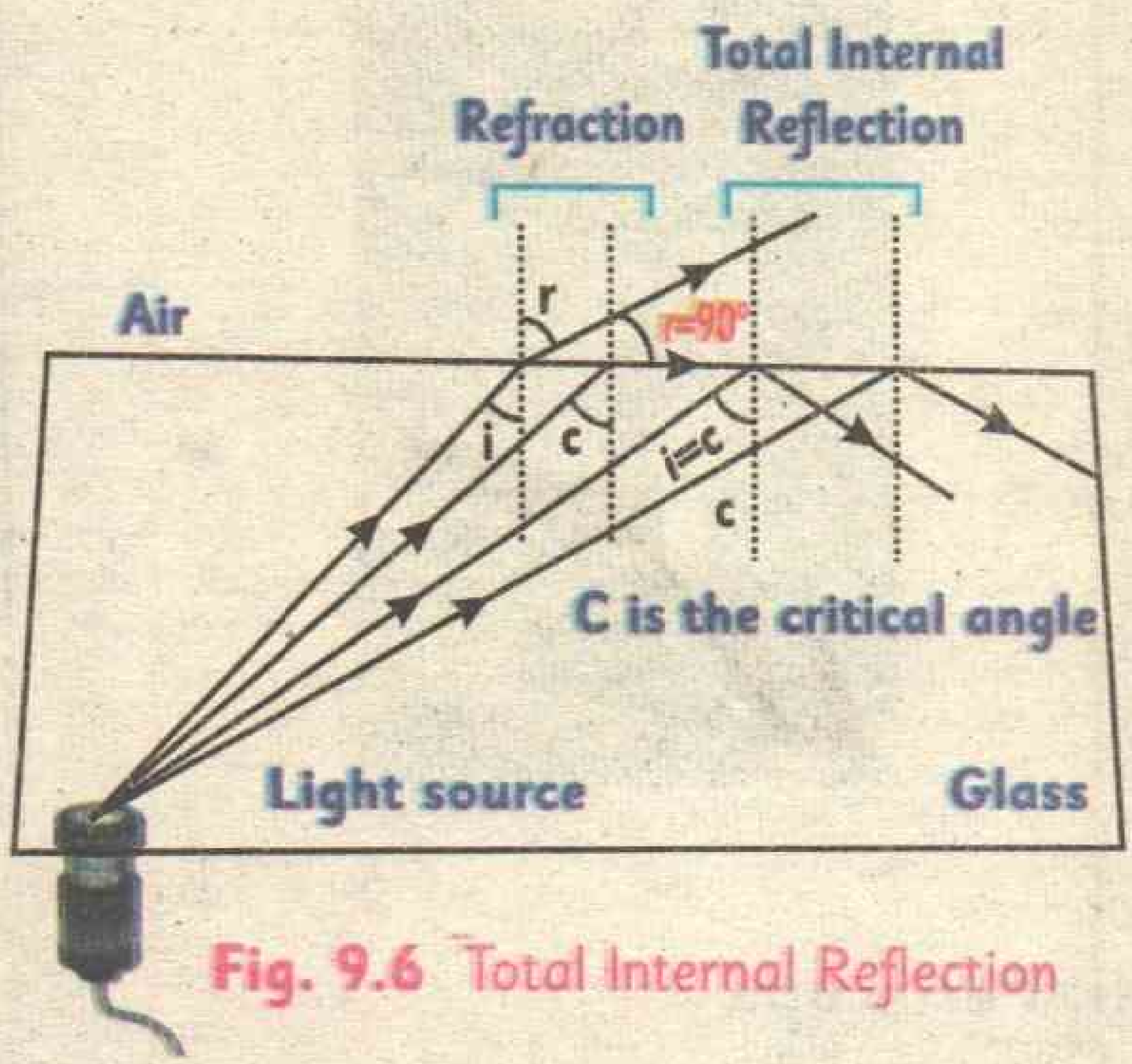


Fig. 9.6 Total Internal Reflection

Whenever light enters from a denser medium to a rarer medium it refracts away from the normal. At the critical angle of denser medium maximum refraction occurs. However, when the angle of incidence of light becomes greater than the critical angle, then no refraction of light occurs rather the light reflects back in the same denser medium. Such a reflection of light in the same medium is called total internal reflection. Total internal reflection occurs under the following conditions:

i. Light must enters from a denser medium to rarer medium.
ii. The angle of incidence must be greater than the critical angle of denser medium.

9.5.1 Applications of Total Internal Reflection

i. Reflecting Prism

A reflecting prism is made of transparent material (glass) which has three rectangular surfaces and two triangular surfaces. Each triangular surface has one angle of 90° and other two angles of 45°. The critical angle of glass is 42°. When a light ray enters the prism perpendicularly, it meets the hypotenuse at angle 45°. As the angle of incidence is greater than the critical angle of glass, so the light ray undergoes total internal reflection. This reflected ray strikes the other face of prism perpendicularly and thus comes out unrefracted from the prism. This phenomenon is used in several optical instruments.

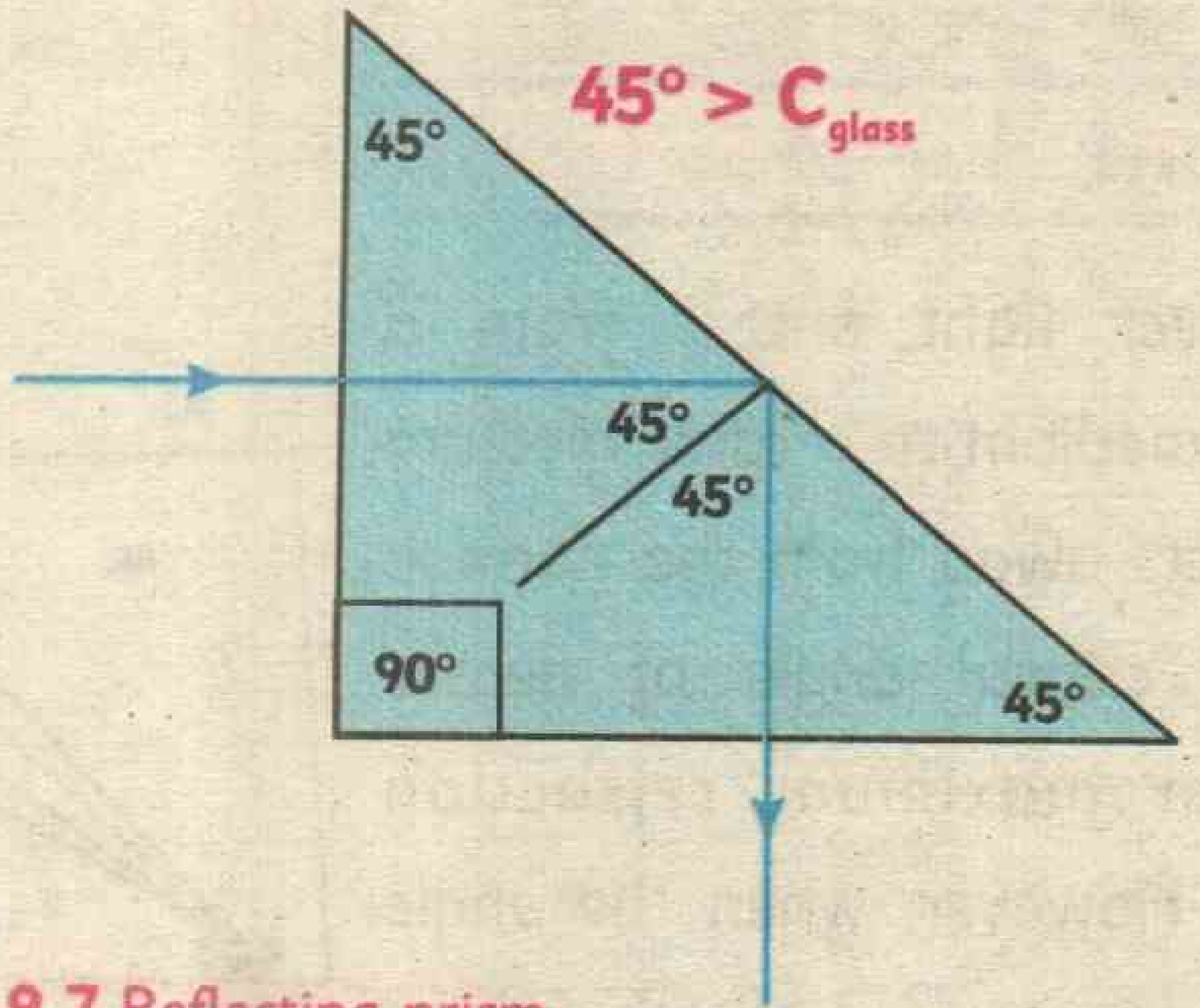


Fig. 9.7 Reflecting prism

ii. Periscope

A periscope is an optical instrument used to see the objects which are above the level of the viewer or which cannot be seen directly. A simple periscope consists of a tube which has two reflecting prism at its both ends. It works on the principle of total internal reflection. When the light rays coming from the object strikes the first prism, it sends the light rays towards the second prism through the process of total internal reflection. The second prism sends these light rays towards the viewer through the process of total internal reflection. Thus the viewer is able to see the image of the object which cannot be seen directly. Periscopes are used in tanks, submarines, etc.

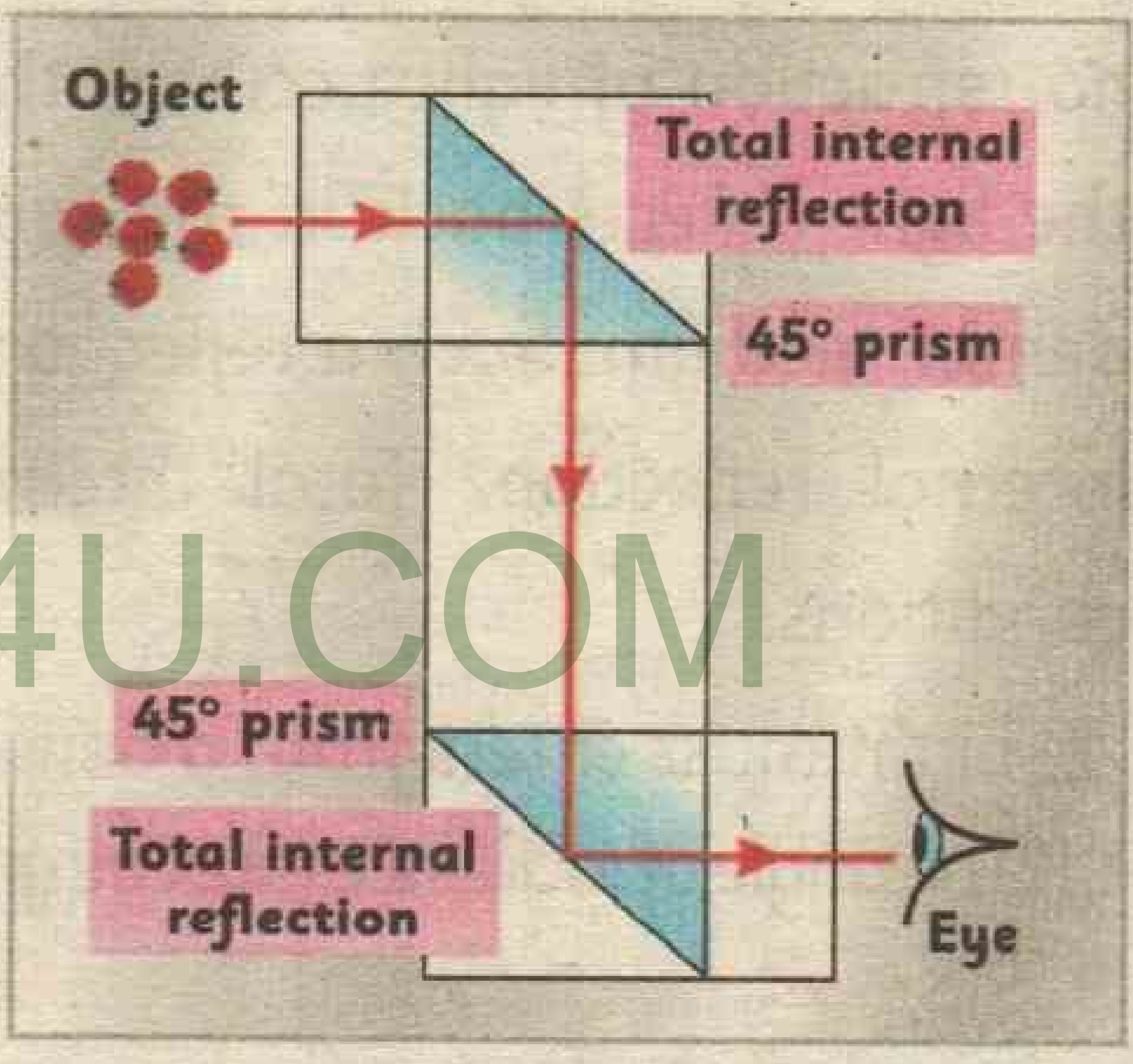


Fig. 9.8 A Periscope

Activity 9.1

Identify different uses of lights of different colours at home, school and country and relate the choice of colours to their purposes.

(Teacher should facilitate the students in this activity)

iii. Mirage

A Mirage is a natural optical phenomena in which we see an inverted image of the distant objects on road and desert during hot summer days due to total internal reflection. Mirages happen when the ground is very hot and the air is cool. In deserts during day time, the sand becomes hot due to the heat of sun. The hot ground warms a layer of air just above the ground. When the light moves through the cold air into the layer of hot air it is refracted (bent). When these rays enter the eye of a traveller, the inverted image of the tree is seen (Fig. 9.9) and the sand appears like a lake or pond of water. However, this phenomenon is only an optical illusion.

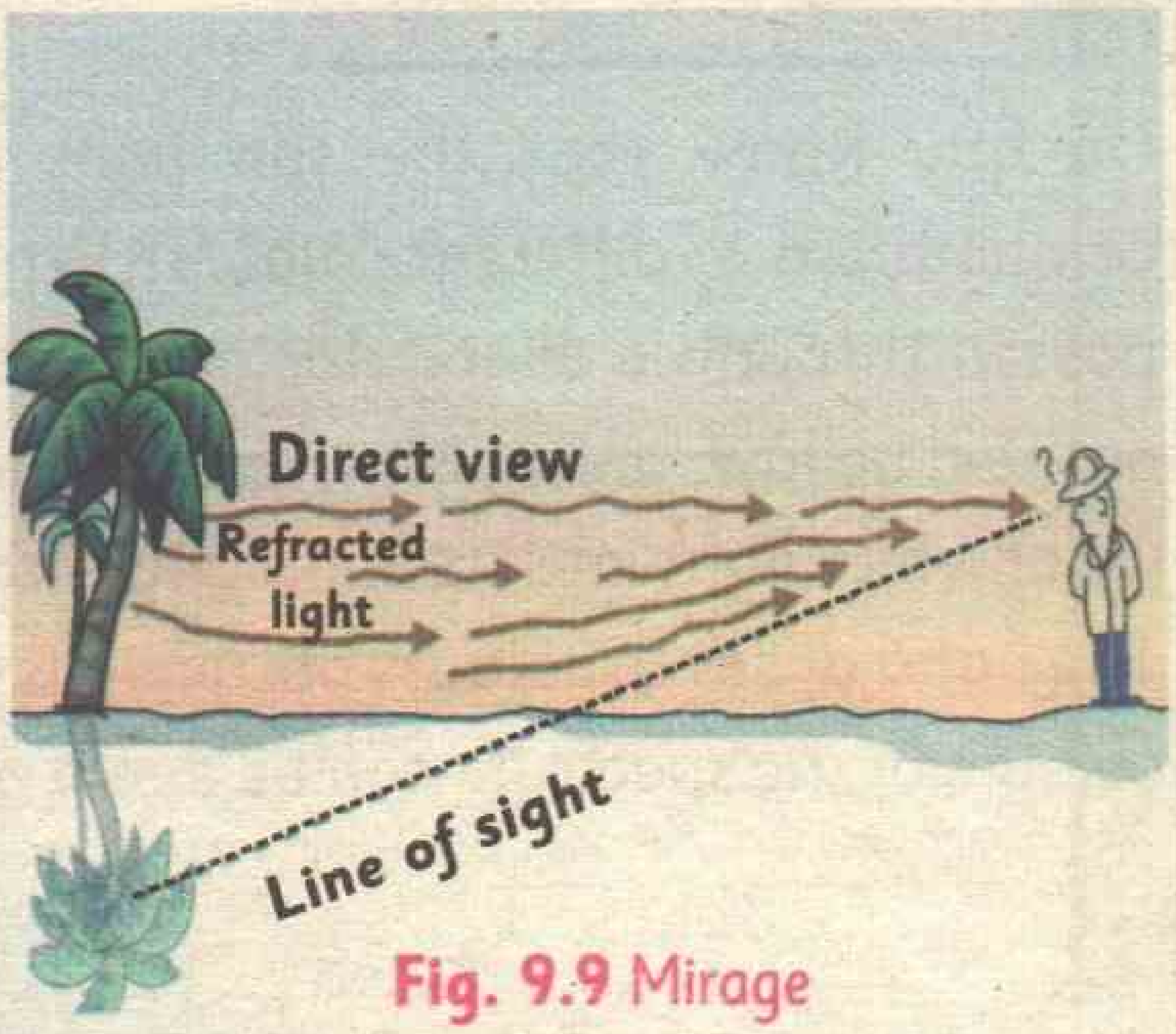


Fig. 9.9 Mirage

iv. Fish Eye View

You know that when light passes from water (denser medium) to air (rare medium), it bends away from the normal. When the angle of incidence becomes greater than 48° (Critical angle of water), the phenomenon of total internal reflection occurs. Due to this total internal reflection, a fish or a diver is able to see the objects in the sides and bottom of a pond. While due to refraction, the fish or a diver is able to see the objects outside the water.

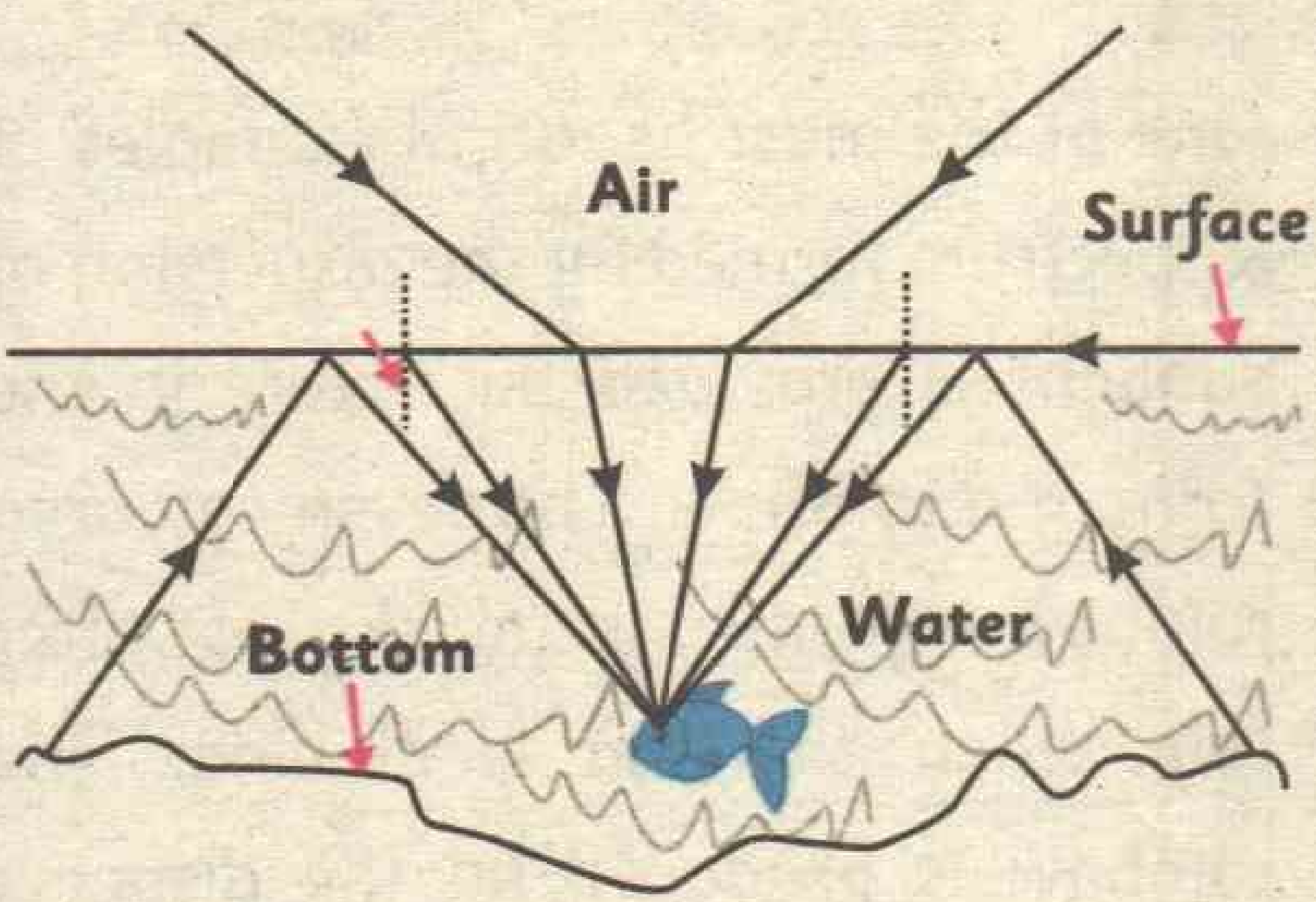


Fig. 9.10 Fish Eye View

9.6 Dispersion of Light

Do you know that the sun light is called white light and it is the combination of different colours? When a beam of white light (sun light) is passed through a triangular prism, it splits up into seven colours i.e. red, orange, yellow, green, blue, indigo and violet. The phenomenon of splitting up of white light into its component colours, is called **dispersion of light.** The band of seven colours obtained is called **spectrum of light.** The seven colours of the spectrum can be denoted by VIBGYOR.

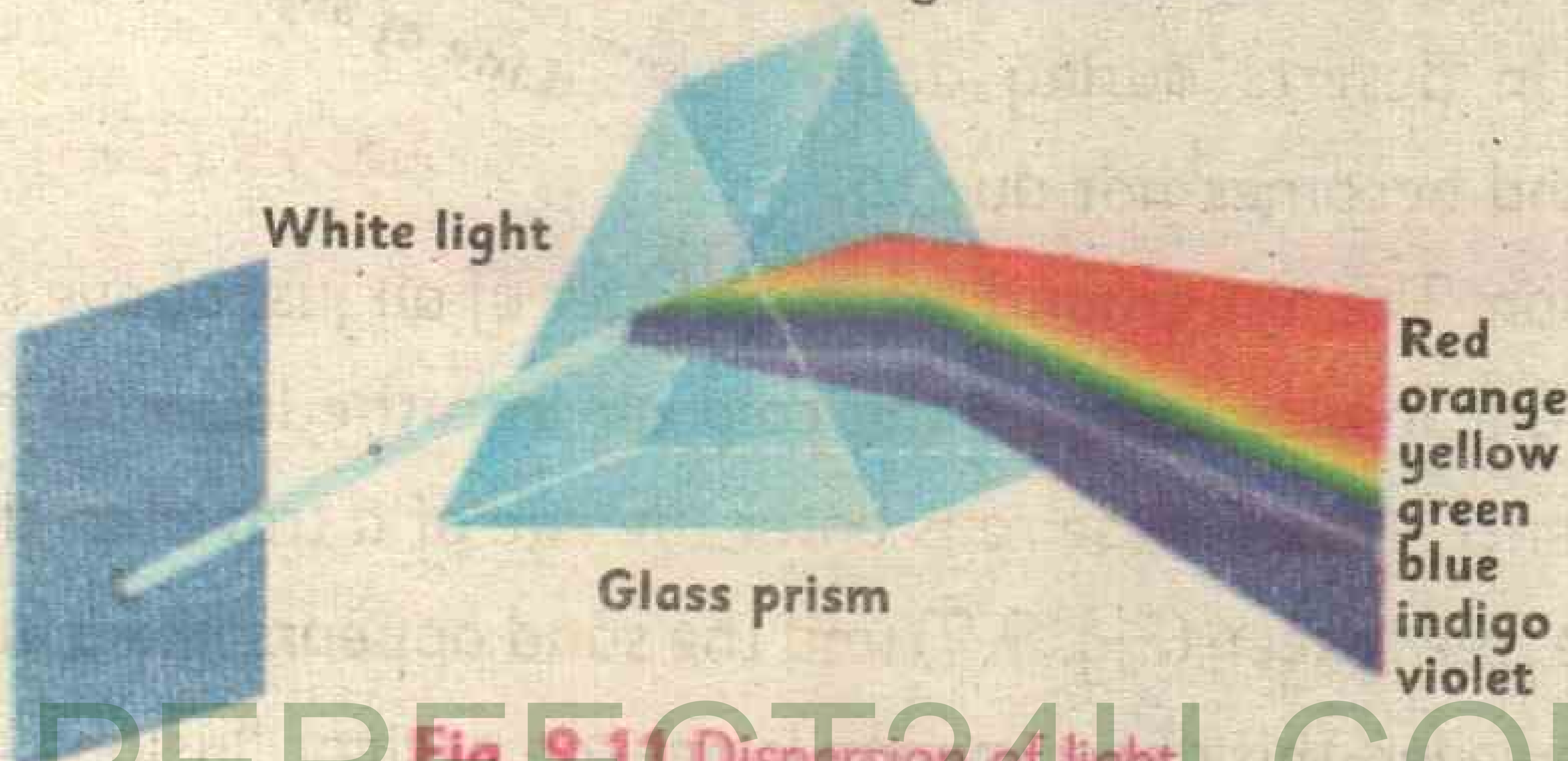


Fig. 9.11 Dispersion of light

9.6.1 The Rainbow Formation

Fig. 9.12 Rainbow formation

One of the most beautiful examples of a spectrum formed by the dispersion of sunlight is provided by nature in the form of a rainbow. The seven coloured rainbow is formed in the sky just after rain when the sun is shining. The rainbow is produced by the dispersion of sunlight by tiny rain drops suspended in the air, which act like many small prisms. Red colour appearing on the upper side of the rainbow and violet on the lower side. The formation of rainbow in the sky shows that white sunlight consists of a mixture of visible colours.

9.6.2 Colours of Light

i. Primary Colours of Light: The colours that can be used to make any other colour are called primary colours. Red, Green and Blue are called primary colours of light (or basic colours of light). All the other colours can be obtained by mixing these three colours in different proportions.

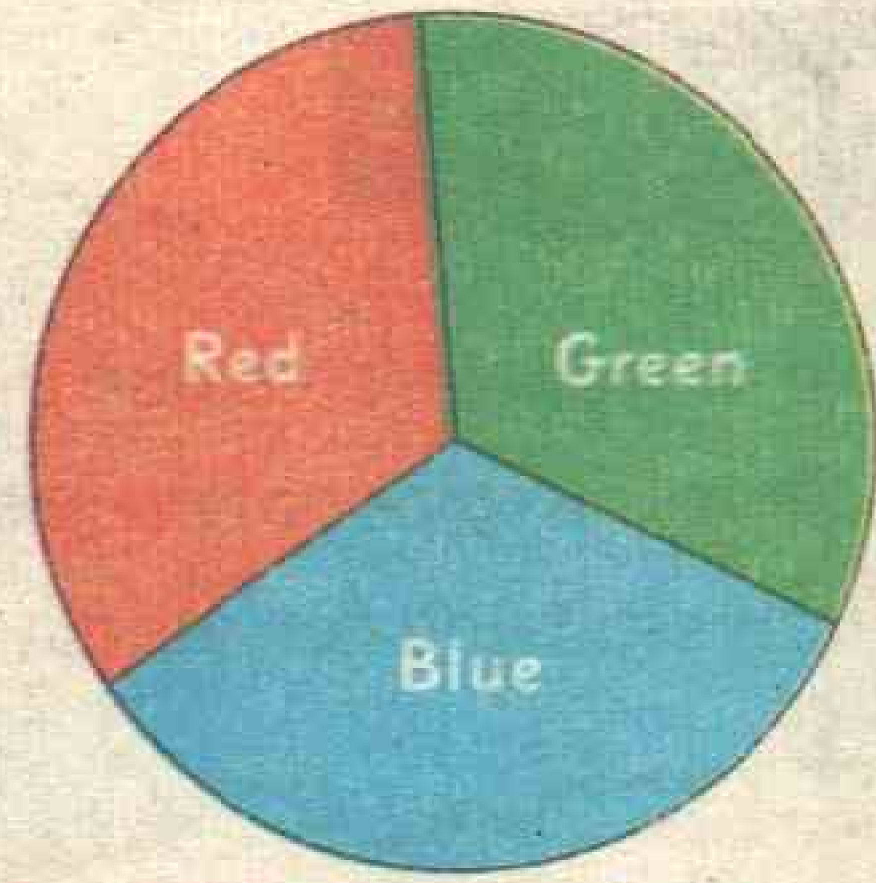
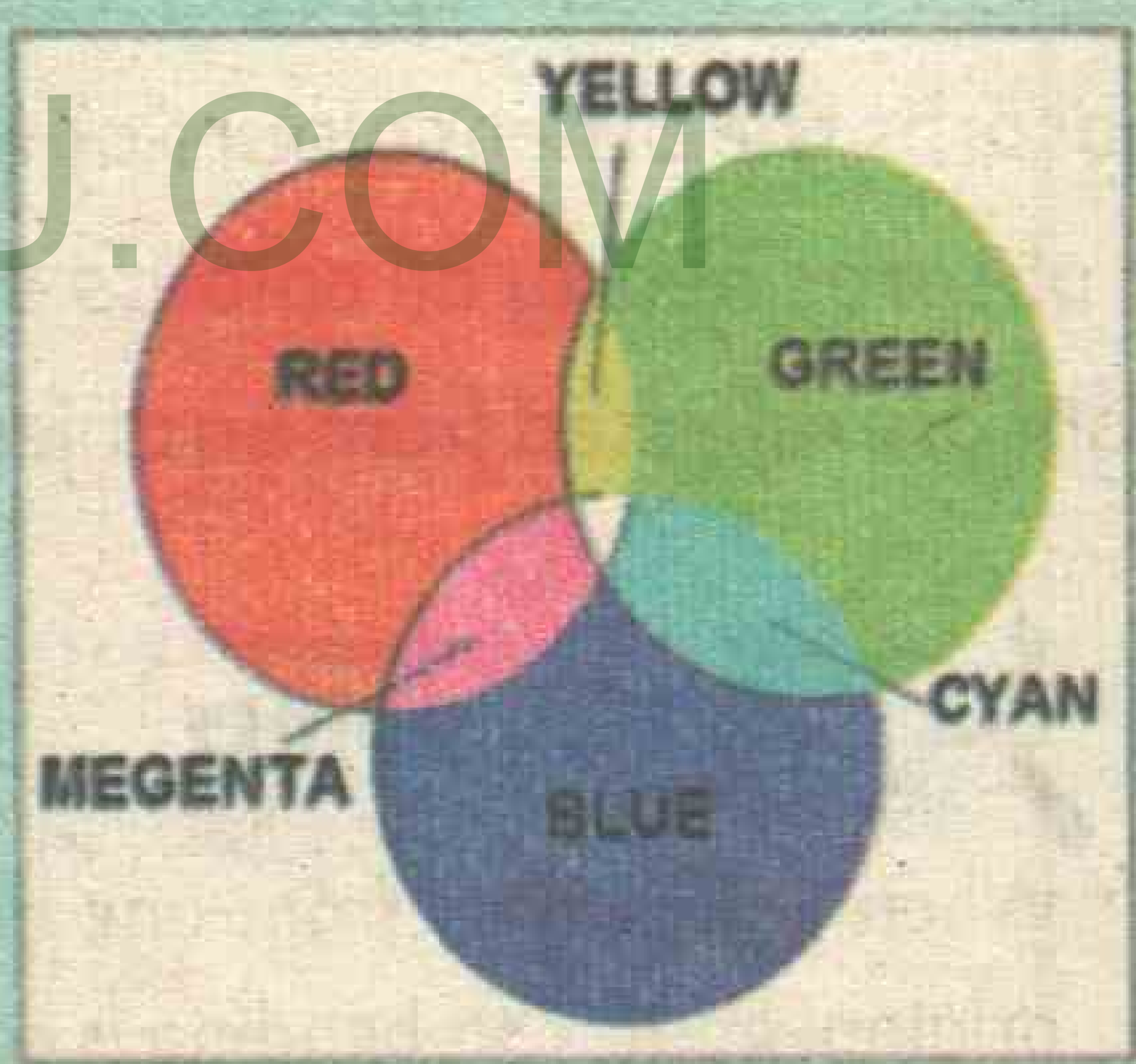


Fig. 9.13 Primary Colours

ii. Secondary Colours of Light: The colours produce by mixing any two primary colours are called secondary colours. Thus, magenta, peacock blue (or cyan) and yellow are secondary colours or composite colours.

Activity 9.2

The effect of mixing coloured lights can be seen by using three torches whose glasses are covered with red, green and blue cellophane papers so that they give out red, green and blue lights respectively. When the red, green and blue lights (given out by the three torches) are reflected on a white screen placed in a dark room, their colours overlap and produce new colours as shown in Fig.



Secondary Colours

It has been found that:

Red + Blue = Magenta

Blue + Green = Peacock Blue (or Cyan)

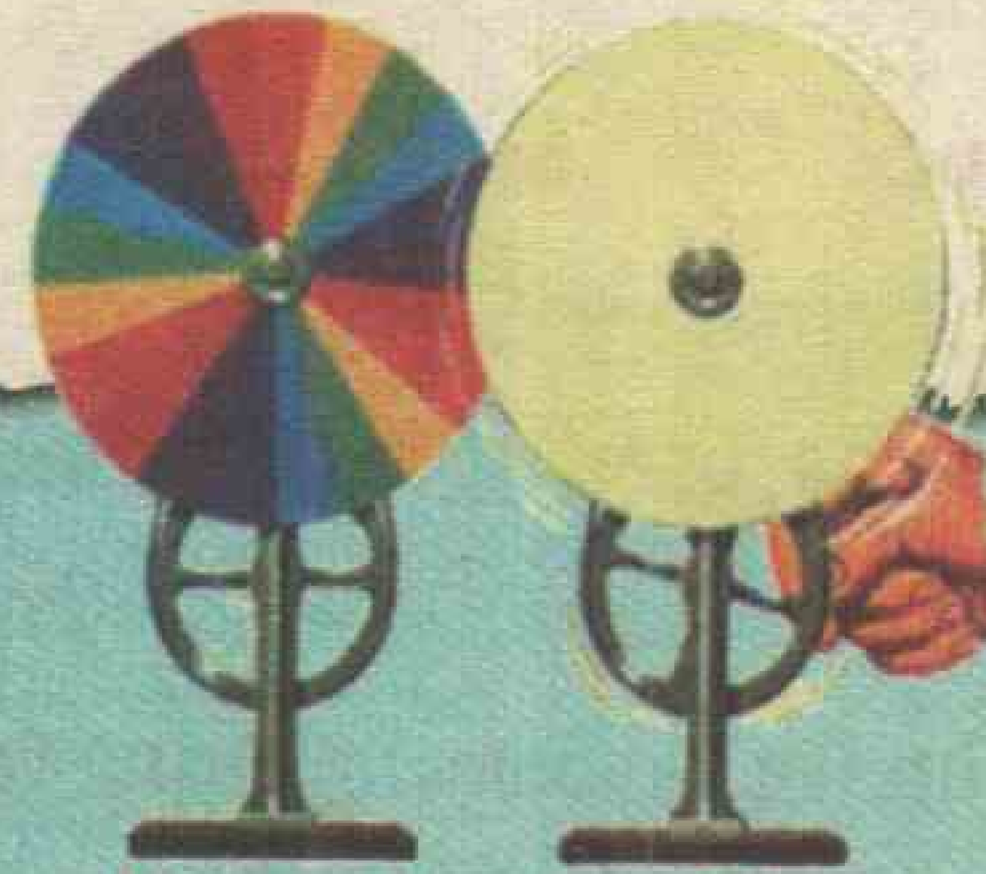
Red + Green = Yellow

9.7 Newton colour disc

A Newton disc is a device which is divided into sections, each of which has the rainbow colours. With the help of this device, Newton demonstrated that white light is a combination of the seven different colours found in a rainbow.

Activity 9.3

Take a Newton's colour disc. Rotate it rapidly and observe the colour of the disc during rotation.
What result you can obtain from this demonstration?



Newton's colour Disc

9.8 Colours of Objects

When white light falls on an opaque or non-luminous objects they reflect some of the colours while absorb the rest of the colours. The colour of an object is the colour which it reflects. For example, a leaf looks green because it absorbs nearly all the colours and reflects only green colour of light. A red car appears red because it reflects red colour of light and absorbs the other colours of white light. A black board looks black because it absorbs nearly all colours of light. Similarly, when all the colours of white light are reflected from an object into our eyes, the object looks white.

Key points

- When light enters from one medium into another, it bends slightly from its original path. This bending is called refraction of light.
- Rainbow is the spectrum of seven colours.
- Red, orange, yellow, green, blue, indigo and violet are the component colours of white light.
- The colour of an object is the colour of light it reflects. A red flower reflects red colour and appears red.
- Red, green and blue are called primary colours of light (or basic colours of light), because all the other colours can be obtained by mixing these three colours in suitable proportions.

Exercise

A. Colour the circle for the best suitable answer.

i. When light enters from one medium into another, it bends slightly from its original path. This bending is called:

- ○ reflection
- ○ refraction
- ○ dispersion
- ○ total internal reflection

ii. When light enters from air into glass it bends reflection

- ○ towards normal
- ○ away from normal
- ○ does not change the path
- ○ all the light is reflected

iii. After rain, when sunlight falls on tiny rain drops suspended in the air, rainbow is produced due to:

- ○ reflection of light
- ○ refraction of light
- ○ dispersion of light
- ○ diffraction of light

iv. The primary colours of light are:

- ○ red, green, yellow
- ○ red, green, blue
- ○ red, yellow, blue
- ○ green, yellow, blue

v. In the deserts, mirage is seen due to which phenomenon:

- ○ reflection
- ○ refraction
- ○ diffraction
- ○ total internal reflection

B. Write down the short answers to the following questions.

i. A coin that cannot be seen at the bottom of a cup, comes into view if water is poured into that cup. Use diagrams to explain this illusion.

ii. Explain the phenomenon of "mirage".

iii. A beam of light travelling in a block of glass emerges into air. Draw a ray diagram indicating the change in its path.

iv. What happens, when you pass the white light through the prism? Identify colours list for this.

v. What colours are obtained by mixing the following colours?

(i) Red and Green (ii) Red and Blue (iii) Blue and Green

C. Write down the detailed answers to the following questions.

i. Explain refraction of light, its effects and laws of refraction.

ii. What is meant by total internal reflection? Write down any two applications of it with diagrams?

iii. Define dispersion of light. How it helps in rainbow formation?

Project

To show that a white light is a combination of seven colours.

Material required:

Glazed papers of different colours (yellow, green, blue, indigo, violet, red and orange.) A string and A cardboard.

Procedure:

1. Cut cardboard into circle. Paste equal-sized pieces of glazed papers of seven colours on it as shown in the figure.
2. Make two holes near the centre of the cardboard.
3. Make a loop of a string through these holes.
4. Hold the two ends of the loop into your hands and also twist the string strongly.
5. Let loose the string and stretch your hands in and out alternately.
6. Repeat this again and again.
7. The cardboard will start revolving.
8. Watch the revolving cardboard carefully and observe either still you can see the different colours on the cardboards or any new colour form.

Unit 10

Sound Waves

At the end of this unit, the students will be able to:

- Explain the wavelength, frequency and amplitude of sound and give their units.
- State factors on which sound depends.
- Investigate objects in home and surroundings that are designed and made to produce different sounds.
- Compare audible frequency range of humans and different animals.
- Design a musical instrument to explain the relation between its sound and shape.
- Identify the applications of different sounds in daily life.

Introduction

In previous grades, you have already learnt that whatever be the kind of sound, it is produced by a vibrating object. On the basis of previous knowledge you know that sound can travel through a material medium (solid, liquid or gas) but cannot travel through a vacuum. That is the reason we do not hear the sounds of the explosions that occur in the core of sun. You also know about the production and propagation of sound in different media (solids, liquids and gases) and how human ear receives a sound. In this unit, you will learn about the types of sound waves and audible frequency range for human. You will also learn about the applications of different sounds in daily life.

10.1 Sound Waves

Sounds are produced by vibrating objects. It is a form of energy produced by vibrations, carried in the form of waves and which can be recepted by our ears. The vibrating strings of a sitar or guitar make sounds, as does the vibration of the membrane on a drum when it is struck. The vibrations sent out by a musical instrument are then carried through the air as sound waves. Sounds travel through solids, liquids and gases.

Try it out

Place your fingers lightly at your throat where you voice box lies. Do you feel any vibrations? Now, talk or sing and feel your throat. Are there any vibrations?

10.1.1 Longitudinal Waves

A wave in which the particles of the medium vibrate back and forth parallel to the direction of motion of wave is called a longitudinal wave. For example, sound waves, waves produce in a helical spring etc.

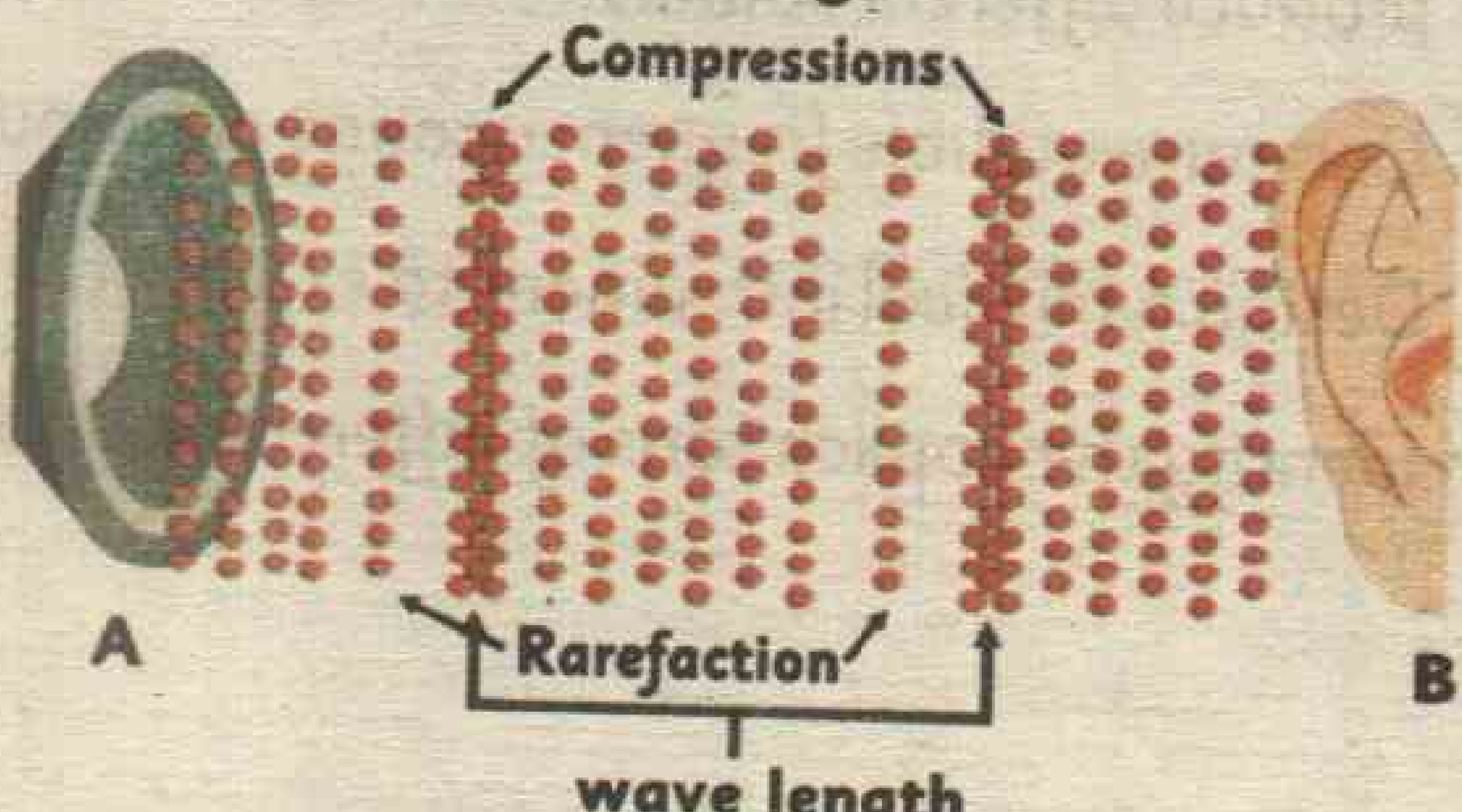


Fig. 10.1 Longitudinal sound wave

A longitudinal wave has been illustrated in Fig 10.1. In this figure, the direction of wave has been shown from A to B. The direction of vibrations of the particles of air is also along AB, parallel to the direction of waves.

Science tidbit

Sonar is a technique that uses sound propagation to navigate and communicate with or detect objects on or under the surface of the water.

A. Rarefactions

All those regions in the longitudinal wave in which vibrating particles of medium are moving further apart from one another and a momentary increase in volume and decrease in density occur, are called rarefactions. They are marked as "R" in figure 10.2.

B. Compression

All those regions in the longitudinal wave, in which vibrating particle of medium are moving closer to one another and a momentary decrease in volume and increase in density occurs, are called compression. They are marked as "C" in figure 10.2.

The sound waves travel through the air in a series of rarefactions and compressions as the object vibrates until it reaches the ear. Without molecules or particles, sound will not be able to travel. This is why sound waves need a medium to travel.

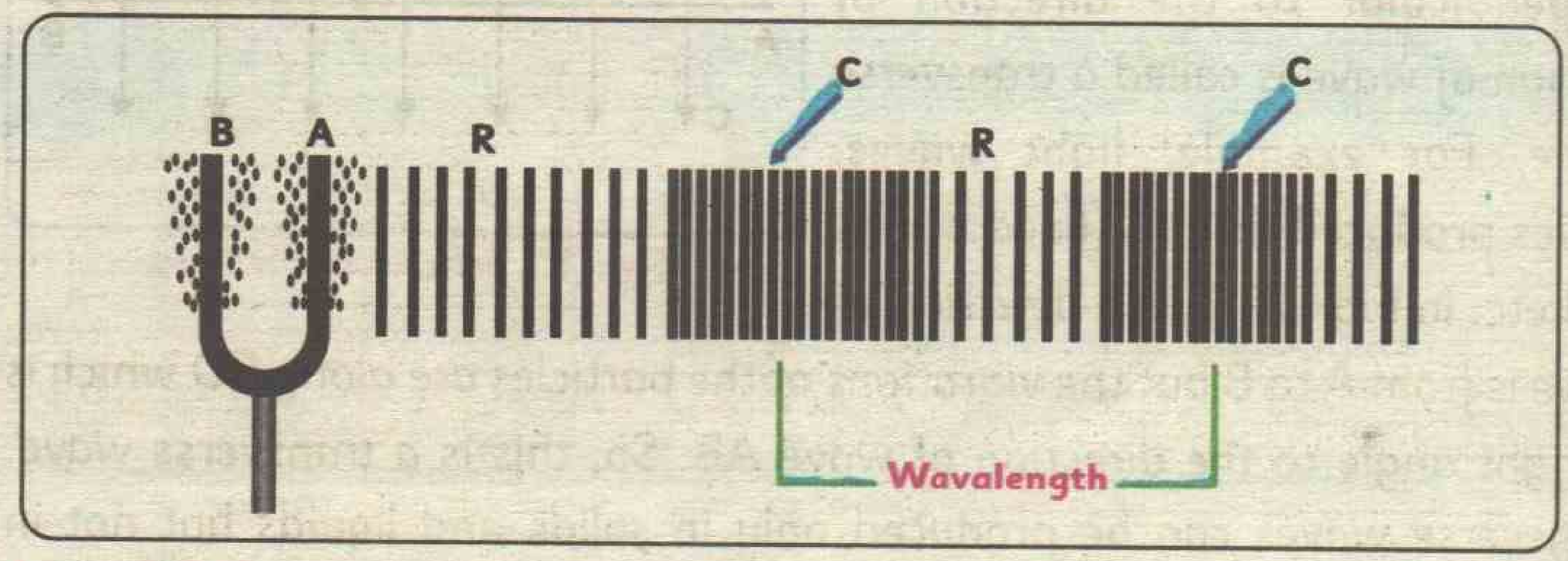


Fig. 10.2 Compressions and rarefactions of a longitudinal wave in tuning fork

Sound travels fastest through materials with particles which are densely and closely packed for example, solids.

Table. 10.1 Speed of sound in various materials

Material (or medium)		Speed of sound (or velocity of sound)
1. Dry air	(at 0°C)	322 m/s
2. Dry air	(at 20°C)	344 m/s
3. Water (Distilled)	(at 20°C)	1498 m/s
4. Sea-water	(at 0°C)	1531 m/s
5. Blood	(at 37°C)	1570 m/s
6. Iron (or steel)	(at 20°C)	5130 m/s
7. Glass	(at 20°C)	3962 m/s

10.1.2 Transverse Waves

A wave in which the particles of the medium vibrate up and down perpendicular to the direction of motion of wave is called a transverse wave. For example, light waves, waves produced on rope fixed at one end etc. In Fig. 10.3, the direction of wave is from A to B but the vibrations of the particles are along CD which is at right angle to the direction of wave AB. So, this is a transverse wave. Transverse waves can be produced only in solids and liquids but not in gases.

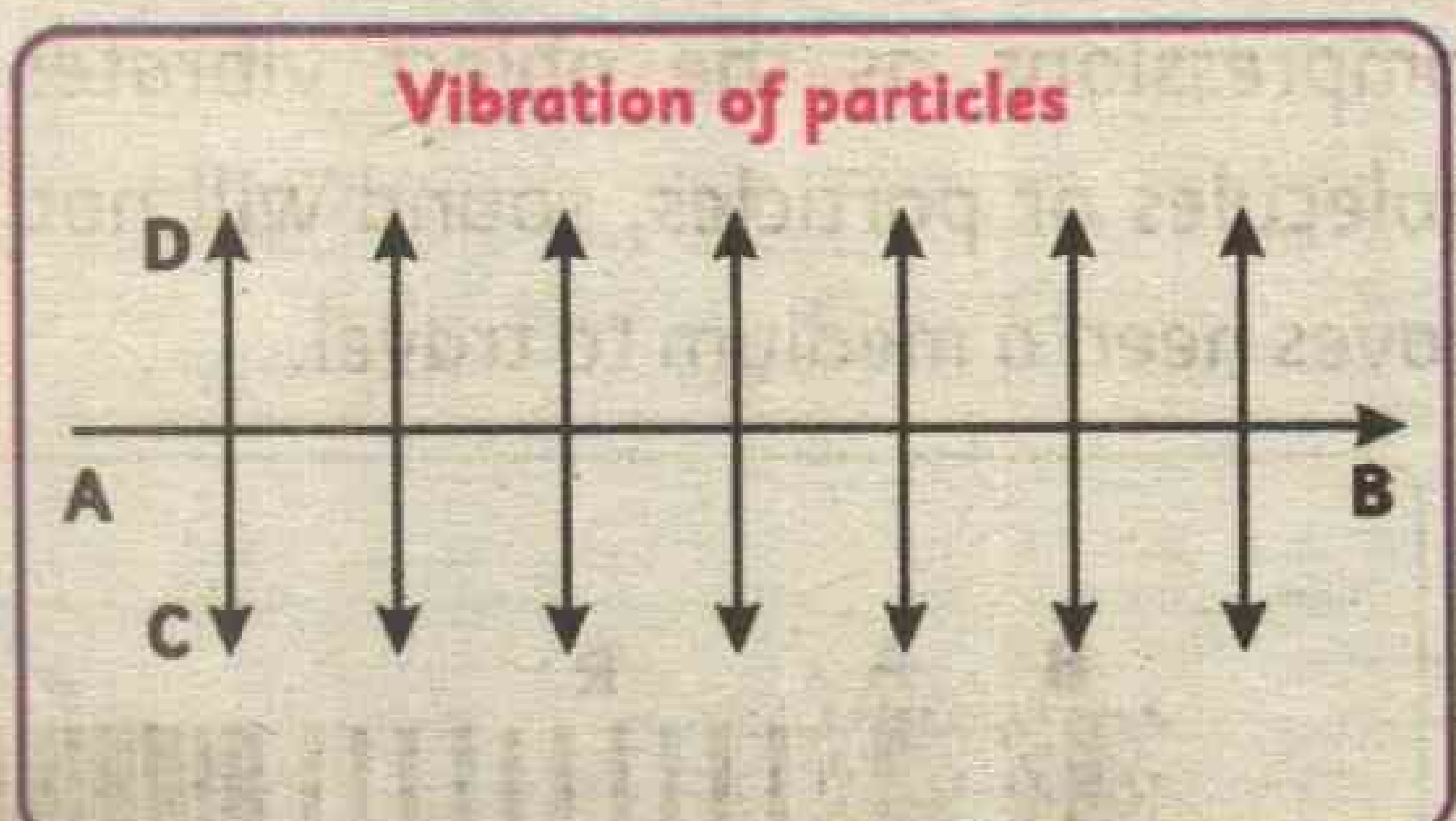


Fig. 10.3 Transverse waves

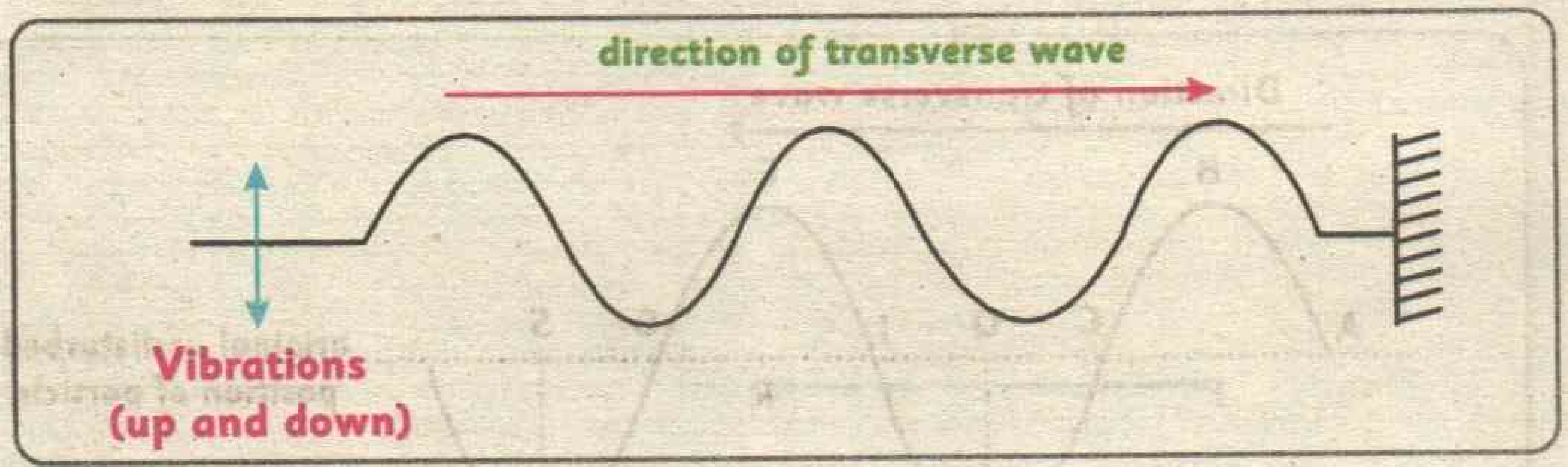


Fig. 10.4 Transverse waves on a rope

Crest

The part of transverse wave, where the particle of the medium are above the undisturbed position is called crest.

Trough

The part of transverse wave, where the particle of the medium are below the undisturbed position is called trough.

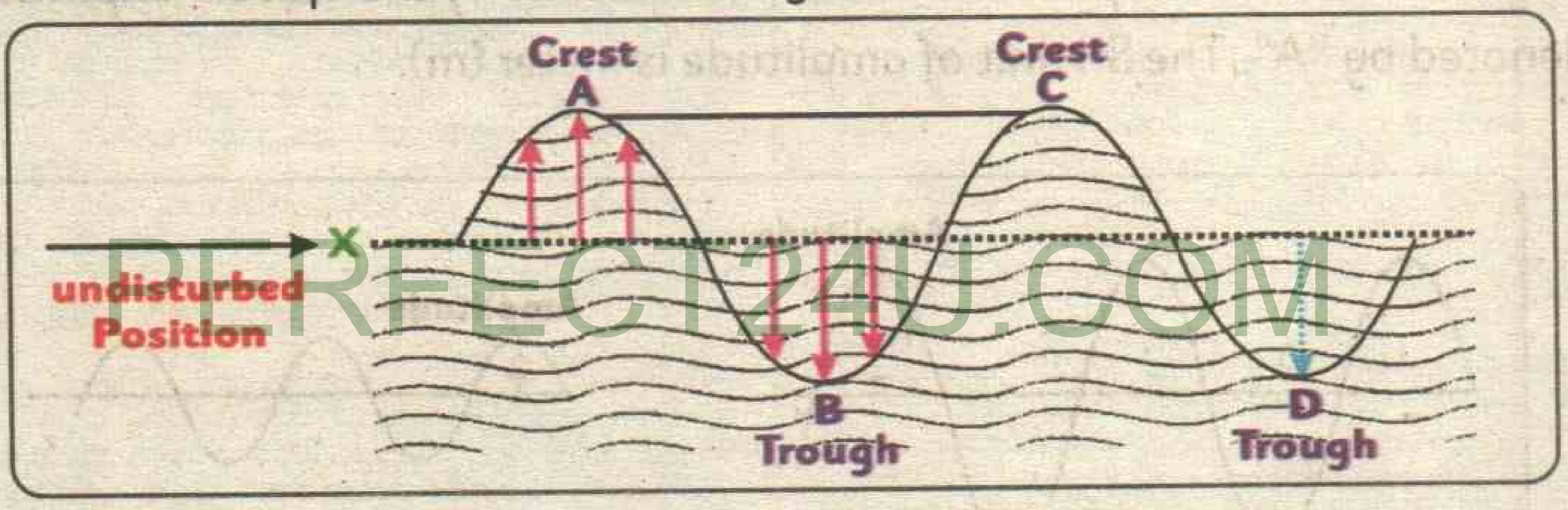


Fig. 10.5 Transverse wave

10.2 Characteristics of Waves

Wave length, amplitude, time period, frequency and velocity (or speed) etc. are the terms related to waves. These terms can be explained for both types of waves, however, for simplicity we explain them with reference to transverse wave.

A. Wave length

The distance between two consecutive crests or two consecutive troughs of a transverse wave is called the wavelength. The wavelength is denoted by the Greek letter lambda (λ). The S.I unit for measuring wavelength is meter (m).

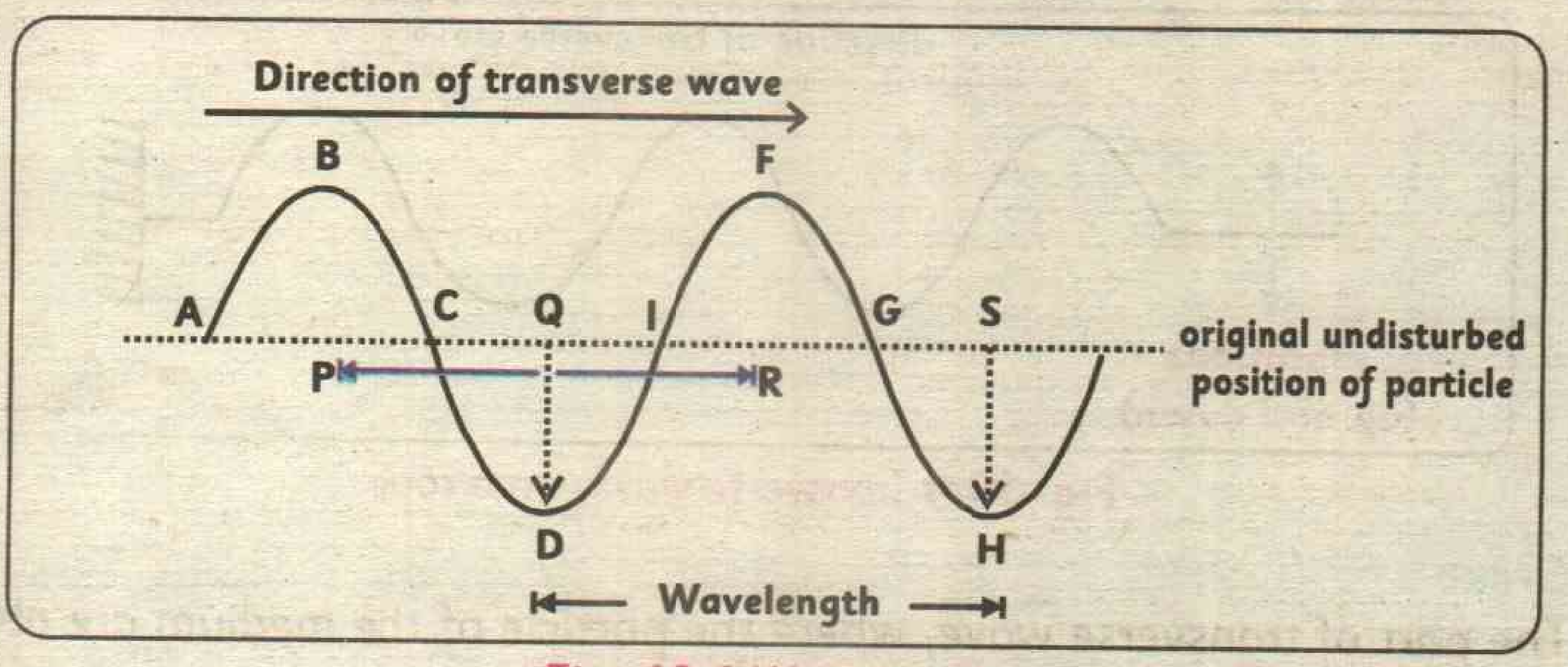


Fig. 10.6 Wave length

B. Amplitude

The maximum displacement of the particles of the medium from their original undisturbed position is called amplitude of the wave. Amplitude is denoted by "A". The S.I unit of amplitude is meter (m).

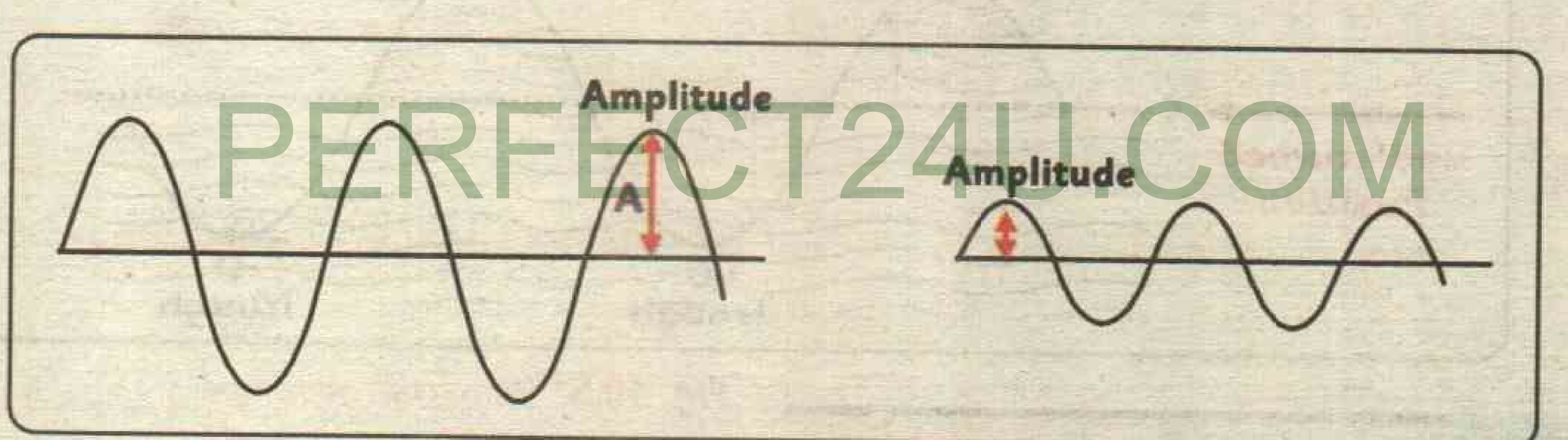


Fig. 10.7 Comparison of loud sound versus soft sound

C. Time Period

The time taken to complete one vibration is called time period. The time period of a wave is denoted by (T). The unit of measurement of time-period is second (s).

D. Frequency

The number of vibrations / waves per second is called frequency, it is denoted by "f". The unit of frequency is hertz (Hz). The shorten the wavelength, the higher the frequency and vice versa.

E. Velocity of Wave

The distance travelled by a wave in one second is called speed/velocity of the wave. The velocity of a wave is represented by the letter (v). The S.I. unit for measuring the velocity of a wave is meter per second (m/s or ms^{-1}).

10.3 Pitch

The characteristic of sounds by which a shrill sound can be distinguished from a grave one is called pitch of the sound. It depends upon the frequency. The greater the frequency, the higher the pitch and vice versa. The frequency of the voice of ladies and children is greater than that of men. Therefore, the voices of ladies and children are shrill and of high pitch.

10.4 Loudness of Sound

It is such a characteristic of sound by which a loud and a faint sound can be distinguished. When we talk to our friends, our voice is low but when we address a public gathering our voice is loud. Loudness of a sound depends upon area of vibrating body, amplitude of vibrating body and distance from vibrating body. A loud sound carries more energy than a soft sound. Loudness is measured in units called decibels (dB).

Making sounds

When two objects collide, sound is produced. Hit two spoons together and hear the sound. A flute is a musical instrument. When we blow air into it, a sound is produced. Sounds are also produced while hammering the nail and ringing the school bell. Sounds which are unwanted and loud are called noises.

Fig. 10.8 Making sounds

Point to ponder

What are some sources of noise in your environment? How do the noises affect you?

10.5 Audible Frequency Range

We know that sound is produced by a vibrating body. A simple pendulum also vibrates but it does not produce any sound. The reason is that its vibrations are very slow. A human ear can hear a sound only if its frequency lies between 20Hz to 20,000Hz. In other words, a human ear neither hears a sound of frequency less than 20Hz, called infra sound nor a sound of frequency more than 20,000Hz, called ultra sound. Sounds of frequency beyond 20,000 Hz are inaudible because the eardrums cannot vibrate so rapidly. The audible frequency range differs a little, for different persons. The above mentioned audible frequency range is only an average. It also decreases with age. Young children can hear sounds of 20,000 Hz frequency but old people cannot hear sounds even of 15,000 Hz frequency.

Fig. 10.9 Silent whistle to called dogs

Science tidbit

Some people use silent whistle to call dogs whose frequency lies between 2,000 Hz to 50,000 Hz. It is silent for humans but not for dogs because their audible frequency range is much more than humans.

Activity 10.2

Match the sounds producing instruments with their applications.

S.No	Sounds	Application in daily life
1.	Smoke detector	To judge that some one is at the door.
2.	Telephone	Warns about incoming danger.
3.	Radio	Attracts our attention towards the person on line.
4.	Siren	Help to listen news, music and other informative programs.
5.	Security system Alarm	Play the cassettes of the religious scholor and music.
6.	Door Bell	Alarm you about the smoke of fire.
7.	Stereo Player	Alert people to the danger.

Activity 10.1

Audible frequency Ranges of various animals

Animals	Frequency range (Hz)
Cow	23.......35000
Elephant	17........10500
Pigeon	45........7000
Owl	200.......12000
Dog	50.........46000
Cat	45.........64000
Bat	2000.......110000
Frog	100........3000
Mouse	1000......100000
Human	20 20,000
Gold fish	20 3000

- Which two animals can hear sounds of the highest frequencies?
- Which animal can hear low pitch sounds which humans can not?

10.6 Application of different sounds in our daily life

- Doctors use ultrasound to examine a patient internally.
- Manufacturers of concrete slabs use ultrasound wave to check for cracks and cavities in slabs.
- Animals are able to pick up some infrasonic noises which warn them of natural disasters before they happen generally earth quakes and tsunamis.
- Whales, elephants, giraffes and alligators etc. communicate over distance of hundred miles through infrasonic sounds.

Key points

- A wave in which the particles of the medium vibrates back and forth parallel to direction of wave is called the longitudinal wave.
- A wave in which the particles of the medium vibrates up and down perpendicular to the direction of motion is called a transverse wave.
- The distance between two consecutive crests or two consecutive troughs of a transverse wave is called the wave length.
- The maximum displacement of the particles of the medium from their original undisturbed positions is called amplitude of the wave.
- The time required to complete one vibration is time period.
- The number of complete waves or cycles produced in one second is called frequency of the wave.
- The distance travelled in one second is called speed of the wave.
- The characteristic of sound by which a shrill sound can be distinguished from a grave one is called the pitch of the sound.
- Loudness is such a characteristic of sound by which a loud and a faint sound can be distinguished.
- A human ear can only hear a sound of frequency between 20Hz to 20,000Hz.

Exercise

A. Colour the circle for the best suitable answer.

i. Sound waves are:

○ longitudinal ○ transverse ○ x-rays ○ electromagnetic

ii Which one of the following media is worst for transmitting sound waves?

○ water ○ iron ○ vacuum ○ wood

iii. Which of the following is related to the pitch of sound waves?

○ wave length ○ speed ○ amplitude ○ frequency

iv A human ear can hear a sound only if its frequency lies between.

○ 20—200 Hz ○ 20—20,000 Hz

○ 2—20 Hz ○ 20—2000 Hz

v. The maximum displacement of the particles of the medium from their original undisturbed position is called.

○ pitch ○ time period ○ frequency ○ amplitude

B. Match Column I items with Column II items.

Column I	Column II
Sound	Transverse waves
Human ear	Maximum distance
Spoon sound	Energy
Amplitude	(20—20,000) Hz
String	Shrill

C. Write down the short answers to the following questions.

i. What happens to the sound of a sitar or rabab string if you shorten the string?

ii. What is the frequency range of hearing in humans?

iii. Explain the wavelength, frequency and amplitude of sound and give their units.

iv. Why a sound cannot be heard on the moon?

v. Define pitch. Which factor is responsible for high and low pitch sounds.

D. Write down detailed answers to the following questions.

i. How sounds are produced and propagate with special reference to longitudinal waves?

ii. Investigate objects in home and surroundings that are designed and made to produce different sounds.

iii. State the factors on which sound depends.

Project — Sound waves

"Design a Musical Instrument"

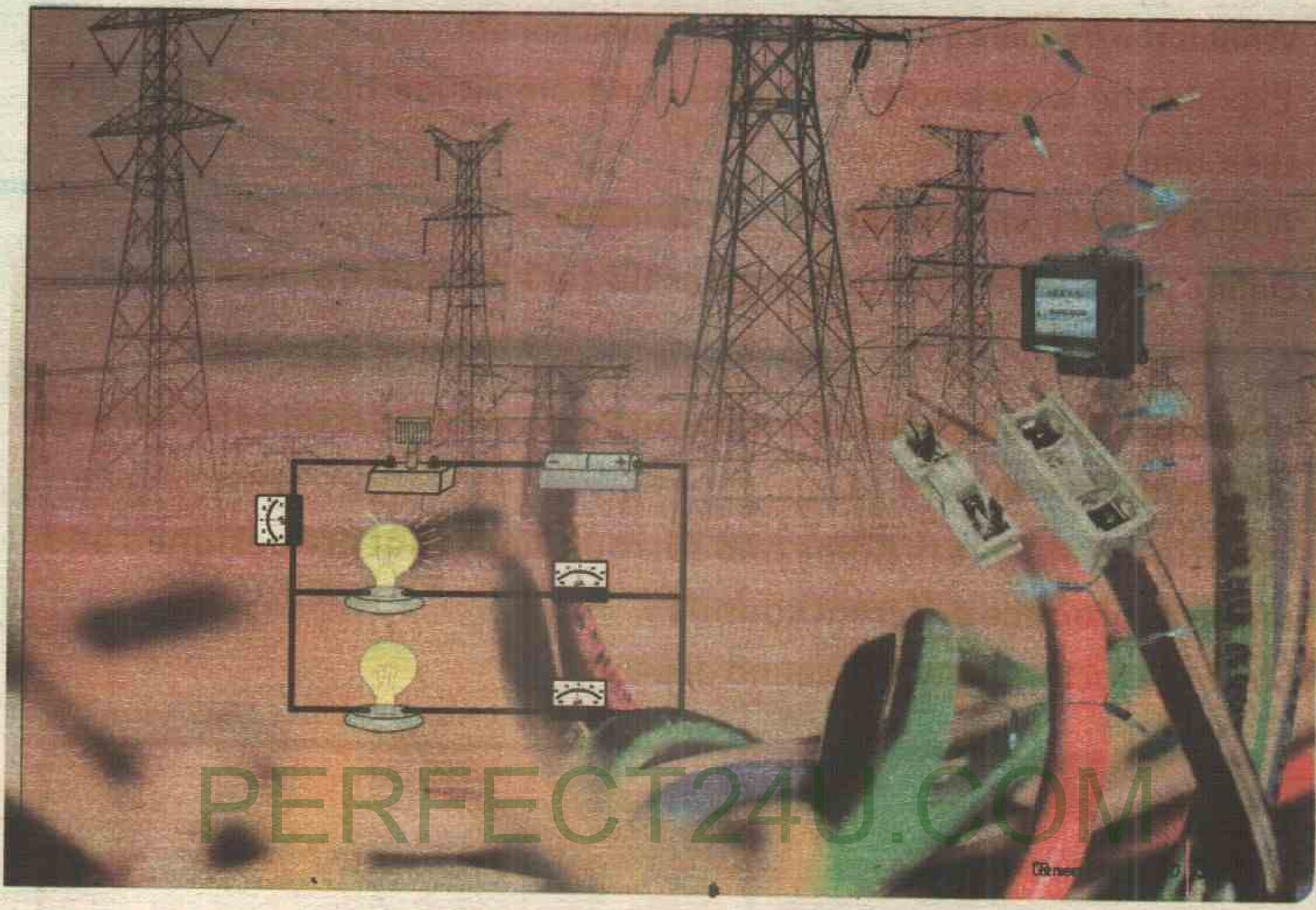
Use materials from home such as cans, cups, tubes, paper, plastic, metal, rubber bands, tape, combs, balloons, hangers, string, floss, bottles, boxes, straws, etc.

Work with your group to build your instrument. Think about how you can adapt or change materials to change pitch through length, mass, volume, etc.

Present and play your instrument, explaining why you chose the materials you did, how sound is heard through your medium, and how you planned and played different pitches with your design.

Unit 11

Circuits and Electric Current



At the end of this unit, the students will be able to:

- Define current.
- Make parallel and series circuits.
- Investigate about types of circuit used for different purposes.
- Identify a disadvantage of a series circuit.
- Differentiate between current and energy.
- Explain the effects of electric current in daily used appliances.
- Describe voltage.
- Explain the resistance as an opposition to the flow of current.
- Describe the relationship between voltage and resistance.
- Measure current by using different devices.
- List the major uses of electricity in homes.
- List electrical hazards and precautionary measures to ensure the safe use of electricity at home.
- Describe why electricity is dangerous to humans.

Introduction

Electrical instruments are used everywhere in our lives. We live in the age of electricity. It lights up our homes, cooks our food, powers our computers, television sets and other electronic devices. Without electricity, our lives would be completely different and less comfortable. In this unit you will try to understand how electricity flows from a power source through wires to your home, offices, factories etc. You will also study about the electrical hazards and precautionary measures to ensure the safe use of electricity at homes.

11.1 Electric current

When you switch on a television, computer, iron, deep freezer or a torch, the electrons in the wires begin to flow through the wires. This flow of electrons is called current and represented by symbol "I". A current is measured in amperes (or amps). When the current reaches the device from the source, the device starts working.

Science tidbit

Current is a flow of charged particles or charged carrier, not flow of charges.

Activity 11.1

Cells and batteries are useful sources of current. Figure shows a dry cell connected to a bulb by copper wires through a switch. What do you see when the switch is on? Turn the switch off. What do you see now?

A simple circuit

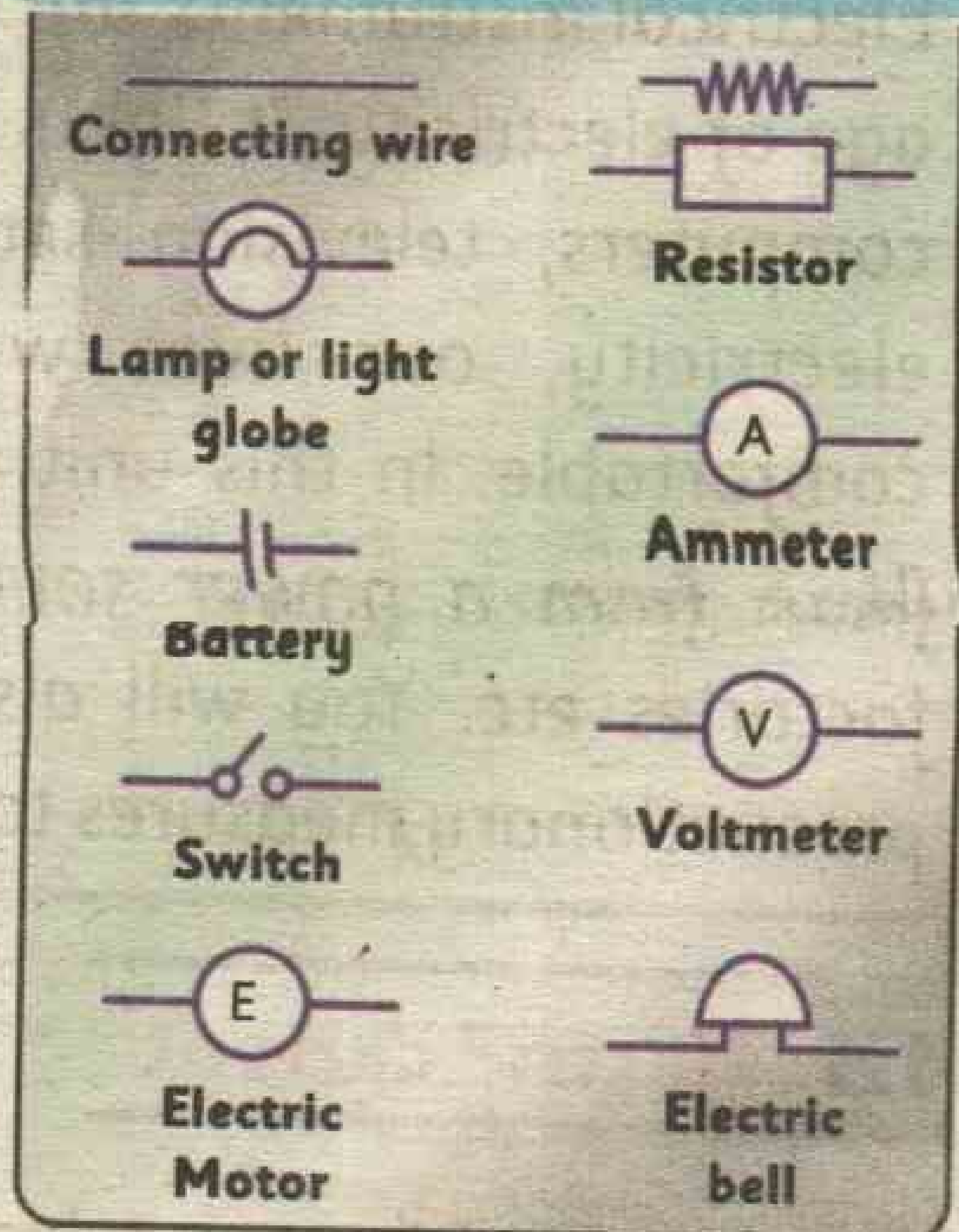
11.2 Electric circuit

An electric circuit is the path along which electric current flow. It consists of following components.

- Power sources / Battery
- Connecting wires
- Electrical components such as bulbs, switches etc.

An electric circuit is a complete unbroken path through which electric current can flow, such a circuit is called a **closed circuit**. If there is a break in a circuit, no electric current will flow, such a circuit is called an **open circuit**.

Table 11.1
Some important electrical symbols



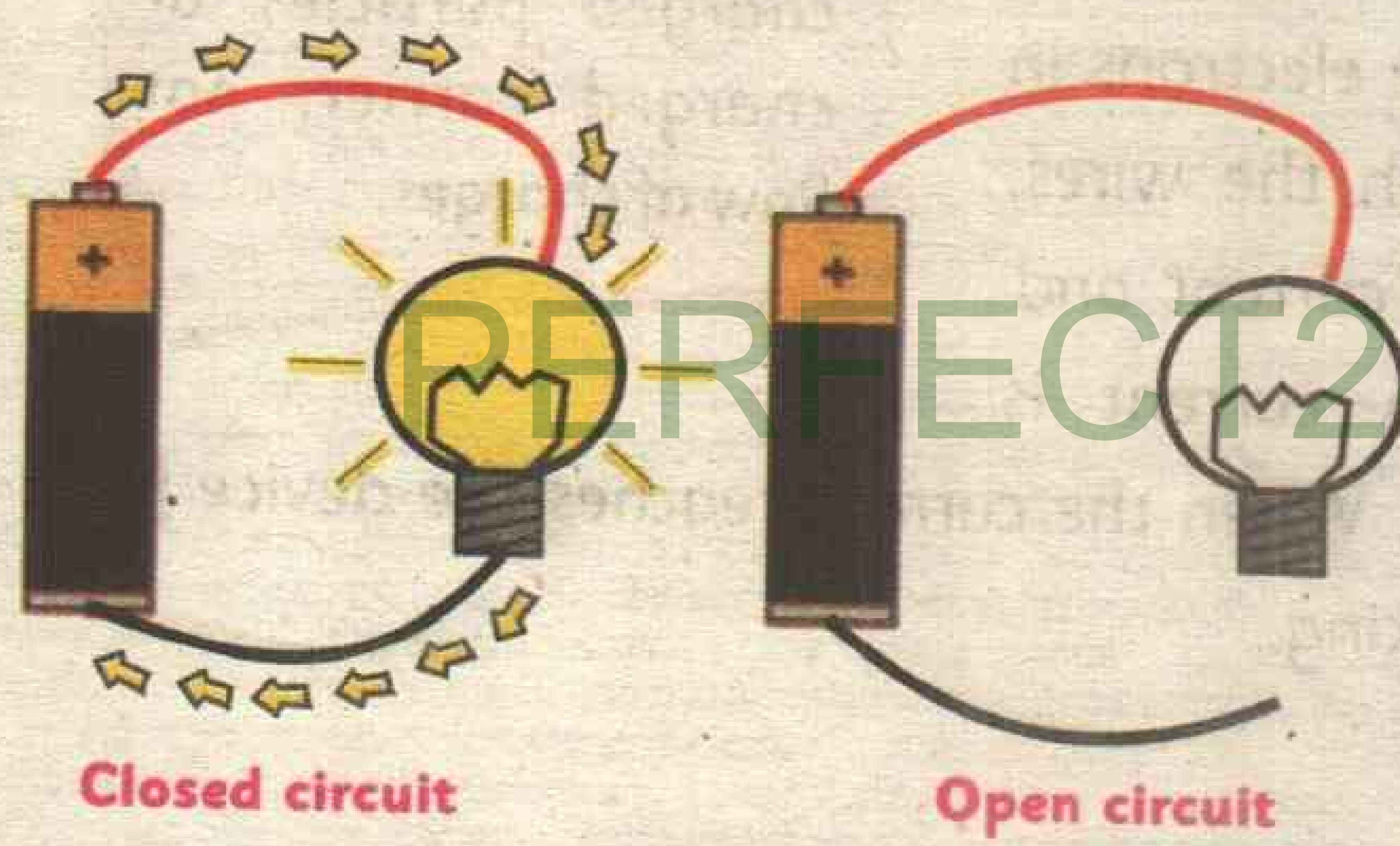


Fig. 11.1 Types of circuit

Science tidbit

A switch is used to close or break a circuit. Closing the switch completes the circuit while opening it breaks the circuit.

11.2.1 Types of electric circuits

Components of an electrical circuit or electronic circuit can be connected in many different ways. The two simplest of these are called series and parallel.

A. Series Circuit:

A series circuit is the one in which all the devices / electrical components are connected one after another, with no branches as shown in figure 11.2. It consists of a single pathway through which current can flow.

The current flowing through each electrical component in a series circuit is same. If one of the components in the circuit is broken then no current will move through the circuit because there is only one path. There is no alternative route.

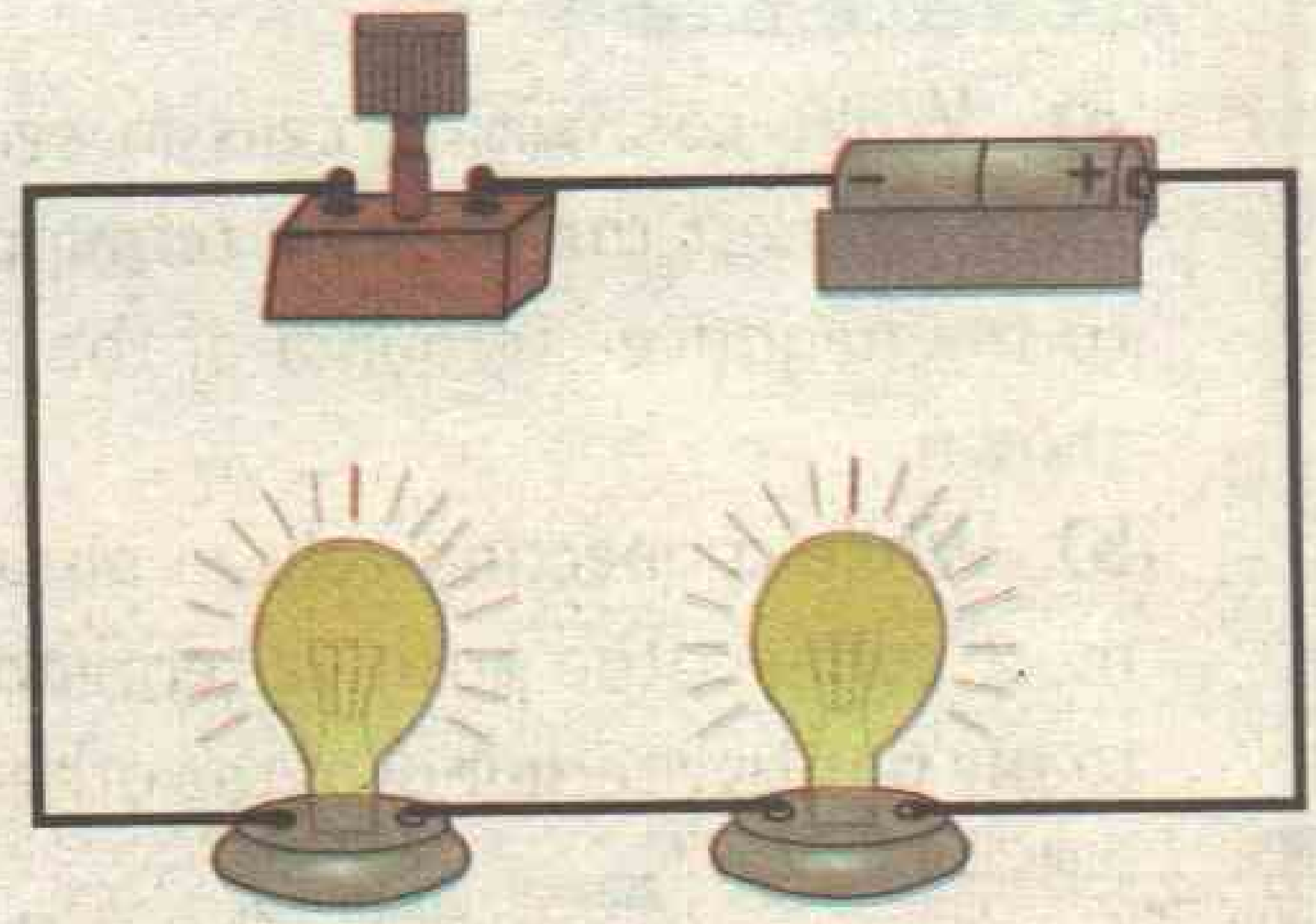


Fig. 11.2 Series circuit

Example

1. Strings of decorative light – the little bulbs are in series.
2. Batteries in the remote control – they are in series.

B. Parallel Circuit

A parallel circuit is a closed circuit in which the current splits into two or more branches before recombining to complete the circuit as shown in figure 11.3. The current flowing through each branch in a parallel circuit may be same or different. Each load connected in a separate path receives the equal circuit voltage.

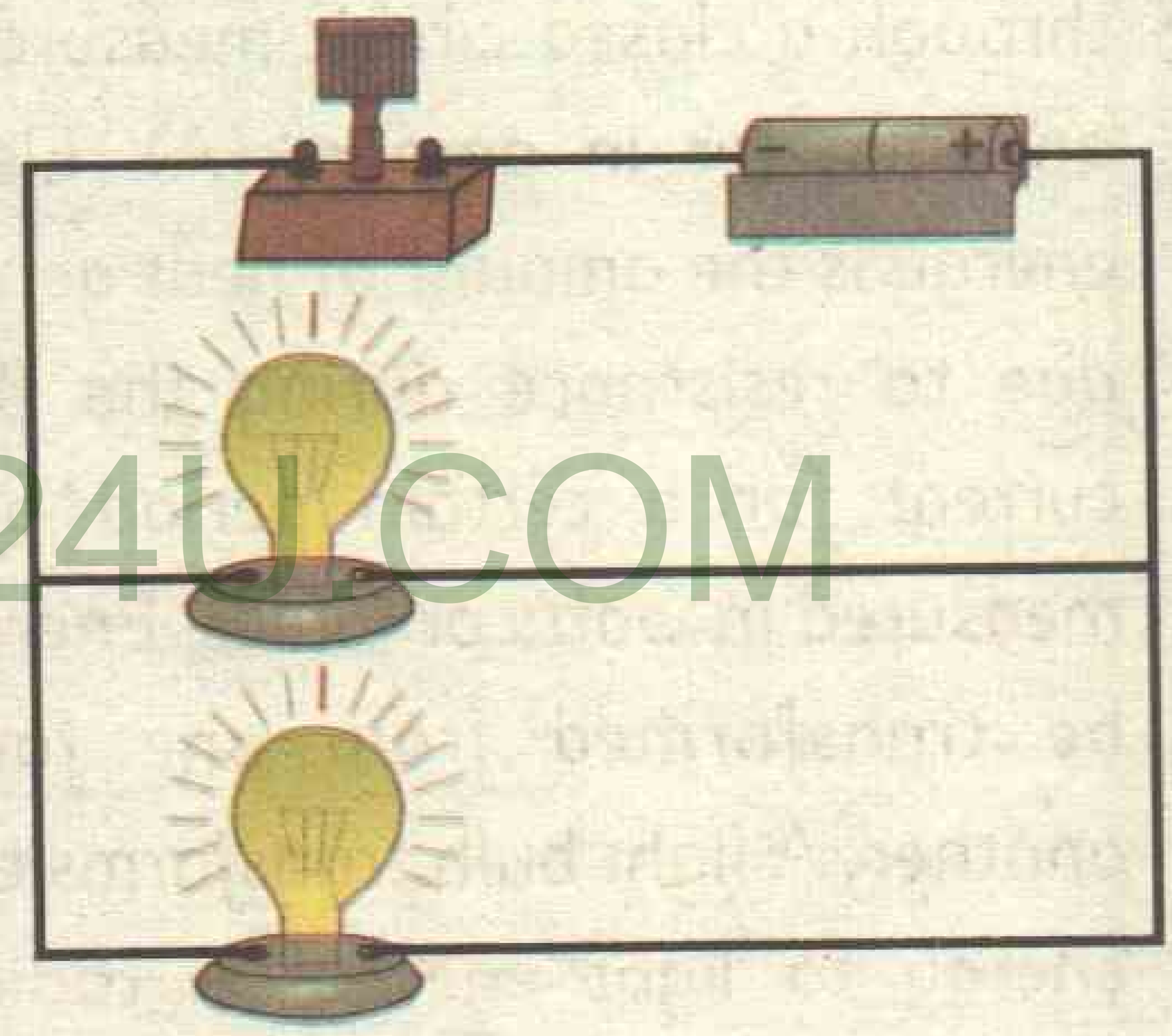


Fig. 11.3 Parallel circuit

If there is a break in one of the branches in the circuit, current can still flow through the other branches.

Example

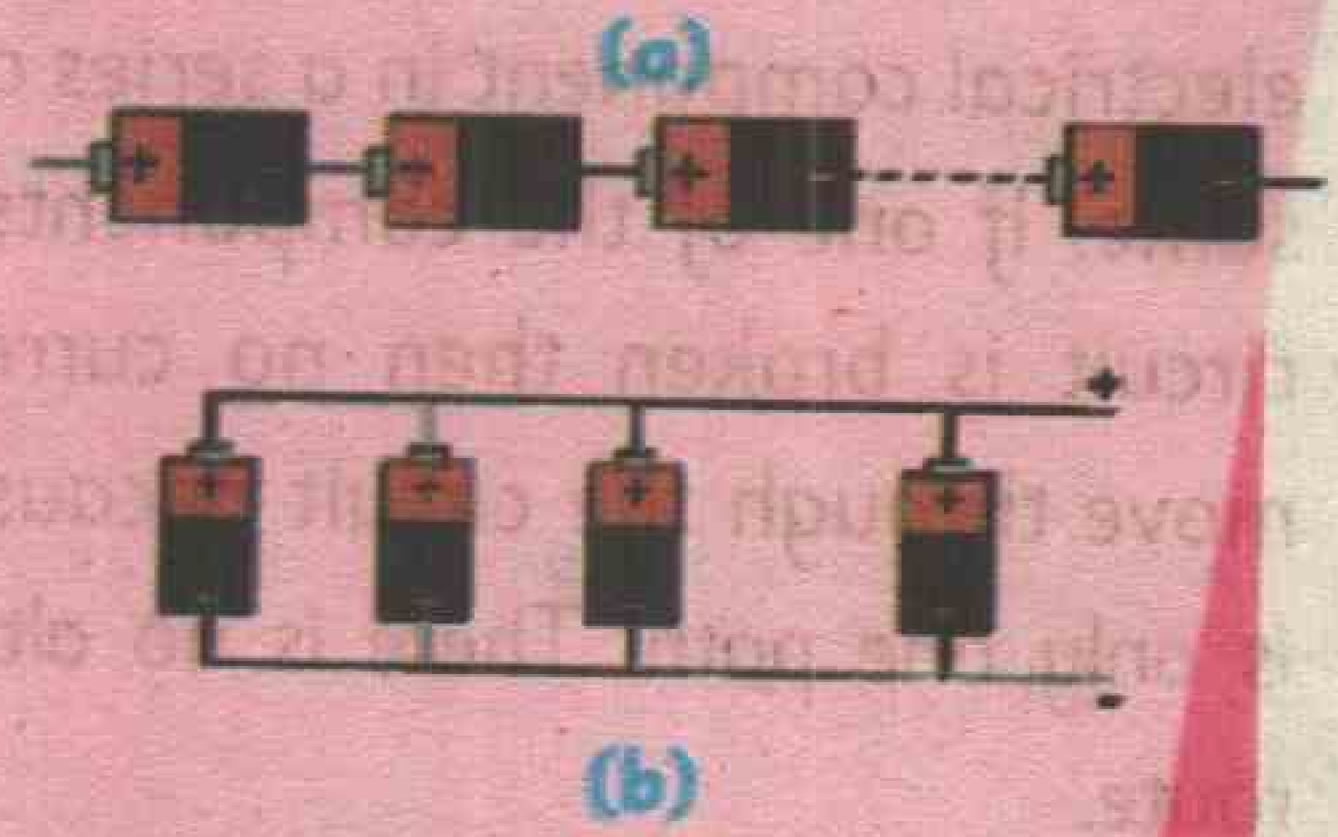
1. A chandelier: All the light bulbs are in parallel.
2. Electrical appliances in your house: All appliances are in parallel to the main supply.


Fig. 11.4 Chandelier

Science tidbit

a) While connecting cells in series, you must connect the positive terminal of one to the negative terminal of the other, as shown.

b) While connecting cells in parallel, you must connect the positive terminal of one to the positive terminal of the other.



11.3 Current and energy

Electrical current is the flow of electrons through a closed circuit measured with an ammeter in ampere (A). Electrical energy is the amount of heat generated due to resistance during the flow of current for a certain period of time measured in watts or joules. Energy can be transformed from one form to another. A light bulb transforms electric energy to light energy. A radio and electric bells transforms electric energy to sound energy. A fan converts electric energy into mechanical energy.

Science tidbit

Each material offers resistance to the flow of current through it. Good conductors such as copper, aluminum and silver offer very little resistance to the flow of current. Insulators such as plastics, glass and rubber gives more resistance. Similarly, long wires have more resistance than short wires. Also thin wires have less resistance than thick wires of the same material.

11.4 Effects of an Electric Current

A. Magnetic Effect: Current flowing in a wire always gives rise to a magnetic field around it. It can deflect a magnetic needle when placed near it. Electromagnets are used in electric bells, electric motors, loud speaker etc.

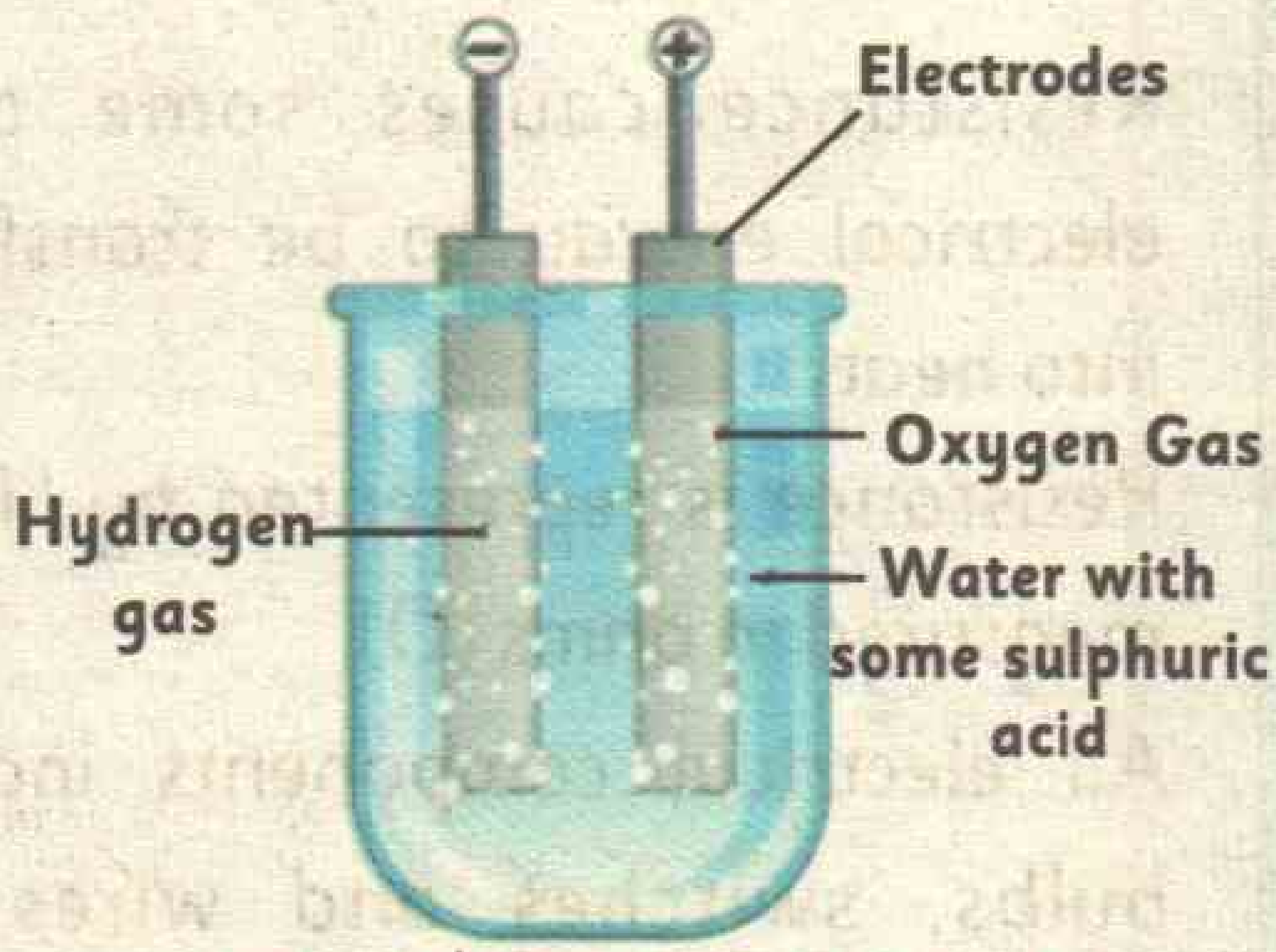


Fig. 11.5 Electrolytic cell

B. Chemical Effects: Electric current can bring chemical changes. For example, when electric current is passed through copper sulphate solution by using carbon electrodes, a chemical reaction takes place to form copper metal and oxygen gas at electrodes.

The chemical effect of current is used in:

i. electroplating
ii. the extraction of metal
iii. the purification of metals

Fig. 11.6 Electric appliances

C. Heating Effect: When an electric current is passed through a wire, the wire becomes very hot and produces heat. This effect is utilized in different electric appliances like electric bulbs, iron and room heater etc.

11.5 Voltage and resistance

> **Science tidbit**
> This increase in current through a component, will increase it's temperature.

The potential difference between two points in a circuit or battery is called voltage. It is measured in volts. In simple words, voltage is the measure of energy provided by a cell, battery or the main supply to the components. The unit "volt" is named after the Italian physicist Alessandro Volta who invented the first chemical battery. Voltage is represented by the letter "V".

11.5.1 Resistance

Resistance is the opposition to the flow of current. The lower the resistance, the higher the current in the circuit and vice versa.

Fig. 11.7 Circuit showing potential difference

Resistance causes some of the electrical energy to be transformed into heat.

Resistance is represented by "R" and measured in ohms (Ω).

All electrical components including bulbs, switches and wires have electrical resistance.

Fig. 11.8 (a) A Voltmeter


Fig. 11.8 (b) Digital Voltmeter

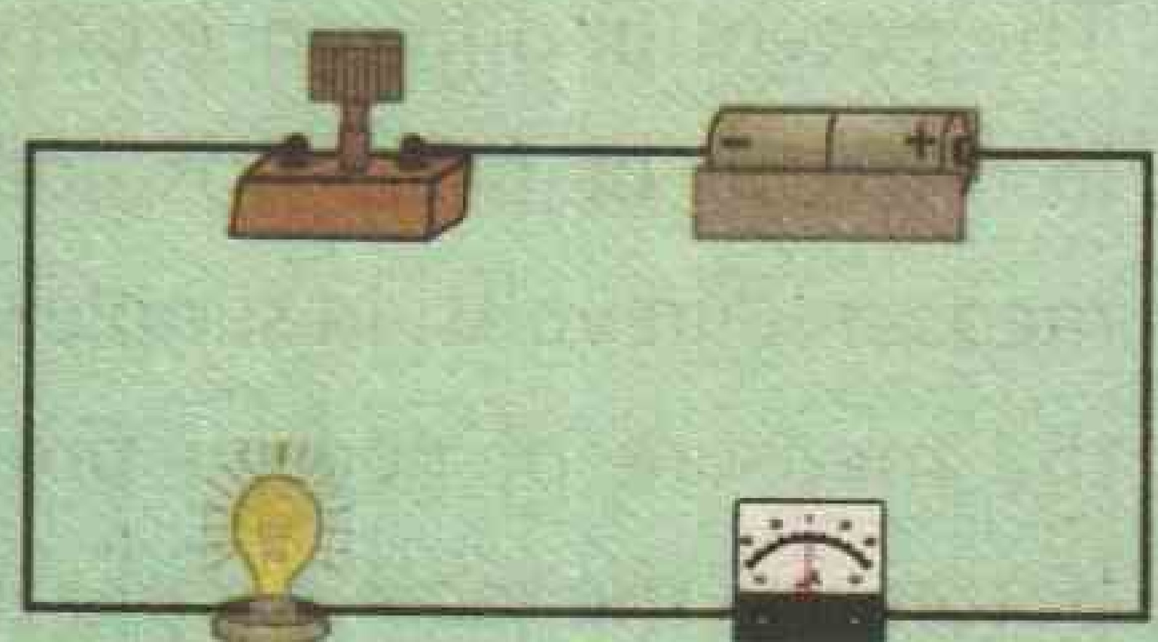
Science tidbit

A dimmer switch makes use of resistance to slow the fan. When you turn a dimmer to slow the fan, you are actually increasing the resistance in the circuit so that less current flows through the circuit. When less current flows, the fan becomes slow.

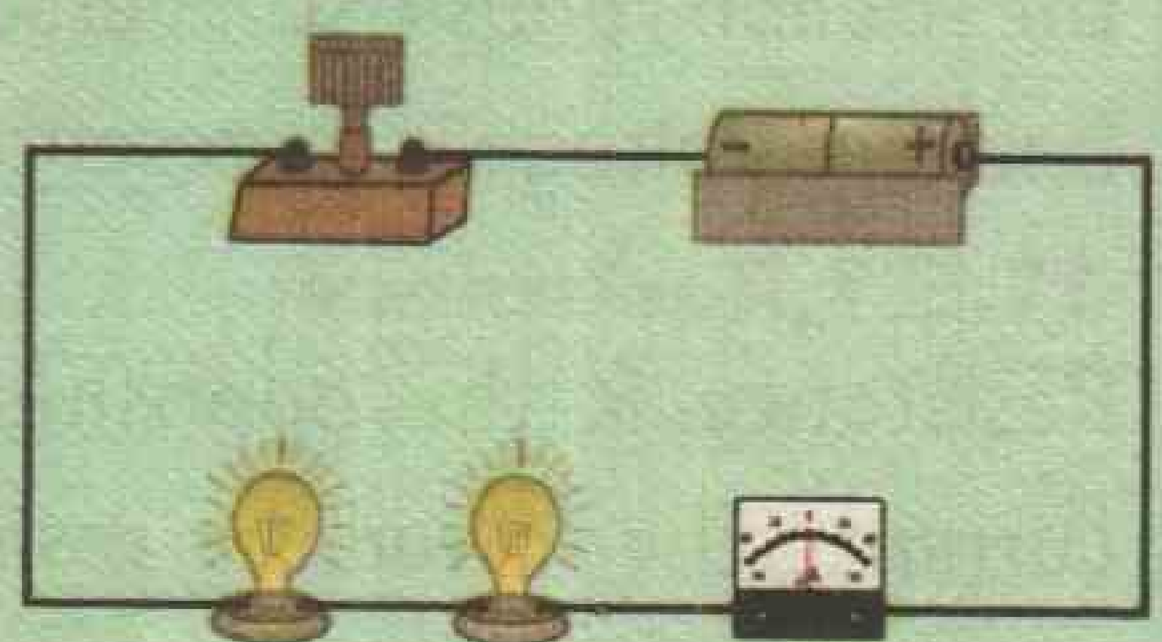
In a **series circuit**, the resistance increases as more bulbs are added. Each bulb reduces the flow of current and it's resistance is added to the total resistance of the circuit.

Activity 11.2

1. Set up the circuit as shown. On the switch and observe the brightness of the bulb. Measure and record the current in the circuit.



2. Connect another bulb in series to the first bulb as shown. On the switch and observe the brightness of the two bulbs. Measure and record the current in the circuit.

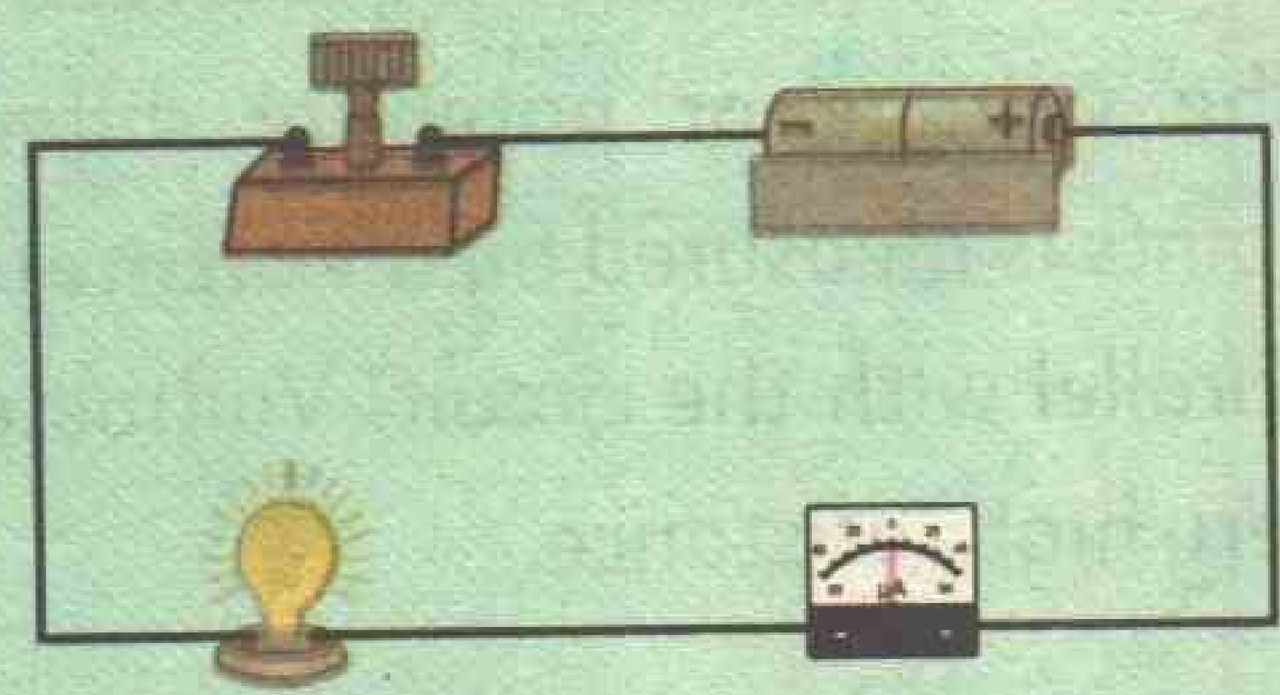


Are the bulbs brighter or dimmer than the bulb in step 1? Is the current higher or lower than the current in step 1?

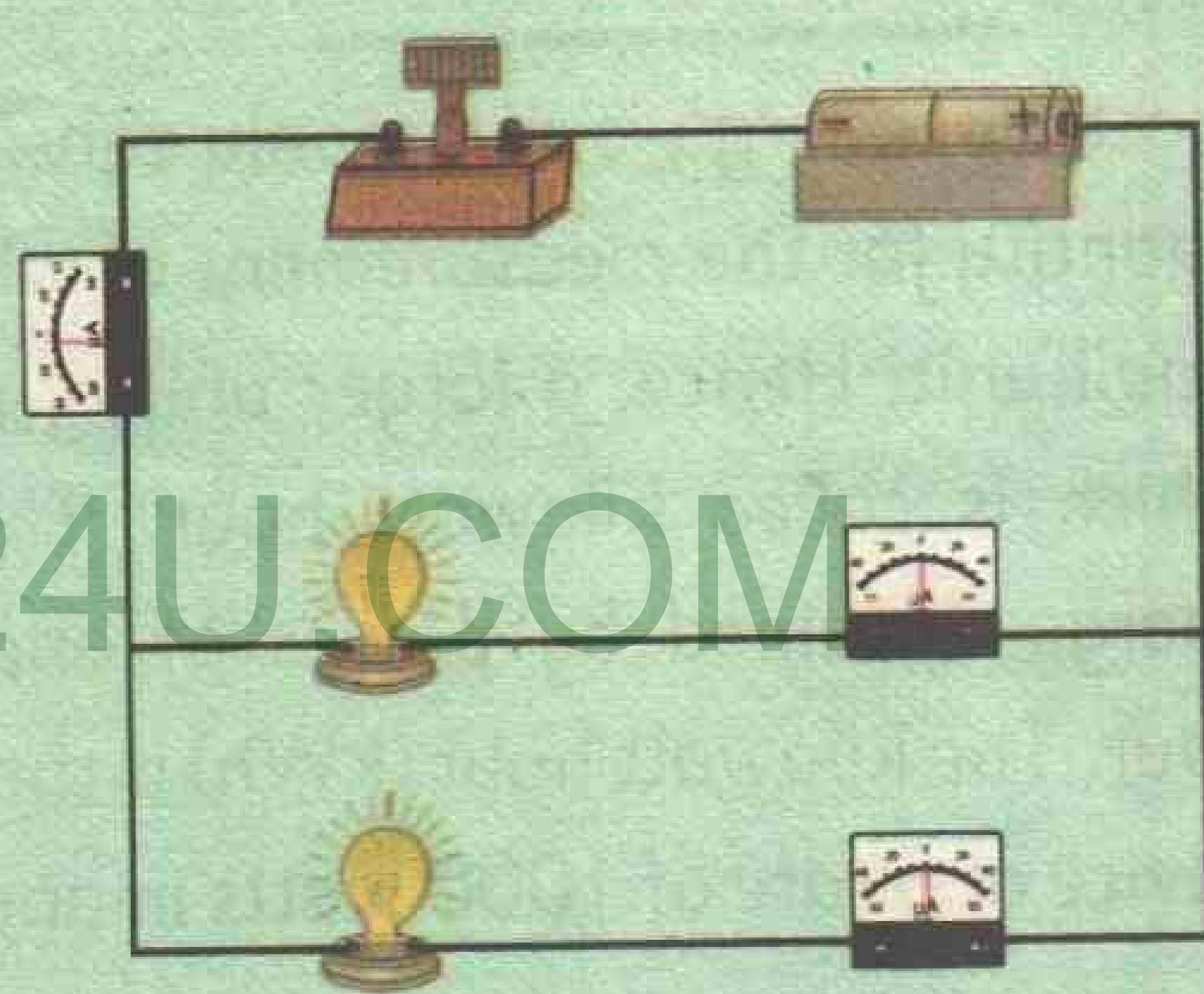
In a **parallel circuit**, resistance decreases as more resistors are added. Each resistor provides an alternate route for the current to flow.

Activity 11.3

1. Set up the circuit shown. On the switch and observe the brightness of the bulb. Measure and record the current in the circuit.



2. Connect another bulb in parallel to the first bulb and ammeters in the circuit as shown. On the switch and observe the brightness of the two bulbs. Measure and record the current in the main circuit and each branch.
Are the bulbs brighter or dimmer than the bulb in step 1? Is the current higher or lower than the current in step 1?



11.5.2 Relationship Between Voltage and Resistance

The relationship between voltage, current and resistance is described by Ohm's law.

Voltage = Current X Resistance

Ohm's law tells us that the current (I) flowing through a circuit is directly proportional to the voltage (V) and inversely proportional to the resistance (R).

11.6 Measuring current by using different devices

An **ammeter** is the device to measure the amount of current in an electric circuit. It is connected to the circuit in series so that the full current passes through it. An ammeter has very low resistance.

Fig. 11.9 Ammeter

The voltage or potential difference between two points is measured by a **voltmeter**. It is connected in parallel with the circuit. Voltmeters generally have a very high resistance.

Fig. 11.10 Voltmeter

11.7 Kilowatt Hour

Electrical energy is commonly consumed in very large quantity for the measurement of which joule is a very small unit. Hence, a larger unit of energy is required which is called kilowatt hour. It is the amount of energy obtained by power of one kilowatt in one hour. The kilowatt hour (kWh) is the energy used by a device at a rate of 1000 watts in one hour.


Fig. 11.11 Meter

$$1\ \text{kWh} = 1000\ \text{W} \times 1\ \text{hour}$$

$$1\ \text{kWh} = 1000\ \text{W} \times 60\text{s} \times 60\text{s} = 3600000\text{J}$$

The energy in kilowatt hour can be obtained by the following formula.

$$\text{The amount of energy in kWh} = \frac{\text{Watts} \times \text{time (in hours)}}{1000}$$

11.8 Paying the price

Suppose you watch cricket world cup on television for several hours each day. During one month you watch the matches for a total of seventy hours and your television uses two hundreds watts of electric power.

The electric company PESCO charges 3.23 rupees for each kilowatts hours of electric energy, how much does it cost to watch seventy hours.

To solve this problem begin by changing watts to kilowatts.

$$200 \text{ watts} = 200/1{,}000 = 0.20 \text{ kW}$$

Then you multiply the kilowatts by the number of hours.

$$0.20 \text{ kW} \times 70 \text{ h} = 14 \text{ kWh}$$

Finally you multiply kWh by the cost per kWh.

$$14 \text{ kWh} \times 3.23 \text{ rupees per kWh} = \text{Rs. } 42.7/-$$

So, electric company will charge you 42.7 rupees for watching the cricket world cup on television.

11.9 Safe Use of Electricity at Home

A. House wiring

Electricity is supplied to each house through a main cable which contains a live wires and a neutral wire. A main wire switch as well as a main circuit breaker are fitted in the path of the live wire. All the household appliances are connected in parallel as shown in Fig 11.12.

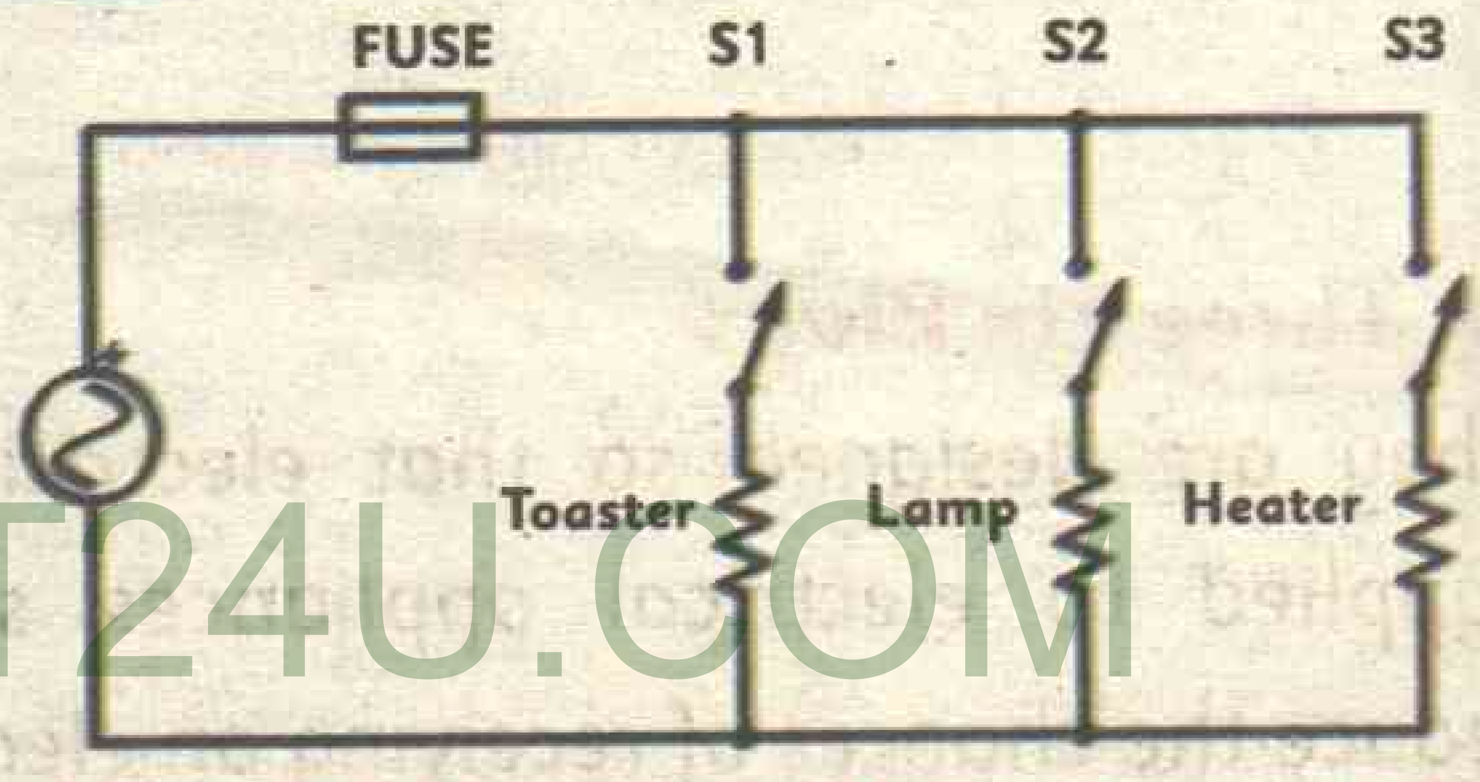


Fig. 11.12. House appliances in parallel

B. Earthing of Electrical Appliances

To avoid the risk of electric shocks, the metal body of an electrical appliance is earthed. Earthing means to connect metal case of electrical appliance to the earth by means of a metal wire called earth wire.

Fig. 11.13 . Earthing of electrical appliances

C. Fuse

A fuse is a safety device having a short length of a thin wire made up of tin or tin-lead alloy having low melting point. It melts and breaks the circuit if the current exceeds a safe value. The fuse works on the heating effect of current. A fuse wire is connected in series in the electric circuits.

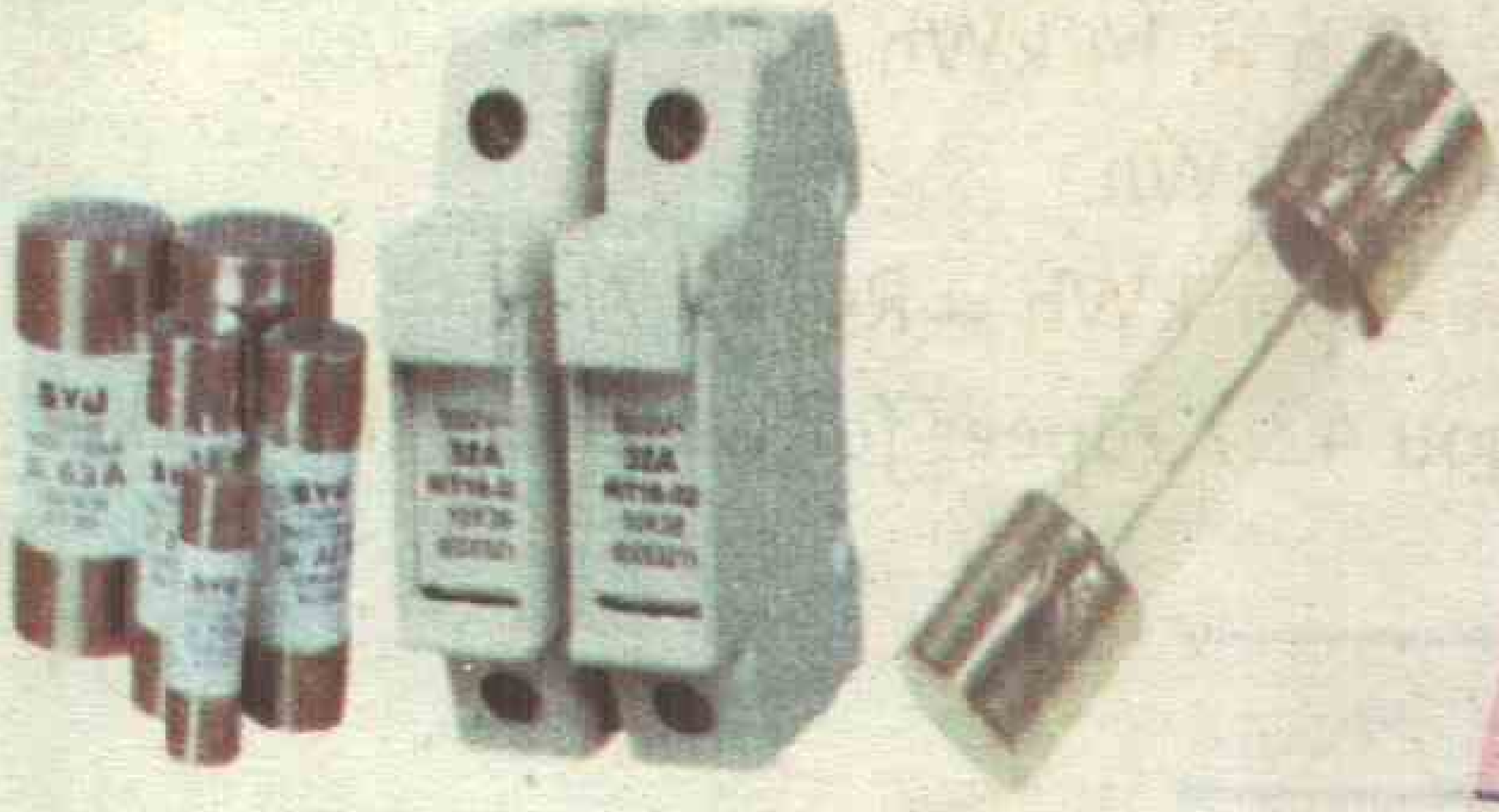


Fig. 11.14 Fuses of different sizes

Science tidbit

A copper wire cannot be used as a fuse wire because it has high melting point due to which it will not melt easily when a short circuit take place.

D. Three Pin Plugs

They are designed so that electricity can be supplied to electrical appliances safely and reduce the chances of receiving an electric shock. The earth pin on a plug is longer than the live and neutral pins, so that the earth pin cannot be inserted into the live or neutral hole of the socket even by mistake. Fuse is present with it, which breaks the circuit if too much current flows.

Fig. 11.15 Three pin plugs

E. MCB (Miniature Circuit Breakers)

It automatically switches off the electrical circuit during abnormal condition of the network (i.e overload or faulty condition). MCB is much more sensitive to current than fuse.

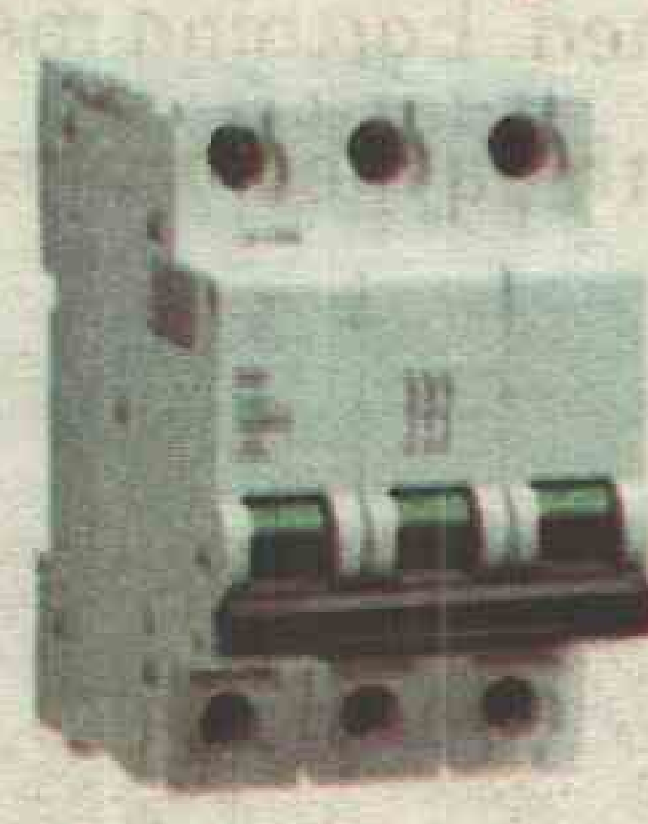


Fig. 11.16 MCB

F. ELCB (Earth Leakage Circuit Breaker)

The main purpose of ELCB is to prevent injury to humans and animals due to electric shock. It detects small stray voltages on the metal enclosures of electrical equipment and interrupts the circuit if a dangerous voltage is detected.

Fig. 11.17 ELCB

11.9.1 Precautionary measures to ensure the safe use of electricity at home

We must use electricity with extreme care. Here are some safety precautions to take to ensure the safe use of electricity.

1. Do not touch electrical appliances with your wet hands because water can conduct electricity.
2. Do not insert anything into power sockets.
3. Do not use appliances which are damaged or have exposed wires.
4. Do not change the bulb while light switch is on.
5. Do not overload an electrical socket by plugging too many appliances into it.
6. Do not repair electrical appliances yourself. Get a qualified electrician to do it.

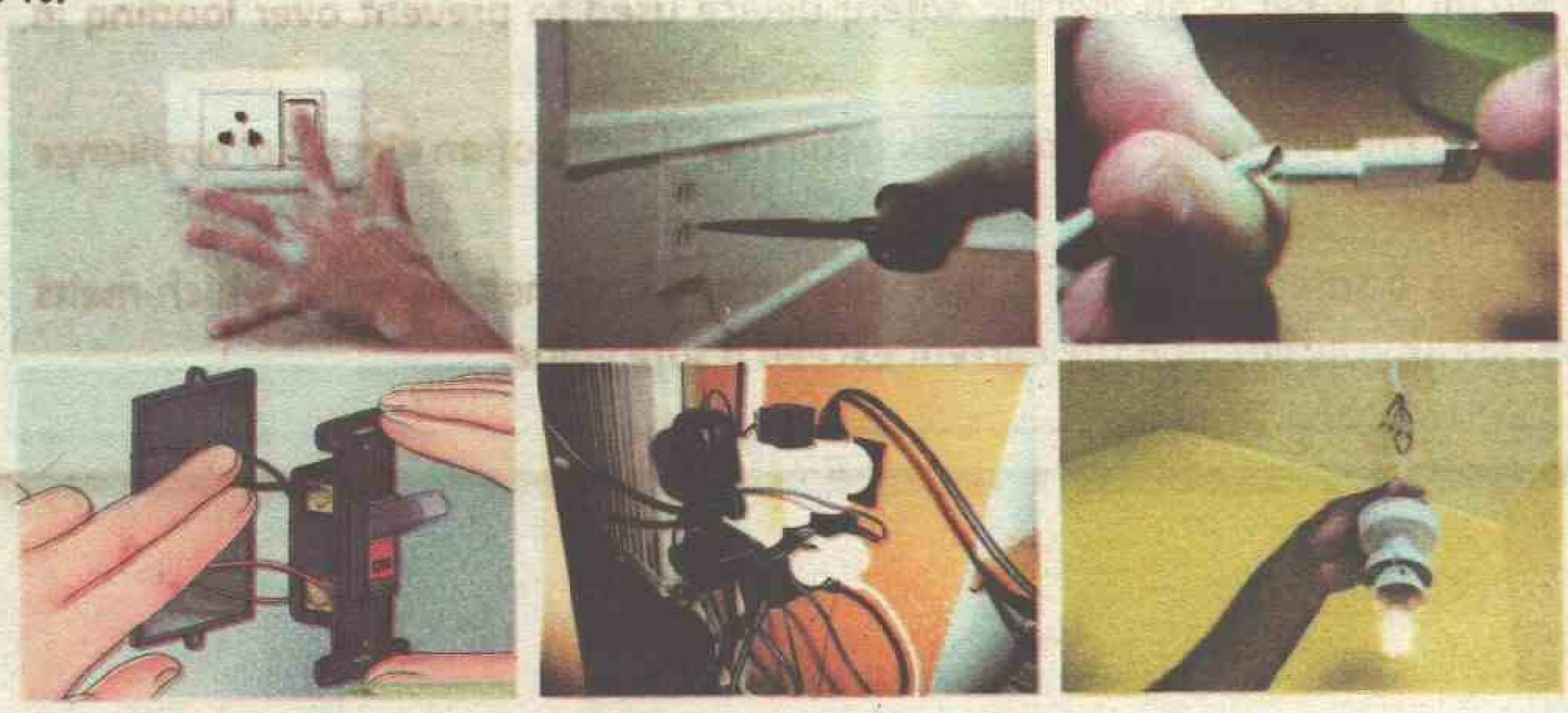


Fig. 11.18. Safe use of electricity at home

11.9.2 Why Electricity is Dangerous to Humans?

Did you know that an electric current can pass through the human body? Besides electric shock, it can cause burns, nerve damage and death. Most of the parts of human body are composed of water which makes human a good conductor for electricity. The nerves in the human body are electrical conductor and they carry messages in the form of electrical signals. They act like a circuit in the body. That is why when a high current passes through a body, one can get electric shock.

Key points

- The flow of electrons is called current.
- The path for the flow of current is called circuit.
- A series circuit provides one path for the flow of current in the circuit.
- Parallel circuit provides separate paths for flow of current.
- The rate of flow of electric charge through a wire is called current.
- Electric current has magnetic effect, chemical effect and heating effect.
- Voltmeter is a device which is used for measuring voltage.
- Ammeter is a device which is used for measuring current.
- A circuit breaker is an electric safety device used to prevent over loading in high current flow.
- To avoid the risk of electrical shocks, the metal body of an electrical appliance is earthed.
- A fuse is a safety device of a thin wire having low melting point which melts and breaks the circuit if the current exceed a safe value.

Exercise

A. Colour the circle for the best suitable answer.

i. A fuse is used to:

- ○ prevent electrical flow
- ○ save electrical energy
- ○ prevent excessive current
- ○ increase voltage

ii The earth wire is used to:

- ○ Prevent excessive current flow
- ○ Prevent electrical shocks
- ○ Prevent the appliance form exploding
- ○ Protect the appliance from fluctuating voltages

iii. Charge in motion produces:

- ○ Current
- ○ Voltage
- ○ Circuit
- ○ Energy

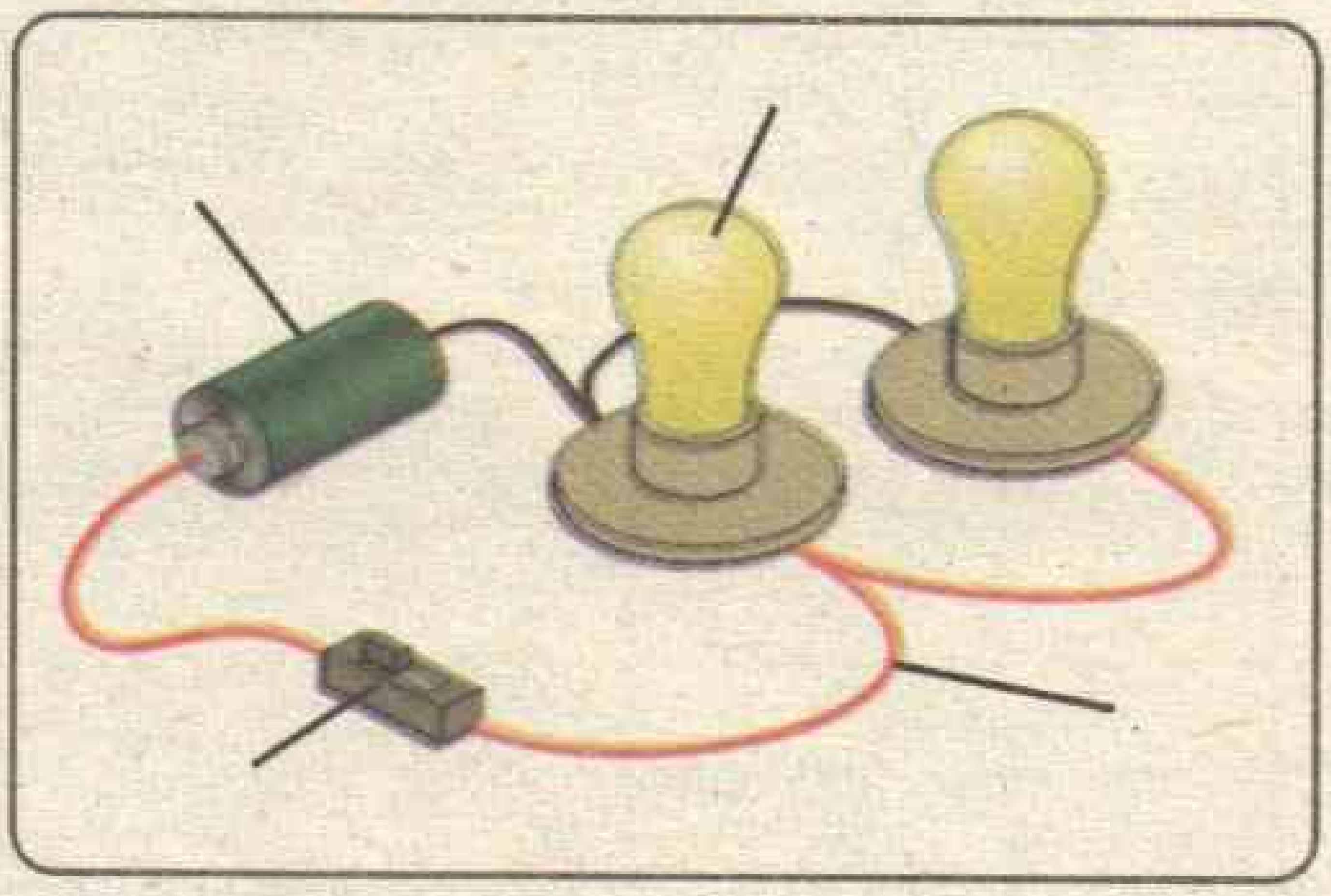
iv The larger unit of electricity is:

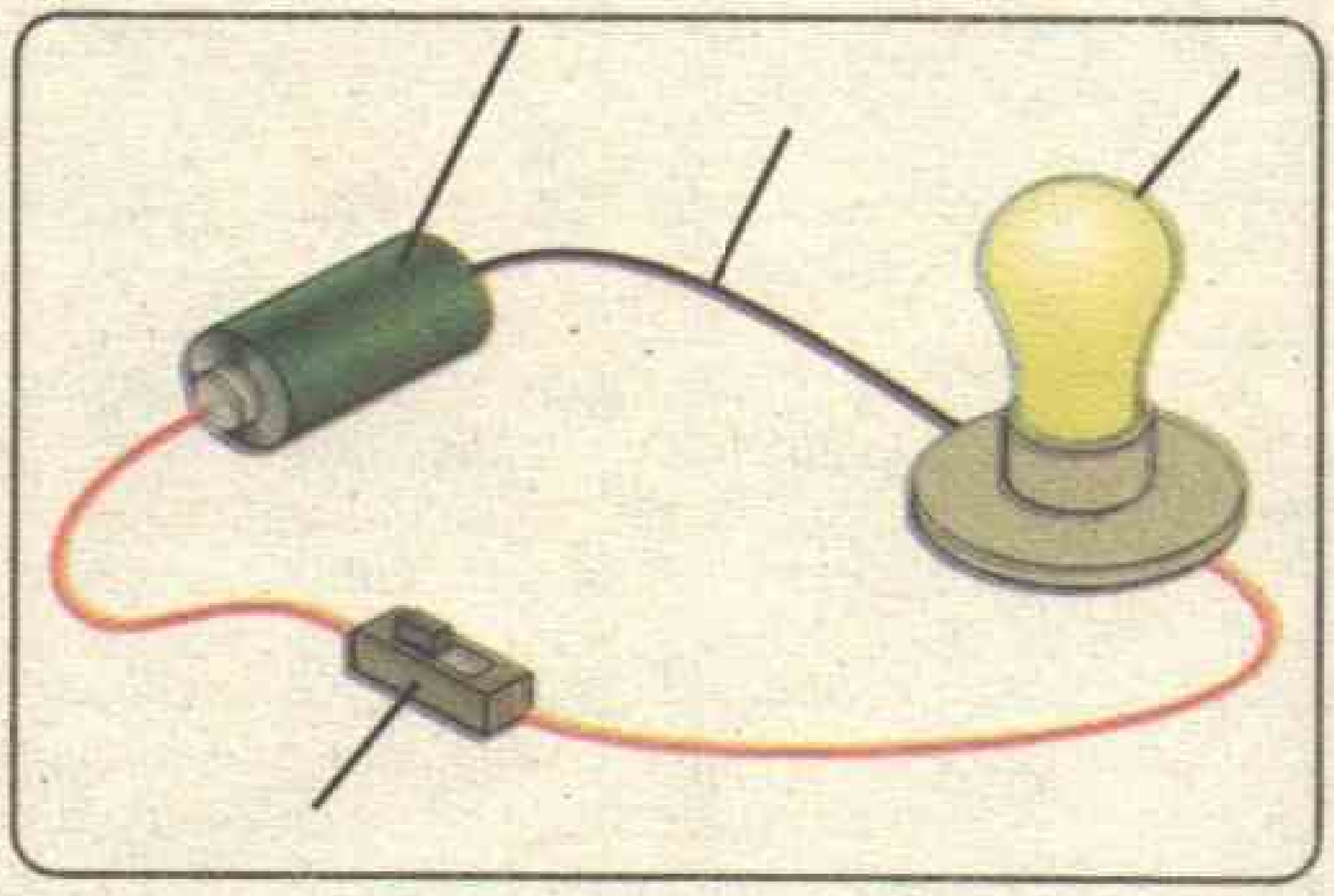
- ○ Joule
- ○ Watt
- ○ Kilowatt
- ○ Ampere

v. Two kilowatt hour is the energy

- ○ 3600000 joule
- ○ 720000 joule
- ○ 800000 joule
- ○ 10800000 joule

B. Name the parts labelled in the diagrams and also name the types of circuits.





C. Write down the short answers to the following questions.

i. Name the commercial unit of electric energy?

ii. Describe the function of MCB.

iii. What is the function of a fuse in a circuit? Briefly describe how it works

iv. Suggest an advantage of connecting the lightings in a room in parallel instead of in series circuit?

v. Which electrical component can be used to open or close a circuit?

D. Write down the detailed answers to the following questions.

i. Define circuit. Explain series and parallel circuit with diagrams.

ii. What are some hazards of electricity from the power mains? Suggest five safety precautions to take while using electricity from the power mains.

iii. Explain the effects of electric current in daily use appliances.

Project

Design and build a simple series and parallel circuits with LED bulbs with holders, wires and battery.

Unit 12

Investigating the Space

At the end of this unit, the students will be able to:

- Explain the Big Bang Theory of the origin of the Universe.
- Describe a star using properties such as brightness and color.
- Identify bodies in space that emit and reflect light.
- Suggest safety methods to use when observing the sun.
- Define the terms star, galaxy, Milky Way and the black holes.
- Explain the types of galaxies.
- Explain the birth and death of our sun.
- Evaluate the evidence that support scientific theories of the origin of the universe.
- Identify major constellations visible at night in the sky.
- Describe the formation of black holes.
- Explain the working of a telescope.

Introduction

Nobody knows how big the universe is or whether it has any limits. The sun which sustains all the life on our planet is only one of the billions and billions of stars that exists in this universe, whereas, the planet Earth on which we live is only a tiny speck in the vast space called universe. The billions of stars which exist in the universe are not distributed uniformly in space. These stars occur in the form of clusters of billions of stars called galaxies. In this unit, you will study about star, galaxies, milky way and the black holes.

12.1 What is beyond our solar system?

Our solar system is an extremely small part of the universe. This universe is immensely vast. According to scientists, most of the universe is empty space. However, this expanding universe contains gases, dust, stars and galaxies. Galaxies are the building blocks of the universe.

How and when did the universe come into being? This and many such questions may arise in our mind. Efforts have been made by scientists like Edwin Hubble, Arno Penzias and Robert Wilson in understanding the nature and origin of the universe.

Fig. 12.1 Solar system

12.1.1 Big – Bang Theory

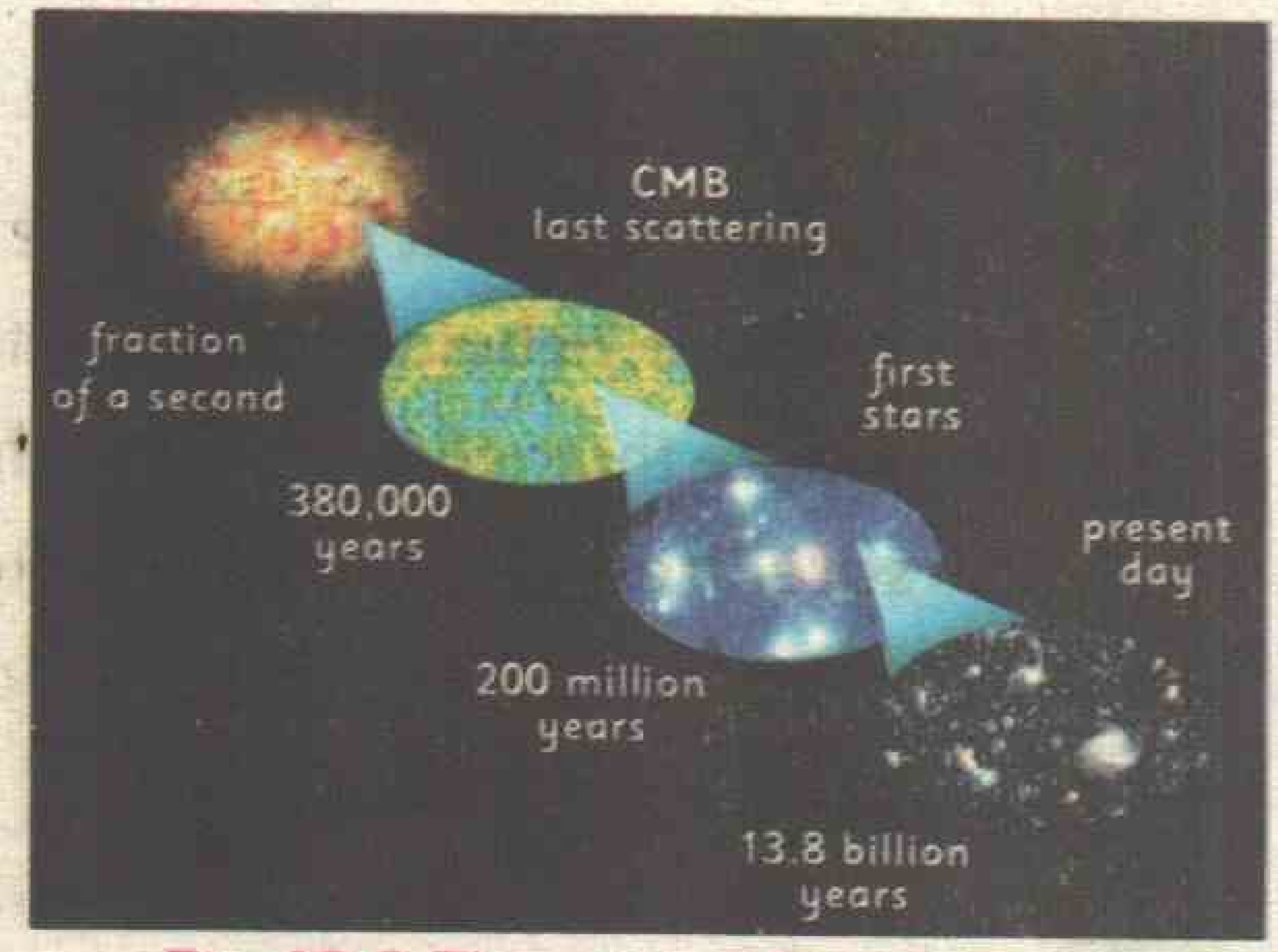
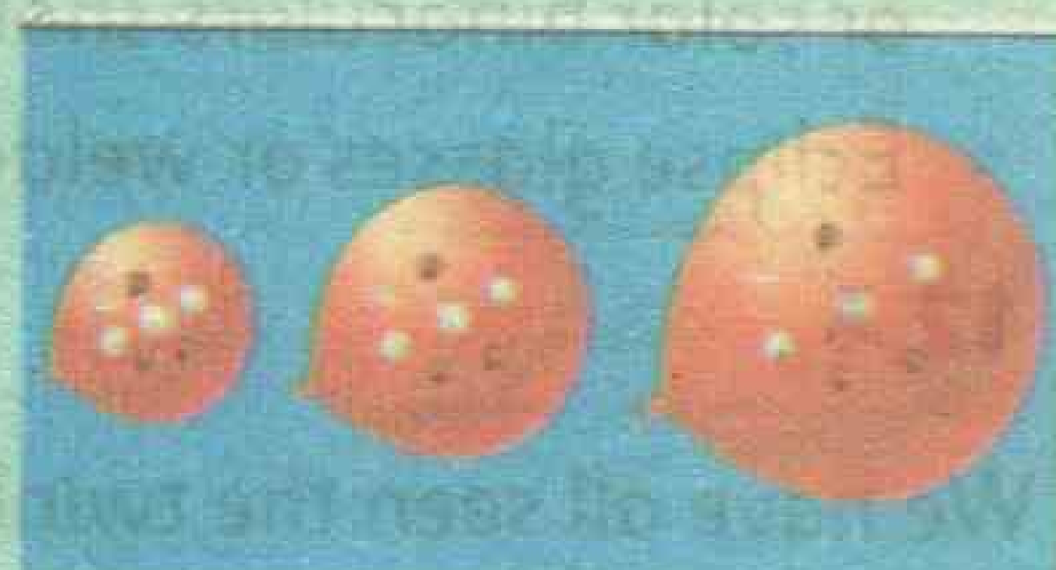


Fig 12.2 The origin of the universe

One of the most popular theories about the beginning of this universe is the big-bang theory. The big-bang theory explains the formation of heavenly bodies like planets, stars and galaxies etc. This theory was developed from the observation of the universe which shows that galaxies are moving away from each other at great speed in all directions. According to the big-bang theory, "all the matter in the universe was originally concentrated in one micro meter". About 15 billions years ago, this superdense and extremely hot atom exploded with a big-bang and the matter and energy dispersed in all directions throughout space leading to the formation of galaxies of stars and other heavenly bodies. This big-bang theory of the origin of the universe was proposed by Edwin Hubble.

Activity 12.1

Make a model of the expanding universe.



- Take small circles from sticky labels.
- These circles will be considered as galaxies, in your model.
- Take a large balloon and blow it up partially.
- Paste the sticky circles on the partially blown up balloon. (you can also draw spots on the balloon).
- Hold the end of the balloon to keep the air from escaping.
- Balloon represents the universe and the circles are galaxies.
- Now fully blow up the balloon until it is completely inflated.
- Observe what happens to the galaxies (sticky circles).
- What does this experiment tell you about the expanding universe?

12.2 Bodies that emit and reflect light in space

- Objects in space that emit light are the sun, stars, galaxies, nebulae, meteors etc.
- Objects in space that reflect light are the Natural satellites (moon), artificial satellites, comets, asteroids and meteoroids in space etc.

Science tidbit

Each second 600,000,000 tonnes of hydrogen are converted to helium in the Sun.

12.3 Safety Tips for Observing the Sun

Sun is a hot body that emits dangerous radiation which can damage our eyes if you viewed it directly. Before viewing the sun make sure of the following safety precautions:

- A pinhole or small opening is used to view the image of sun on a screen placed a half meter beyond the opening.
- Use two or three x-rays film sheets for viewing the Sun.
- Specially designed solar telescopes or solar binoculars should be used.

Fig 12.3 Using Eclipse glasses

- Eclipse glasses or welder's goggles rated 14 or higher should be used.

12.4 A Star

We have all seen the twinkling stars that decorate the night sky. A star is a luminous ball of gases, mostly hydrogen and helium, held together by its own gravity. A star emits energy in the form of heat and light. There are a few hundred billions stars in the milky way galaxy alone and billions of galaxies in the universe. The sun is the nearest star to planet earth. It sustains life on earth through the heat and light it emits. Stars can be classified in terms of brightness and colour.

12.4.1 Colours of stars

Stars come in a range of colours, from reddish to yellowish to blue. The colour of a star depends on surface temperature. A star might appear to have a single colour but actually emits a broad spectrum of colours. Different elements or compounds absorb and emit different colours or wavelengths of light. In terms of colour, we can classify stars as orange, yellow, blue, red and white. The colour of our sun is yellow.

Science tidbit

In all the stars (including the sun) hydrogen atoms are continuously being converted into helium atoms and a large amount of energy in the form of heat and light is released during this fusion process. It is this heat and light which makes a star shine.

12.4.2 Brightness of Stars

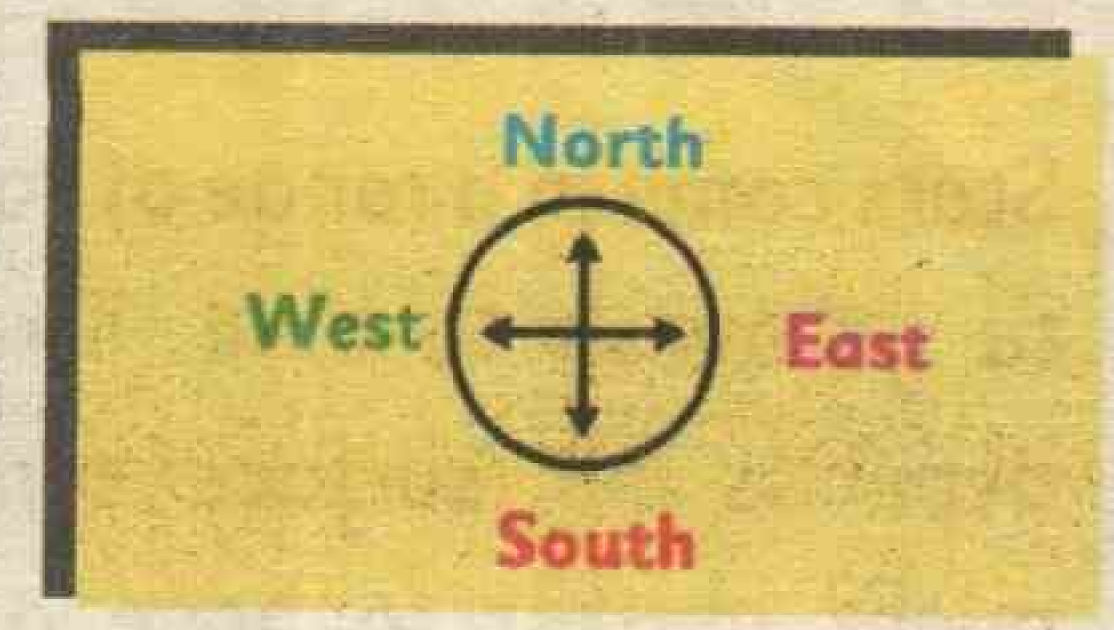
The brightness of a stars depends on its distance from earth and the amount of energy it emits.

12.4.3 Star Distance

The distances among the stars are very large and are ever increasing. The distance between stars is measured in light years. One light year is the distance covered by light in one year. Light rays travel at a speed of 300,000 km/second. The light from the sun reaches the earth in about 8 minutes. The sun is the nearest star to planet earth. After the sun the next nearest star is Alpha Centuari which is 4.5 light years away from earth.

12.5 Constellations

When we look at stars in the night sky, they appear to make patterns. These stars have been grouped together into different patterns called constellations. In ancient times, people saw the different constellations in the sky and imagined various figures resembling animals or people by joining different stars of the constellations such as Big Bear, Scorpion etc.



These stars patterns are still used by astronomers to make star maps. With these figures, we can identify the stars and can ascertain the place and time on earth.

These are visible in the north and appear to be revolving around the pole star called Polaris. Some major constellations are shown in figure 12.4.

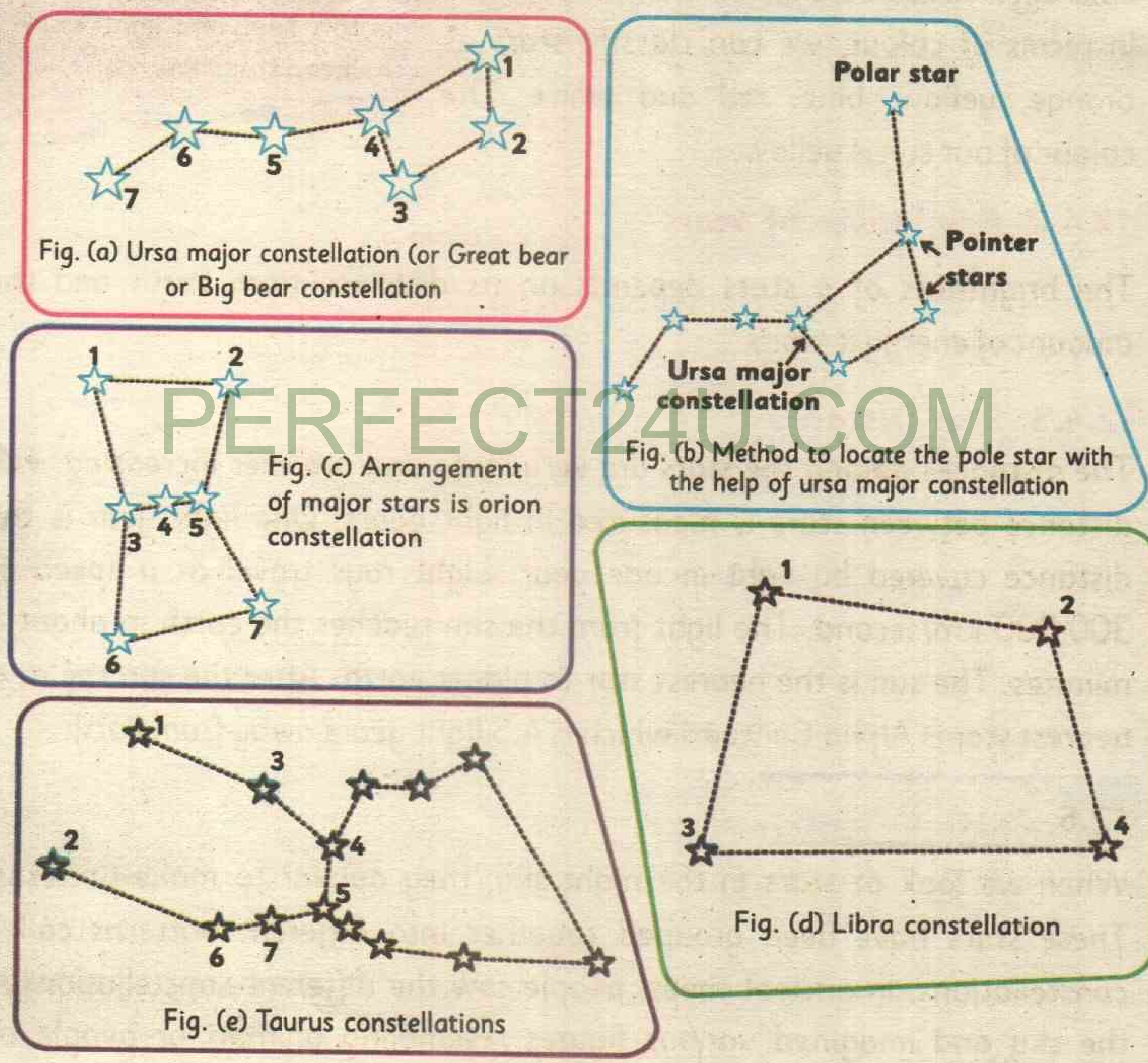


Fig. (a) Ursa major constellation (or Great bear or Big bear constellation

Fig. (b) Method to locate the pole star with the help of ursa major constellation

Fig. (c) Arrangement of major stars is orion constellation

Fig. (d) Libra constellation

Fig. (e) Taurus constellations

Fig. 12.4 Some constellations

12.6 Galaxies

We know that a galaxy is a vast system of billions of stars, which also contains a large number of gas clouds and dust and is isolated from similar systems.

Fig. 12.5 Galaxy

Two important galaxies in the universe are:

i. Milky way galaxy   ii. Andromeda galaxy

i. The Milky way (Our own Galaxy)

The Milky Way is a galaxy in which our solar system resides. The Milky Way galaxy is a spiral type of galaxy. It contains several hundred billions stars. The view of the Milky Way galaxy from above is shown in Fig. 12.6. The stars are not uniformly distributed in the plane of the disc but are arranged in spiral arms emerging from the nucleus of the galaxy. The stars in the Milky Way galaxy are slowly rotating about its center.

Fig. 12.6 Milky way

ii. Andromeda Galaxy

The Andromeda galaxy is the closest galaxy to the Milky Way. It is the only galaxy that can be seen with the naked eye from the earth.

Fig. 12.7 Andromeda

12.6.1 Types of Galaxies

There are many types of galaxies in the universe. The three main types on the bases of shapes are as under:

i. Spiral galaxies

Those galaxies which have a flat disk like shape with a bulge in the center and have a few or many spiral or curved arms, are called spiral galaxies for example, Milky way and Andromeda.

Fig. 12.8 Spiral galaxy

ii. Elliptical galaxies

Those galaxies which have oval shape are called elliptical galaxies. An elliptical galaxy contains only old stars, new stars cannot form in most of them. These galaxies do not rotate like spiral galaxies. For example, Messier32, M60 and M87.

Fig. 12.9 Elliptical galaxy

iii. Irregular galaxies

These galaxies have no definite shape these galaxies are not very common. For example, Magellanic cloud and IC5152.

Fig. 12.10 Irregular galaxy

12.7 Formation and Death of a Star

A star takes million of years to form from a cloud of gas and dust. It begins to shine when the nuclear fusion starts at its core. When stars run out of hydrogen and grow in size, they eventually turn into red giants, which later turn into blue giants and white dwarfs before they explode. This leads to a supernova. The outer layers blast out to space and what is left is the collapsed core, which becomes a neutron star or a black hole.

Our Sun was formed in a cloud of gas and dust about 4.5 billion years ago. It will continue to consume hydrogen in its core while emitting light and heat for another 5 billion years or so. Then it will swell to about 100 times its present diameter. Its outer surface will then cool to a red glow. It will become a red giant. Eventually, the sun's outer layer will drift into space exposing a hot, dense core called a white dwarf. This stray star will use helium as its nuclear fuel. When this runs out, the star will cool and fade forever.

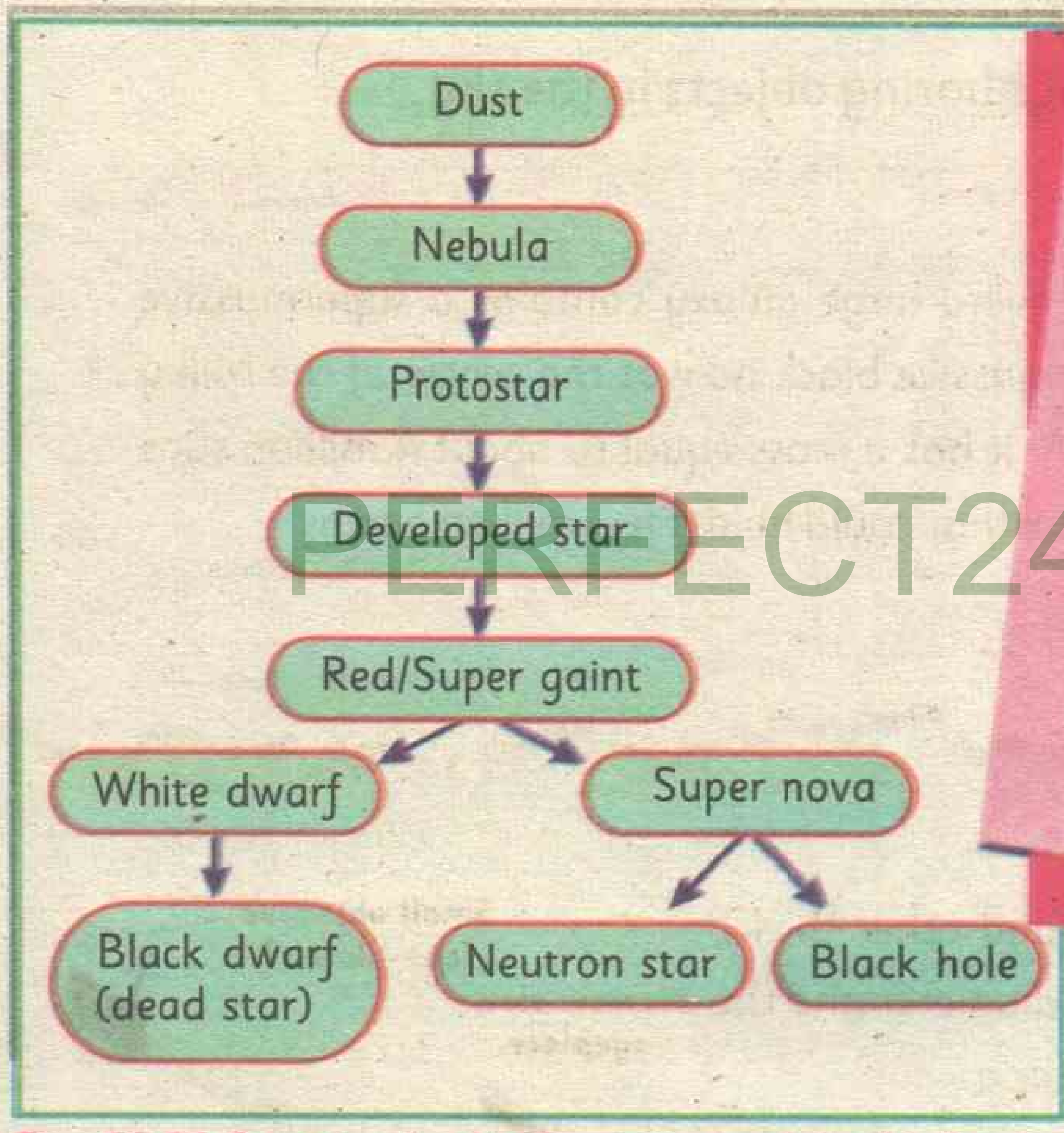


Fig. 12.11 Steps involved in formation and death of a star

Science tidbit

A supernova is the explosion of a star. It is the largest explosion that takes place in space. When these explosions take place, they release a tremendous amount of light which outshines everything around it.

12.8 Black Holes

Black holes are some of the strangest and most fascinating objects found in outer space. They are objects of extreme density with such strong gravitational attraction that even light cannot escape from their grasp if it comes near enough. A black hole may be formed when a very big object undergoes uncontrolled contraction (a collapse) because of the inward pull of its own gravity. Sometimes black holes are made when the center of a very big star falls in upon itself or collapses. Black holes are invisible. The presence of a black hole can be felt only by the effect of its gravitational field on its neighboring objects in the sky.

Fig. 12.12 Black hole

Science tidbit

Scientists have found proof that every large galaxy contains a supermassive black hole at its center. The supermassive black hole at the center of the Milky Way galaxy is called Sagittarius A. It has a mass equal to about 4 million suns and would fit inside a very large ball that could hold a few million earths.

Activity 12.2

How to make a working telescope?

Material needed: Two lens (one thin and other thick), Two card board, tubes one with large diameter and the other with small diameter and scotch tape.

Steps of preparation

1. Fix the thin lens on the tube with small diameter.
2. Now fix the thick lens on the tube with large diameter with the help of scotch tape.
3. Slide the small tube open end into the open end of large tube to make telescope
4. Observe the object through small lens (eye piece).

Key points

- Stars are heavenly bodies which have light of their own.
- Galaxies are the building blocks of the universe. There are billions of galaxies in the universe. Each galaxy has billions of stars.
- All the galaxies are travelling away from each other at a high speed.
- According to the Big-bang Theory "all the matter in the universe was originally concentrated in one very hot lump which exploded with a big-bang and matter dispersing in all directions through space.
- The Milky Way galaxy is a spiral type of galaxy. It contains several hundred billion stars.
- A black hole is an object with such a strong gravitational field that even light cannot escape from its surface.
- The stars which appear in the form of closed groups and patterns are known as constellations.

Project

Make a labelled model of a solar system.

Find out:

- The largest planet
- The most distant planet to orbit the sun
- The planet which supports on diversity of life
- The number of moons in each planet.
- The distance of each planet from the sun.

Exercise

A. Colour the circle for the best suitable answer.

i. The building block of the universe is:

○ Earth ○ Sun ○ Galaxy ○ None of these

ii Light rays travel at speed of:

○ $332Kms^{-1}$ ○ $3000Kms^{-1}$ ○ $300,000Kms^{-1}$ ○ $300Kms^{-1}$

iii. The milky way is:

○ Spiral ○ Elliptical ○ Irregular ○ All of the above

iv A black hole has a very strong:

○ Electric field ○ Gravitational field
○ Magnetic field ○ Electromagnetic

v. The light from sun reaches the earth in about:

○ 4 minutes ○ 6 minutes ○ 8 minutes ○ 10 minutes

B. Write down the short answers to the following questions.

i. What are the characteristics of black holes?

ii. Write the name of our galaxy? What is its shape?

iii. What is constellation? Name two constellations.

iv. State the Big Bang theory.

v. Arrange the following celestial bodies according to their average size, starting from the smallest to the largest:

star, planet, moon, galaxy

C. Write down detailed answers to the following questions.

i. Define a light year? Why is the light year a useful unit for measuring distance between stars than kilometer?

ii. Explain the birth and death of our sun.

iii. Define the following with examples.

a. a star b. a planet c. a moon d. an asteroid
e. an artificial satellite f. a black hole

GLOSSARY

acceleration: Rate of change of velocity.

amino acids: Carbon, hydrogen, oxygen and nitrogen compounds the composition of which are determined by genes.

anion: A negatively charged ion.

atomic number: The number of protons or number of electrons in an atom.

atomic symbol: The letters representing each of the elements.

atomic weight: The average weight of an atom.

atom: The smallest part of a substance that can take part in a chemical reaction. Click the smallest particle of a chemical element that can exist.

boiling point: The temperature at which a liquid boils and turns to vapour.

bond: A chemical link between atoms.

capacitance: The ability of a system to store an electric charge.

carbohydrates: The major energy source within plants and animals: sugars, starches and glucose polymers.

carbon: The basic element in all organic compounds.

catalyst: a substance that alters/increase the rate of a chemical reaction without itself undergoing any permanent chemical change.

cation: A positively charged ion.

cell: the smallest structural and functional unit of an organism.

charge: The amount of unbalanced electricity in a system. Either positive or negative.

chemical equation: The mathematical representation of a chemical reaction.

chemical reaction: The transformation of substances by the rearrangement of their atoms.

compound: A substance containing more than one element.

conduction: Heat or electricity transfer through molecular interaction, eg: heat passing along a metal bar.

convection: Heat transfer through the movement of a fluid, eg: warm air rising.

crystal: Solid substance with a regular geometric arrangements of atoms.

diffraction: The deviation in the path of a wave that encounters the edge of an obstacle.

diffusion: The random movement of molecules within a fluid.

electric current: A flow of electrons through a conductor, the size of the current is proportional to the rate of electron flow.

electrons: Negatively charged atomic particles.

electromagnetic waves: Waves with both an electric and magnetic component. They are: radio, micro, infra-red, visible light, ultraviolet, X and gamma rays.

electrolyte: An ion solution that is an electrical conductor.

element: A substance composed of atoms all with the same atomic number. A substance that cannot be split chemically into smaller substances.

energy: The capacity to do work. Work is done by transferring energy from one from to another. For example the chemical energy in a fuel is converted to thermal energy as it burns. See also Laws of Thermodynamics.

enzymes: Biological catalysts, proteins that control specific processes within the body.

fats: Molecules of fatty acids or glycerol. Used as a food store, insulation and for shock absorption.

field: A region in space that is defined by a vector function. Common fields are: gravitational, electric and magnetic.

fission: Splitting the nucleus of an atoms into smaller units.

force: An action (transfer of energy) that will accelerate a body in the direction of the applied frequency. The rate as which periodic motion repeats itself.

fundamental particles: Those particles that are not known to contain any smaller components: leptons, quarks and guage bosons.

heat: The internal energy of a body (substance).

hydrocarbon: Compounds containing only hydrogen and carbon atoms.

ion: Atom with an unbalanced electrical charge caused by the loss or gain of one or more electrons.

ion bond: A bond formed by the electro-magnetic attraction between ions of opposite charge.

isotope: An element that has more or less neutrons than normal. Many isotopes are radioactive.

kinetic energy: The energy possessed by a body in motion.

light: The visible part of the electromagnetic spectrum: red, orange, yellow, green, blue, indigo and violet. White light is a combination of all the above colours.

magnet: A body which produces a magnetic field. All magnets are di-pole and follow the rule that like poles repel and unlike poles attract.

mass: The quantity of matter in a body.

metals: Elements characterised by their opacity, malleability and thermal and electrical conductivity.

molecular formula: The number and types of atom in a molecule. For example the molecular formula of methane is CH_4, one atom of carbon and four atoms of hydrogen.

molecule: A group of atoms bonded together. It is the smallest part of a substance that retains the chemical properties of the whole.

monomers: Small molecules that link together to form a polymer.

neutralization: A reaction in which the characteristics of an acid or base disappear.

neutrons: Particles with zero charge forming part of an atomic nuclei. 3 quark hadrons.

organic compounds: Substances that contain Carbon.

ozone: An isotope of oxygen that blocks ultra-violet radiation. Normally found in the stratosphere.

photosynthesis: The conversion of water and carbon-dioxide by plants into glucose and oxygen. Light is used as an energy source.

polymerisation: The repetitive bonding of small molecules (monomers) to produce large molecules (polymers).

polymers: Long chain molecules such as PVC, nylon or DNA produced by the polymerisation of monomers.

potential difference: The voltage difference between two points. Electricity flows from a high to low level of potential.

potential energy: Amount of useable energy within a body at rest.

power: Amount of work done per second.

Index

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The seeking of Knowledge is obligatory for every Muslim.

(Al-Tirmidhi # 74)

"Corruption erodes society"